CURRENT MULTIDISCIPLINARY STUDIES IN VETERINARY MEDICINE II

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(The Licence Number of Publicator: 2014/31220)
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USA: +1 631 685 0 853
E mail: iksadyayinevi@gmail.com
www.iksadyayinevi.com
It is responsibility of the author to abide by the publishing ethics rules.
Iksad Publications – 2023©
ISBN: 978-625-6404-47-2
Cover Design: İbrahim KAYA
February/ 2023
Ankara / Turkey
Size = 16 x 24 cm

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PREFACE

As it is known, food and nutrition are the basic needs of humanity. The prerequisite for producing healthy animal foods is to provide healthy raw materials. As it is known, food and nutrition are the basic needs of humanity. The prerequisite for producing healthy raw materials; is to obtain meat, milk and eggs from healthy animals that areraised in healthy conditions in enterprises with modern technology and are under veterinarian control.

In order to feed the ever-increasing world population in a sufficient, balanced and healthy way, foods of plant and animal origin are needed. Despite the continuous increase in the world population, arable land areas in the world; global warming, drought, opening of arable land to settlement, conversion to industrial areas, etc. reasons are decreasing day by day. In order to feed the increasing world population, the current food production is insufficient in some countries and continents. Hunger and diseases brought about by inadequate and unbalanced nutrition are still a problem today. On the other hand, traditional breeding methods to increase plant production take a very long time and the desired product increase cannot be achieved.

In ruminant enterprises, the share of feed in operating expenses is around 60-70%. The cheapest feed sources of livestock farms are feeds such as natural meadows and pastures, intermediate crop fodder crops, plant and industrial product residues. Insufficient quality feedstuffs in ruminant feeding, which is mostly based on roughage in our country, is the main reason for low reproduction and milk yield.

Healthy and disease resistant animal for cultivating a deliberate feeding is of great importance. Malnutrition causes slow development of breeding animals and delay of the first lambing age. In order to obtain high efficiency from breeding animals; animals should be fed with balanced and high digestible rationsin terms of essential amino acids, oils, vitamins and minerals.

In this book, information on Current Multidisciplinary Studies in Veterinary Medicine has been compiled. We would like to thank our valuable academic friends for their contributions in the preparation of the book "Current Multidisciplinary Studies in Veterinary Medicine II", and we hope that this book, prepared with great effort and devotion, will be useful to students, Veterinarians, Agricultural Engineers and researchers.

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CHAPTER 1

METABOLISM DISEASES IN SMALL RUMINANT ANIMALS

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1. INTRODUCTION

Among domestic animals, metabolic diseases are more common in sheep during pregnancy. Such diseases cause significant economic losses in terms of fertility and other yields. It is stated that the deaths due to these diseases in some herds have reached significant levels. Malnutrition program due to nutrient deficiencies and imbalances causes various nutritional disorders in ruminants (Baran 2018).

2. METABOLISM DISEASES

2.1. Pregnancy Toxemia (Ketosis-Twin Lamb Disease)

It is a metabolic disease that occurs as a result of carbohydrate and lipid metabolism disorders in the last month of pregnancy. It is found in barns with concentrated feeding, especially in sheep with very good fattening and twin or more offspring (Alaçam 2002; Aytuğ et al., 1990; Baran 2018). It is more common in animals that will give birth for the first time (Umucalılar and Gülşen, 2005).

It is due to the high glucose requirement of pregnant sheep carrying more than one calf or having large calves, and this need is not met with feed (Baran 2018).

A pregnant sheep needs energy equivalent to at least 800 grams of starch and at least 120 grams of protein per day in the last 6 weeks of its pregnancy. This need is even greater in twins. Sheep have low glucose and glycogen reserves. Since the lamb grows very fast in the last stages of pregnancy, the energy need of the mother increases considerably (Baran 2018; Baran 2021).

2.2. The main factors that predispose to pregnancy toxemia are:

- ✓ Pregnancy toxemia is a disorder observed in the last 6 weeks of pregnancy and the first 4 weeks of lactation in sheep. More rarely, it occurs in pregnant women in the last weeks of pregnancy. Disposal by pregnancy. The fetus may also die later in the spread. The generation of sheep that can discard the dead fetus by abortion can recover (Aytuğ et al., 1990).
- ✓ The feature of causing an excessive increase in energy consumption of pregnant animals is also observed in twin, triplet and quadruplet pregnant sheep (Baran 2018).
- ✓ The disease is rarely seen in sheep managed in pasture provisions; Persistent weeping is seen in intensively fed pregnant ewes.
- ✓ Functional inadequacies of those that occur at the onset of pregnancy toxemia have a primary role. In sheep with heavy weight damage, gluconogenetic activity and energy storage capacity are low. It plays an important role in the circular course of feeding, which can lead to fat degeneration in its target (Aytuğ et al., 1990).
- ✓ The most important factor is that the energy level of the ration cannot meet the increasing needs of the animal. As well as the lack of energy, feeds that are not suitable for pregnant animals with energy-protein components can also facilitate birth. For example, when pregnant sheep are fed with livestock rations, they become fat and fat, and energy accumulates in excess fat; occurs,

fat degeneration occurs (Aytuğ et al., 1990; Baran 2018; Baran 2022).

- ✓ Feeding only one meal a day, leaving the feeders completely empty between feed meals, pets not eating at all for a long time.
- ✓ Immobility, excessive lubrication, heavy parasite invasions
- ✓ Sudden weather paradise, exposure to cold, lack of shelter in very bad weather conditions
- ✓ Increasing the volume of the uterus and compression of the rumen during pregnancy, restriction of rumen movements and disruption of its enlargement in the rumen in the server (Aytuğ et al., 1990).
- ✓ Pregnant sheep with ketosis appear insensitive and reluctant to eat. It is observed that animals reduce grain feed consumption first and then silage and roughage consumption (Baran 2019; Umucalılar and Gülşen, 2005). It is possible to save the deaths of sheep whose offspring were removed by early cesarean section (Aytuğ et al., 1990).

2.3. Prevention

- ✓ During the gestation period, the sheep are not kept indoors, they are walked around for a few hours a day at the latest.
- ✓ Sudden feed changes are not made. Care is taken to ensure that the meal times are in the same place every day.
- ✓ Dry grass is always kept in front of them. Concentrated feed is given in 2-3 meals a day, not one meal. In the last six weeks of pregnancy, daily concentrate feed consumption is increased.

- ✓ Pregnant sheep are not given feed for fattening animals; the animal is not lubricated unnecessarily (Baran 2019).

3. MILK FEVER (HYPOCALCEMIA)

It is a metabolic disease similar to “calf fever” in cattle. It is found mainly during pregnancy in sheep and in the first 3 days after birth in goats. It is less common in sheep during lactation (Baran 2021; Sarı et al., 2008).

The cause of the disease is a decrease in the level of calcium in the blood. The serum calcium concentration, which is normally 9-12 mg/100 ml in sheep, decreases below 7 mg/100 ml in hypocalcemic conditions and from 9.4 mg/100 ml to 3.6 mg/100 ml in goats (Baran 2018; Aytuğ et al., 1990).

The main causes of the disease are; pregnancy, old age, stress situations that put the organism under load (sudden cessation of feeding and starvation of the animal, fatigue), pregnancy with twins or more offspring and improper nutrition, age and breed of the animal in goats. Since mineral consumption is very high in animals pregnant with more than one offspring, hypocalcemia events are more common in animals pregnant with one offspring (Ergün et al. 2006).

Since the calcium requirement of sheep reaches its highest level in the last stages of pregnancy, the disease is more common in the last 6 weeks before birth. It is more common in sheep and goats older than 4 years of age compared to younger ones, due to lower intestinal mineral

absorption in older animals and the inability of mineral metabolism to adapt to stress conditions (Baran 2021; Bilal 2005; Aytuğ et al. , 1990).

The high ratio of oxalate-rich feed materials in the rations of pregnant sheep, continuous and abundant feeding of the herds by grazing on grain-planted fields, mineral imbalances (changes in calcium-phosphorus ratio, magnesium excess) and feeding errors (too much concentrated feed, too much roughage). less feeding; not giving quality roughage etc.) can also be counted among the reasons for preparation (Baran 2019).

3.1. Prevention

- ✓ Care should be taken not to give the rations given to livestock to pregnant sheep.
- ✓ Addition of chemical or similar mineral salts (such as dicalcium phosphate) to feeds; or continuous addition to feed at doses specified in the package inserts of feed additive preparations that inspire vitamins and trace elements along with phosphorus and wings (Baran 2019).
- ✓ During pregnancy, it is recommended not to keep the groups indoors all the time, and to walk around the pasture for a few hours a day without thinking (Baran 2019).

4. HYPOMAGNESAEMIA

Tetanics end with cramping and excitation, with a decrease in blood weight elevation (if less than 1 mg/100 ml) a few days or a few weeks

after the introduction of animals into pastures rich in very rapid growth, fertile and moist. It is a sickness of salvation. It is rare in sheep (Ergün et al., 2006).

Landscapes on poor pastures with typical sheep pasture characteristics generally develop slowly, with high feature content. The content of wild enclosures and culture enclosures belonging to the legume family, and dry feeds given in the enclosure feeding are also rich. For this reason, forest deficiency events are not encountered in normal sheep pastures and at the start of the run-in feed. Very fast offspring of grasses, the disease is encountered 2-3 weeks after the sheep in the early rainy spring start to graze in fertile pastures or in fields planted with cereals. Because the paintings in these pastures and fields (definitely those that belong to the grass family) are of poor financial importance (Baran 2019).

The animal vault tries to meet for a while from the material reserves in the bones. In 2-3 weeks, these reserves are depleted and the disease is revealed as the critical point is reached. Side factors such as such images that lead to magnesium deficiency, old age, pregnancy, high milk house, sudden weather protection and transportation also facilitate the emergence of pregnancy (Aytuğ et al., 1990; Tufan et al., 2021)

4.1. Prevention

If the sheep are to be sent to graze in the morning in the spring, they must be fed with some dry grass before leaving the barn in the morning so that they gradually adapt to the pasture and thus replenish the

magnesium reserves in the body. Breeding sheep are given 450 grams of concentrate and 15 grams of MgO per day (Baran 2021; Ergün et al., 2006).

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CHAPTER 2

DISEASES DUE TO MINERAL DEFICIENCY IN SMALL RUMINANT ANIMALS

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1. INTRODUCTION

Deficiency diseases in sheep and goats and deficiency diseases in cattle show great similarities in all aspects. Diseases related to mineral, trace element and vitamin deficiencies of sheep are summarized below.

2. DISEASES DUE TO CALCIUM AND PHOSPHORUS DEFICIENCY

Calcium and phosphorus are the basic building elements of the body and they have many known functions. Since the absorption of these minerals in the form of organic or inorganic salts from the intestines, their storage in the bones, their dissolution in the bones and their elimination from the body are closely related to each other, it is necessary to evaluate both elements together.

Primary calcium deficiency is a very rare phenomenon in natural conditions. Because the roughage materials that animals can find in nature usually contain sufficient amounts of calcium. For this reason, primary calcium deficiency is not very common in sheep and goat herds that are constantly wandering around the pasture. On the other hand, there may be primary calcium deficiency in animals that are constantly fed in the barn with concentrated feed. Secondary calcium deficiencies are relatively higher in sheep and goats. Calcium deficiency due to vitamin D deficiency, namely rickets, can easily occur in young lambs that are constantly kept in closed pens and never exposed to the sun. Secondary calcium deficiency is seen in easily fermentable feeds, feeds rich in protein and oxalates, drinking water rich in fluorine, and using

superphosphate fertilizers rich in fluorine as feed additives (Baran 2018; Ergün et al., 2006; Aytuğ et al. ., 1990; Tufan et al., 2021).

As in cattle, primary phosphorus deficiencies are more common in sheep and goats. Phosphorus deficiency is seen in sheep and goats fed with rations containing less than 0.2% phosphorus. Since the nutrition of sheep and goats is mainly based on pasture, the amount of phosphorus in the structure of grasses in the pasture is of great importance. If phosphorus is insufficient in the soil, phosphorus in the plant will also be low. Factors such as erosion, drought, excess of heavy minerals (iron, aluminum, calcium, etc.) in the soil can reduce the plant's binding of phosphorus in the soil. Secondary phosphorus deficiency results from excess calcium and fluorine in the diet and metabolic disorders (Bilal 2005; Ergün et al., 2006; Sarı et al., 2008)

Calcium and phosphorus deficiencies in sheep and goats lead to various bone dystrophies (especially osteomalacia and rickets) and hypocalcemic parasis. Apart from these, phosphorus deficiency has negative effects on the development of the animal, reaching sexual maturity and various productivity parameters during puberty. Muscles in livestock do not develop sufficiently. Phosphorus deficiencies negatively affect milk yield, wool yield and quality. Phosphorus deficient sheep and goats show signs of “pica” (Aytuğ et al., 1990; Baran 2018; Baran 2021).

3. OSTEOMALASIA

It is a disease characterized by a decrease in the amount of mineral substance in the bones, caused by a calcium-phosphorus metabolism disorder and a lack of phosphorus in the diet. It is more common in old sheep and goats subject to barn feeding (Baran 2018).

It is a disease that results from meeting the increasing calcium and phosphorus needs of the organism from the reserves in the bones and the insufficient amount of calcium-phosphorus absorbed from the intestines to fill this gap. The main preparatory and constructive reasons are:

- Pregnancy and high milk yield, which increases calcium and phosphorus consumption in the animal.
- Disruption of the calcium-phosphorus balance in the diet, giving foods rich in calcium and poor in phosphorus, or vice versa.
- Feeding based on feed materials (eg green cereals) that are sufficient in phosphorus but poor in calcium.
- Vitamin D deficiency (staying closed in the barn all the time, not going out in the sun). Vitamin A deficiencies.
- Immobility, twin, triplet, quadruplet pregnancies, old age.

The amount of inorganic phosphorus in the blood serum decreased below the level of 4 mg/100 ml. It should be noted that when the bones of slaughtered animals are checked, they are easily susceptible to

breakage, and the ash content of the burned bones decreases (Sarı et al., 200; 8Baran 2018; Baran 2021).

3.1. Prevention

- ✓ Bone meal or DCP is added to the ration. Mineral licking stones are placed inside the mangers.
- ✓ Good quality hay or dried clover is kept in front of the animals. Cereal-based concentrated feed is given. The addition of mineral-vitamin premixes into concentrated feeds should not be neglected (Baran 2019).

4. RICKETS

Rickets is a hyperplastic osteodystrophy in growing animals. It is a skeletal system disease that occurs as a result of vitamin D deficiency and disruption of calcium-phosphorus metabolism. They are details about the deformation and warping of bones as a result of the effects of inorganic substances in bone tissues (the ratio of organic matter from inorganic products in bones is normally 3/2, while in rachitic animals this ratio is around ½) (Aytuğ et al., 1990).

The rickets groups found in animals in the growth phase are harbored not in pasture but in animals managed in indoor conditions of use. Rickets in lambs born in the care and nutrition that causes osteoporosis in pregnant sheep (shield-phosphorus imbalance in the ration, vitamin and mineral deficiencies, feeding of breeding sheep with fattening feeds, diet based on only green grain product of pregnancy, chronic

fluoride infection, nitrate excess, etc.) creates a suitable environment for its formation.

The most important leading cause of rickets in lambs is vitamin D3 deficiency. Because, even if sufficient amount of vitamin D is present in milk and non-consumed feeds, these provitamins need ultraviolet rays to be converted into active vitamin form in the skin. After the lambs are born, keeping them closed in the sun-drenched compartments leads to vitamin D3 deficiency. In the deficiency of vitamin D3, since the exits from the wings and the phosphorus resorption and ossification phenomenon are significantly disrupted, the bones soften, the epiphyseal parts thicken, the appendages are deformed, and the long bones are curved (Baran 2018; Baran 2021).

One of the leading causes of rickets, which is very common among birth lambs, is that sheep and goats are exposed to very intense parasitic invasions during their birth journey, so their milk is low and the previous lamb does not suckle to the fullest. The second important reason is that the nets are kept in a dark place for 4-5 weeks after the birth of the lambs and only come out at the time of sucking.

4.1. Prevention

- ✓ Sheep and goats should not be purified from parasites by applying preventive spraying against internal and external parasites during pregnancy and birth. The feeding conditions of the herds should be brought to the best limits, and the young

lambs and kids should be completely satiated during the 1.5-month suckling period.

- ✓ The lambs going out into the open air and enjoying plenty of sunlight have surely disappeared. They have good quality dried clover in front of them. Bone meal and mineral - vitamin premixes are added to lamb rations.
- ✓ Nutritional conditions are improved in pregnant and lactating sheep. Upgrading the phosphorus package is beneficial. However, the shield-phosphorus should not be lower than 1:1.

5. WHITE MUSCLE DISEASE

Selenium; Gluttahion is a trace element that enters the structure of the peroxidase enzyme system. There is a synergistic relationship between vitamin E, selenium and sulphurous amino acids, as they participate in metabolic activities in the same direction (Baran 2018).

Since certain amounts of selenium and vitamin E must be taken from the diet together with the diet, their deficiencies are important for all pets. The deficiency disease of practical importance for sheep, goats and cattle is “White muscle disease”. White muscle disease is a deficiency disease that causes “hyaline degeneration” in skeletal muscles, heart muscle and diaphragm. It is especially important for lambs and kids.

The cause of the disease is the deficiency of selenium or vitamin E in the ration. There is a shortage of both. Selenium deficiency is the main cause of the disease in animals fed under pasture conditions. Because,

in these disease events seen in animals in pasture conditions, it is possible to cure patients and protect healthy ones from patients by simply giving selenium without vitamin E (Baran 2018; Sarı et al., 2008).

Muscular dystrophies due to vitamin E deficiency emerge as an important problem when high amounts of unsaturated fatty acids (oilseed meal and vegetable oils) are present in the diet. Since unsaturated fatty acids may be present at a higher rate in concentrated feeds than in pasture feeds, it is necessary to take into account the deficiency of vitamin E as well as selenium deficiency in animals fed intensively in the barn (Aytuğ et al., 1990).

Selenium deficiency is closely related to the chemical structure of the soil. When the amount of selenium in the soil is low, plants grown in this soil also contain low levels of selenium. When the amount of selenium in the soil falls below 0.2 ppm, it becomes inevitable for animals grazing on these pastures or fed with forage harvested from these lands.

There is also a relationship between the onset of the disease and the age factor. White muscle disease is sometimes seen in newborn lambs, but mostly in the 3-8 weeks after birth (Baran 2018).

5.1. Prevention

- ✓ Attention should be paid to the presence of selenium above 0.1 ppm in all sheep rations. In areas with selenium deficiency,

sodium selenite or another selenium salt is added in the amount of 0.3–0.5 mg/kg to sheep feed.

- ✓ It is extremely important to ensure that adequate amounts of selenium are given to sheep during pregnancy. In the last month and a half of pregnancy, 5 mg selenium is given to pregnant sheep at intervals of 10-15 days.
- ✓ Administering selenium+vitamin E combination or selenium alone (1 mg) to all lambs, either orally or by subcutaneous injection, on or before the delayed form of the disease begins to appear (Baran 2018).

6. ENZOOTIC ATAXIA (SWAYBACK)

The primary cause is due to the low amount of copper in the soil. The copper content of plants grown in these soils is also low. Sheep rations should normally contain around 5 ppm copper. Diets containing less than 3 ppm copper (in other words, pasture grasses) lead to copper deficiency (more than 10 ppm copper also carries the risk of chronic copper poisoning). There are differences between plant species in terms of evaluating copper in the soil. For example, copper content is lower in pasture plants such as cereals and mustard. If such plants are dense in a pasture whose soil is poor in copper, copper deficiency occurs more easily (Ergün et al., 2006).

Secondary copper deficiency is more important in practice. Although there is enough copper in the soil, plants cannot benefit from this copper due to some factors. Likewise, there are factors that reduce the intestinal

resorption of dietary copper. The excess of molybdenum, sulfur and sulfates in the soil reduces the utilization of copper by plants. It is reported that secondary copper deficiency is inevitable in sheep fed with plants grown in soils containing more than 10 ppm molybdenum. If the soil pH is alkaline, the amount of molybdenum in the plant is even higher. In addition to molybdenum, the presence of minerals such as lead, iron, zinc and calcium in the soil at very high rates negatively affects the utilization of copper by plants (Aytuğ et al., 1990; Baran 2018; Ergün et al., 2006). Sulfur and sulfates in the diet have a direct effect on reducing copper absorption.

Enzootic ataxia is a disease encountered in lambs whose mothers suffer from copper deficiency. It can be found in lambs up to 6 months old. There are two most common forms of the disease. The first is the congenital shape, and the second is the delayed shape seen in the 3-8 weeks period. The rate of use of copper in the milk of lambs also decreases with age. In contrast, the need for copper increases as the lamb enters a period of rapid growth. For these reasons, ewes suffering from copper deficiency can only meet their needs for a few weeks from the limited reserve in the liver of the lamb, even if they give birth to their lambs intact. Delayed clinical disease occurs because the needs cannot be met in the 3-8 week period when growth is the fastest (Baran 2018; Ergün et al., 2006).

6.1. Prevention

- ✓ In regions with copper deficiency, the copper needs of sheep should be met continuously during both pregnancy and

lactation periods. Due to its cheapness, copper sulfate is the most suitable drug. An application that will give the sheep an average of 1 gram, a maximum of 1.5 grams per week, and 35 mg per week to lambs from birth through the oral route may be sufficient for protection.

- ✓ It should be ensured that there is 5 ppm copper in sheep and lamb mixed feeds (Baran 2018).

7. COBALT DEFICIENCY

The cobalt present in the ration is used in the synthesis of vitamin B12 by being evaluated by microorganisms in the fore stomach of ruminant animals. This element is found at an average level of 4% in vitamin B12 (Baran 2018; Ergün et al., 2006).

Cobalt is an essential trace mineral for ruminants and should be present in the diet in an amount of 0.1 mg/kg DM. The amount of cobalt in plants varies according to the plant species and the development phase of the plant. It is known that the amount of cobalt in fast growing grasses is lower. The most important reason for cobalt deficiency is the poverty of the soil in terms of cobalt. Pasture and fields with soils containing less than 2 ppm of cobalt carry the risk of primary cobalt deficiency.

Animals tend to eat things that do not qualify as normal feed; They eat soil, gnaw barn walls and mangers, eat wool (Baran 2018; Ergün et al., 2006).

7.1. Protection

In herds with cobalt deficiency, 200-300 mg per sheep every 20-30 days for treatment purposes. cobalt chloride, cobalt sulfate or cobalt oxide is sufficient. Cobalt content of not less than 0.1 ppm must be guaranteed in the mixed feeds of sheep and lambs.

8. IRON DEFICIENCY

Lambs get enough iron from their mothers through the placenta during the embryonal development period. The amount of iron that can be taken with milk after birth is limited. It is possible for lambs fed only with milk and developing very rapidly to suffer from iron deficiency in the first weeks after birth. It is known that anemia occurs in the lambs of ewes that produce less than 35 ppm of iron in their milk within 6 weeks after birth (Ergün et al., 2006).

In order for the lambs not to suffer from iron deficiency, good quality hay or dried clover and mixed lamb feeds should always be kept in front of them. It is obligatory to have at least 50 ppm of iron in lamb and sheep compound feeds.

9. IODINE DEFICIENCY

The effects of iodine deficiency may occur more clearly in embryonal and newborn lambs and kids.

Primary iodine deficiency comes from iodine deficiency in feeds. Events caused by iodine deficiency in the soil are rarely seen in sheep and goats. Secondary iodine deficiencies caused by factors

(thiocyanates) entering the structures of some plants and negatively affecting the use of iodine are more important. For example, cabbage type plants and soy have goitrogen properties and stop thyroxine synthesis. Plants such as linseed, rapeseed, soybean, alfalfa and beet can also predispose to iodine deficiency when they are present in very high amounts in the diet. The amount of iodine in milk is important for newborn lambs and kids. Iodine deficiency can be seen in lambs when there is less than 8 mcg of iodine in 100 cc of milk (Aytuğ et al., 1990).

9.1. Protection

Iodine compounds (15 grams of potassium iodide per 100 kg of salt) are added to feeds or salt. It is necessary to have 0.5 ppm iodine in compound feeds (Aytuğ et al., 1990).

10. ZINC DEFICIENCY

Normally 40-50 ppm zinc should be present in the ration. When the amount of zinc in pasture grasses and forage plants falls below 10 mg/kg, zinc deficiency is observed. Zinc deficiency in plants is related to the chemical structure of the soil. The alkalinity of the soil pH, phosphate and nitrate composition may affect the plant's utilization of zinc in the soil. Lime soils are suitable for zinc deficiency. (Aytuğ et al., 1990).

The main disorders that can be seen in ruminants in case of its deficiency are wool and hair cover disorders, parakeratosis, growth retardation, decreased feed consumption, partial disruption of protein

synthesis and ossification disorders (Aytuğ et al., 1990; Baran 2018; Ergün et al., 2006).).

10.1. Protection

In herds suspected of having a zinc deficiency, zinc is added to the feed at an account of 50 mg per animal per day (Baran 2018).

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CHAPTER 3

ANTIBIOTIC ALTERNATIVES FOR POULTRY

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INTRODUCTION

Alternative feed additives are categorized as substances that prevent, decrease or eliminate the colonization of foodborne pathogens and increase production yields. Although known not to constitute a separate dietary requirement, when incorporated into poultry feed, these substances increase the feed conversion ratio and digestibility of feed, improve intestinal nutrient absorption, and thereby, increase the growth and development of poultry together with their production yields (Stanton, 2013). Thus, they also contribute to public health and the economy.

Poultry holdings have displayed a rapid development in the last 30 years. In previous years, antibacterial drugs were used as both therapeutics and growth promoters. Over the course of time, the uncontrolled dietary use of antibacterials for the purpose of increasing production led to problems related to the development of microbial resistance and antibiotic residues in food products. High levels of microbial resistance to antibiotics and increased numbers of resistant bacterial strains have become a major threat to public health (Selaledi et al., 2020).

Methods have been sought to replace the use of antibacterial drugs with alternatives that would not leave residues in poultry products or show any adverse effect on production yields and product quality. Especially after the prohibition of the use of antibiotics as growth promoters as of January 1, 2006, the availability of reliable tools for the healthy

nutrition and growth promotion of animals has gained increased importance.

In recent years, natural alternatives, including among others, probiotics, prebiotics, organic acids, plant extracts, essential oils, enzymes and immunostimulants, antioxidant plant extracts and toxin binders, have been used to increase appetite and nutrient absorption, prevent and control enteric pathogens, increase yields in poultry production and minimize the use of antibiotics for the treatment of infections. The use of a single replacement or an ideal group of replacements, selected among different options, together with a good inspection enables the protection of poultry from infections, the maintenance of productivity, and the maximization of production yields.

Protecting poultry from viral, bacterial and parasitic infections, rectifying poor management and nutrition conditions, increasing the food conversion ratio, minimizing stress factors in poultry houses, strengthening immunity and taking precautionary measures against economic loss are all essential to poultry production (Baydan ve Arslanbaş, 2018). Maximizing poultry production not only requires the protection of animal health, but also the increase of the feed conversion ratio.

Preliminary data on the growth promoting effect of antibiotics were first derived in 1946 but did not receive much attention at that time. In a study dating back to 1949, for the first time, antibiotics were used to promote the growth and development of poultry. Over long years of use, antibiotics reduced the pathogenic bacterial load of the intestines,

decreased the colonization of the intestines by pathogens, slowed down the passage of nutrients through the intestines, improved the intestinal absorption of nutrients, and thereby, increased the growth and development of animals as well as the production yields and quality of poultry meat and eggs (Cheng ve ark, 2014). However, the use of antibiotics for the purpose of increasing production yields was observed to inhibit the growth of not only pathogenic microorganisms, but also beneficial microorganisms. (Aarestrup, 1999). Long-term antibiotic use has been determined to disrupt the intestinal microbiota, cause the thinning of the intestinal wall, reduce immunity, and induce the development of microbial resistance among pathogenic bacteria (Lu et.al, 2008). In view of the correlation of intestinal imbalances with pathogenic microorganisms, various feed additives have been investigated for the potential they offer in terms of the protection of gastrointestinal health and the increase of body resistance against pathogen colonization.

As a consequence of increased concerns related to the use of antimicrobials in meat and poultry production, and the legal prohibition of routine antibiotic use at production farms, the necessity for feed additives capable of increasing the performance of commercial poultry production while securing food safety has gained increased importance (Dittoe et al, 2018).

The primary antibiotic alternatives for poultry, which have received greater attention, are probiotic microorganisms, enzymes and organic acids, which are known for their positive effects on poultry health and

reliability in terms of food safety (Lu et.al, 2008). The extensification of the use of these alternative products would increase the profits of the production sector and contribute to the prevention of the development of microbial resistance to antibiotics. Furthermore, the use of these products on the field would encourage farmers and veterinarians to follow good agricultural practices and prefer methods that strengthen immunity against diseases. However, it should be noted that, once an infection has developed, immune-enhancing practices are not as effective as chemotherapeutics. Immune enhancers should be preferred for protection, before an infection develops.

Immunostimulants are natural or synthetic compounds used in domestic animals and poultry for multiple purposes, including among others, health protection, growth promotion and increase of performance (Hashemi and Davoodi, 2012). These compounds are known to stimulate the cellular immune system against pathogens. Studies have shown that, when given to poultry at the chick stage or at more advanced stages of development, immunostimulants establish immunity against bacterial, viral and parasitic diseases, increase the viability and growth performance of animals, significantly increase the body weight of animals by the end of the fattening period, and enhance the effects of vaccines and antibiotics. As they are safer than chemotherapeutics, they are also considered as alternative growth promoters. Given that they increase effectiveness as adjuvants, combined use is recommended for these compounds to increase the effectiveness of treatment. Therefore, the single or combined use of

therapeutically effective immunostimulant compounds, known not to have any adverse effect on animals, humans and the environment, has an important place in preventing the development of microbial resistance (Baydan ve Arslanbaş, 2018).

Due to the development of microbial resistance to antibiotics, the European Union banned the use of antibiotic growth promoters as of January 1, 2006 (decision 70/524/EC and regulation 1831/2003/EC), and this was followed by the enforcement of a similar prohibition in Türkiye (21 January 2006 (Official Gazette, number: 26056) and restrictions in some other countries (Tuncer, 2007). In recent years, the use of enzymes, probiotics, prebiotics, organic acids, and antioxidant plant extracts as antibiotic alternatives is on the rise as they offer the desired effects of antibiotics with no associated adverse effect.

Probiotics and Prebiotics

The increase observed in the intestinal infections of poultry and the microbial contamination of poultry products consequential to the development of microbial resistance to antibiotics, and the subsequent prohibition of subtherapeutic antibiotic use in Europe, as well as in the United States of America and other developed countries, have resulted in an increased interest in probiotics. Prebiotics and probiotics are among the few alternatives, which offer the potential to reduce the intestinal infections of poultry, and thereby, the microbial contamination of poultry products.

Meaning “pro life” in Greek, probiotics are microbial feed additives, which are used to improve the equilibrium of the intestinal ecosystem, increase production performance, and prevent gastrointestinal infections (Fuller, 1988); (Hussein, E.O.S. et al., 2020); (Banu et al., 2019). Probiotics are beneficial live miroorganisms, which are naturally found in the intestinal microbiota and are adapted to specific animal species. They constitute a barrier against microbial colonization, improve the intestinal microflora, and thereby, enhance immunity and protect the digestive system (Jernigan et al., 1985); (Fuller, 1988); (Fallah et al., 2013). Probiotic microorganisms are anaerobic and non-pathogenic. They have been included in the composition of biological products that can be used as dietary supplements. Probiotic preparations contain live bacteria, yeasts, fungi and enzymes. Microbial species belonging to the genera Bacillus, Bifidobacterium, Lactobacillus, Lactococcus and Saccharomyces are used as probiotics for poultry.

When administered, probiotics show an antagonistic effect against pathogenic bacteria in the intestines, and alter the intestinal microflora in favour of beneficial microorganisms. They prevent the growth and effects of pathogenic bacteria (Midilli and Tuncer, 2001). Probiotic bacteria are highly resistant to the gastric pH value. They maintain their viability in the intestinal tract, establish in the intestinal epithelial cells and reproduce. They are not absorbed from the digestive tract. The growth of probiotic microorganisms in the intestinal epithelium reduces the oxidation potential. This, in return, reduces the oxygen utilization of aerobic pathogenic bacteria and prevents their growth. Probiotics

also show effect by increasing the acidity of the environment through the synthesis of digestive enzymes (organic acids including lactic acid, acetic acid, etc.), and thereby, preventing the growth of pathogenic bacteria adapted to basic and neutral pH levels. By means of these mechanisms, they prevent the adherence of pathogenic bacteria to the intestinal epithelium and their growth therein.

The effects of ideal probiotics:

- Increase of growth performance
- Increase of carcass yields
- Alteration of the intestinal microbiota
- Increase of nutrient digestibility
- Enhancement of immunity
- Decrease of inflammatory reactions
- Reduction of microbial carcass contamination

Probiotics have been used to increase production yields for many years. Given that they offer the desired effects of antibiotics, but do not display any of the disadvantages of these chemicals, they have been preferred as alternatives for both growth promotion and the increase of production yields. An essential aspect of probiotic use is to ensure the maintenance of their viability. Other important aspects include their incorporation into the diet/ration, storage, environmental temperature, and compatibility with other dietary supplements/feed additives.

Probiotics were first used in poultry in 1976 in Finland with an aim to accelerate the development of the intestinal microflora of particularly chicks and to ensure the development of immune resistance against Salmonellae.

On the other hand, prebiotics are defined as "non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improve the intestinal equilibrium". The most commonly used prebiotics include chitosan oligosaccharides, mannaoligosaccharides, fructooligosaccharides, and beta-glucans. Oligosaccharides are carbohydrate molecules that are composed of 3-10 monosaccharide units. They are found at high levels in pulse crops. They are commercially derived from the cell wall of yeasts and are characterized by poor digestibility. Prebiotics are digested only in the presence of enzymes. On the other hand, they enhance the immune system and prevent the colonization of microorganisms in the gut. They reduce the intestinal pH level by increasing lactic acid levels.

Combinations of prebiotics and probiotics are known as symbiotics. For centuries, probiotic and prebiotic foods have been consumed as either natural food ingredients or fermented food, and their incorporation into animal feed has been observed to increase resistance against infections. The use of prebiotics and probiotics fur gut microbiology and dietary supplementation drew attention in the late 1800s and the early 1900s.

Enzymes

The use of enzymes (amylase, phytase, pectinase, xylanase, protease, cellulase, glucanase, etc.) in animal production for growth promotion and protection against diseases is particularly common in the poultry sector. The primary expense item in poultry production is the feed cost, which constitutes almost 70% of all expenses. Cereals incorporated into poultry feed are polysaccharides that do not contain starch. Non-starch polysaccharides are polymeric carbohydrates that are not well digested by poultry. Poultry do not have the endogenous enzymes required to breakdown these carbohydrates. Therefore, the consumption of non-starch polysaccharides leads to low feed conversion ratios and low metabolic energy. Part of these polysaccharides are water-soluble and form a gel-like viscous consistency in the intestinal tract and lower the performance of the intestines. Furthermore, by increasing the water intake of poultry, they also cause wet and sticky feces that leads to unmanageable litter problems in the poultry house. Thereby, they create an environment favourable for microbial growth, impair hygiene conditions, and reduce carcass quality.

In this respect, the incorporation of enzymes into poultry feed is considered an important protective measure against infections. The use of enzymes in poultry nutrition not only improves performance and increases the feed conversion ratio, but also reduces environmental problems due to less fecal output. Glucanases offer such benefits when incorporated into barley- and rye-based poultry rations. Enzymes used for growth promotion increase the digestibility of food, and while

breaking down polysaccharides, suppress the growth of bacteria that prevent the absorption of nutrients. Thereby, the feed conversion ratio increases. Among cereals, barley is known to be rich in the enzyme phytase. However, phytase found in dry seeds is inactive. On the other hand, oilseeds either contain very low amounts of phytase or do not contain this enzyme at all. Therefore, dietary supplementation with phytase both improves the digestion of feed and increases the feed conversion ratio.

Age and species are two factors that determine enzyme activity in animals. In poultry, the passage of feed through the digestive tract occurs very rapidly and microbial digestion is not well-developed. For this reason, enzymes are used more effectively in the poultry sector. Dietary phytase supplementation increases the utilization of phosphorus as well as the feed conversion ratio, and thereby, promotes growth (Rutherfurd et al., 2002). Phytase is not only used to increase the utilization of phosphorus and promote growth, but also to decrease the fecal excretion of phosphorus and thereby, reduce the environmental phosphorus load. To exemplify, cereals rich in phosphorus have an important place in poultry nutrition. Yet, the enzyme required for the digestion of phosphorus is not synthesized in the digestive system of poultry. Therefore, plant-origin phosphorus is excreted from the body in bound form as phytin (Leske and Coon, 1999). This leads to chelation with other nutrients (P, Ca, Cu, Mg, Zn, Fe), resulting in the poor utilization of other minerals and environmental pollution. Animals are not able to sufficiently utilize

amino acids and ammonia levels increase. Increased ammonia levels not only cause pollution, reduce air quality, cause bad odour and environmental concerns, but also adversely affect the performance and health of poultry (Huff et al., 1998).

Organic Acids

Organic acids, and in particular short-chain fatty acids are well-known for their antagonistic effect against pathogenic bacteria. Organic acids (lactic acid, formic acid, propionic acid, butyric acid, fumaric acid, acetic acid, citric acid) (Saleem et al., 2016) have antibacterial and antifungal effects, increase the digestibility of feed in the intestines, provide an energy source, promote growth, improve the palatability of feed, and protect animal health. Following the prohibition of the use of antibiotics as growth promoters, the use of organic acids has shown a progressive increase in recent years (Zeng et al.,2015); (Khan and Iqbal, 2016). Acetate, propionic acid and butyric acid have received noteworthy attention as feed additives. Formic acid is another promising feed additive.

To date, formic acid has mostly been used to ensure food safety. It reduces the occurrence of foodborne pathogens in feed. Having been first used to control the occurrence of foodborne pathogens in animal feed, later formic acid was also used to increase the performance of animals and protect gut health (Papatsiros et al., 2013); (Ricke et al., 2020).

Organic acids reduce the pH level in the intestines, create an acidic environment and show either bacteriostatic or bactericidal effect (Losa and Köler, 2001; Giannenas, 2006). Not only are they used to limit the presence of pathogens, but also to improve intestinal morphology and increase the height and depth of intestinal villi for the activation of digestive functions (Dittoe et al., 2018; Ricke et al., 2020). They increase the feed conversion ratio by increasing enzyme activity. By means of their antifungal effect, they prevent the growth of mold in feed. Organic acids also support antimicrobial and immunostimulatory effects. They are also used to prevent the microbial contamination of chicken carcasses. They show bactericidal effect on Salmonellae and other bacteria by breaking down the cell wall (Dhawale, 2005; Palupi et al., 2022).

Antioxidants

Antioxidants are of particular importance for poultry breeding. These are either natural or synthetic products. Fish meal and oil can be used as protein and energy sources, respectively, in poultry rations. These ingredients are rich in polyunsaturated fatty acids. Polyunsaturated fatty acids increase the tendency of both feed and poultry meat to rancidify. This effect can be prevented by incorporating antioxidants into feed. It is also known that antioxidant compounds show a cellular protective effect against oxidative stress and reduce the severity (Brenes and Roura, 2010) of *Eimeria tenella* infections by altering the intestinal lipid peroxidation level.

The most commonly used synthetic antioxidants are those derived from phenolic structures, including butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tert-butylhydroquinone (TBHQ), dodecyl, propyl, and octyl gallate. Ethoxyquin (ETOX) is a non-phenolic synthetic antioxidant. Contrary to the others, it is not allowed to be used for human consumption and is only used for the preservation of the feed of large birds.

On the other hand, natural antioxidants are mostly found in plant parts (leaves, tree bark, seeds, fruits). The two most important natural antioxidants are tocopherols (vitamin E) and ascorbic acid (vitamin C). While vitamin E is an essential micronutrient and should be found in the diet, the second is biosynthesized by poultry. Both natural and synthetic antioxidants have common use in the poultry industry as feed additives for the alleviation or reduction of oxidative stress (Botsoglou et al., 2004).

Other natural molecules with antioxidant property include carotenes (β-carotene, lycopene, lutein, xanthine), flavonoids (catechins, epigallocatechins, quercetin, rutin and morin) (Tekeli et al., 2010) and non-flavonoid phenols (rosmanol, rosmaridiphenol, boldine etc.). The incorporation of antioxidants into poultry feed is highly effective for ensuring food safety.

By preventing coccidial infections, chemical anticoccidial feed additives have played a vital role in the growth of the poultry industry. Furthermore, in the last 50 years, anticoccidials have facilitated the provision of good quality poultry meat and other poultry products to the

final consumer at reasonable prices. However, the uncontrolled and frequent use of anticoccidials eventually led to the development of varying levels of resistance to these chemicals. Moreover, drug residues in poultry products may be potentially toxic for humans. To overcome the worrisome level of resistance, integrated approaches are recommended for the control of coccidiosis, including strengthening the immunity of poultry and reducing their exposure to coccidial oocysts. In such cases, there is need for novel therapeutics to replace the old to which resistance has developed. However, the development of novel therapeutics is a long-term process. Due to the high costs of developing novel therapeutics and vaccines, the development of resistance to anticoccidials, and concerns related to the residues of these chemicals in poultry products, botanicals have gained popularity in the safe, effective and low-cost control of avian coccidiosis. Many scientists across the world are actively researching plants and plant products with a view to minimize the economic losses caused by coccidiosis to the poultry industry. The use of natural products as an alternative to anticoccidial drugs is a better and cost-effective approach to control coccidiosis without causing the development of drug resistance. These alternative methods may also reduce the occurrence of enteric parasitic infections.

Nutrition has an important place in the protection of animals from diseases. Antioxidant-rich diets are considered highly important for growth promotion, survival, maintenance, fertility and the reproductive health of animals. Antioxidants are molecules that reduce oxidative

stress, which is caused by high levels of reactive oxygen species (ROS) and leads to cell death or damage by triggering chain reactions in the cell (Marcincak et al., 2008).

Free radicals react with polyunsaturated fatty acids and induce a chain reaction process, referred to as lipid peroxidation. In living organisms, lipid peroxidation causes DNA damage by altering the enzymatic activity and structure of amino acids and shows toxic effect on cells. Normally, the generation and elimination of ROS is in a state of balance. However, when ROS generation exceeds the capacity of the natural antioxidant defense system, the state of balance is impaired. This state of imbalance, which is in favour of oxidants, is referred to as oxidative stress and is involved in the pathogenesis of various infections, including parasitic diseases. Therefore, the use of antioxidant compounds, which strengthen the antioxidant defense system or directly intervene with free radicals, may treat coccidial infections by re-establishing the oxidant/antioxidant balance. In this respect, antioxidants are considered as a promising alternative to anticoccidial drugs for the control of avian coccidiosis. The restriction of the use of synthetic compounds, due to drug resistance and drug residues, has placed antioxidant plant extracts under the spotlight. Natural antioxidants may reduce adversities associated with synthetic drugs, as these are not only nature-derived products, but may also contain molecules to which no resistance has developed yet.

Plant Extracts

Plant extracts are popular natural antibiotic alternatives, which increase the feed conversion ratio, promote growth (Barreto ve ark., 2008); (Denli ve Demirel, 2018), show antibacterial, antifungal and antiprotozoal effects, and reduce oxidative stress in poultry via their antioxidant activity (Hammer et al., 1999).

Medicinal herbs and feedstuffs containing polyphenolic compounds have been investigated for their potential to be used in the control and treatment of avian coccidiosis. These investigations have tested the most effective and safe natural novel compounds with anticoccidial activity. In a study on the anticoccidial effect of grapeseed proanthocyanidin extract (GSPE), which is a natural polyphenolic antioxidant, against *Eimeria tenella* infection, significantly decreased mortality and improved poultry performance were reported. Xanthohumol (XN), a prenylated flavonoid naturally found in hops, has been reported to show anticoccidial activity against various Eimeria species in chickens (Allen, 2007). Chickens infected with *E. acervulina* and *E. maxima*, after being given 20 ppm of dietary XN, were compared to the controls and determined to shed a lower number of fecal oocysts. Furthermore, dietary XN was ascertained to show an inhibitory effect on *E. tenella* schizonts by causing physical damage. XN treatment was proven to prevent parasite growth in the host.

Plant extracts are the best replacement option for chemical anticoccidials. Nevertheless, further experimental studies are needed to

elucidate the efficacy and action mechanisms of plant-derived antioxidants.

Vaccines

Vaccination is a reliable and valid method used to induce immunity and prevent infections in poultry. The combined use of anticoccidial drugs and vaccines on the field yielded successful results in previous years. However, the use of live vaccines requires careful management due to the risk of severe reactions. The use of attenuated vaccines is not cost-effective.

CONCLUSION

The poultry sector, which provides eggs and meat as major food sources, maintains its significance in terms of lower production costs, compared to the red meat industry.

Bacterial diseases are frequently encountered in poultry production. The treatment of bacterial infections in poultry production systems is based on the use of antibiotics at different critical points throughout the breeding period. It should be noted that, when used for therapeutic purposes, antibiotics not only offer benefits, but may also cause harm. Accurate diagnosis, accurate drug selection, correct dosage, and keeping the treatment period short are essential to antibiotic treatment. Excessive and unnecessary antibiotic use should be avoided. The inappropriate and uncontrolled use of antibiotics inevitably leads to the development of microbial resistance to these drugs. Microbial resistance leads to the entry of pathogens and antimicrobial resistance

genes into the food chain. For example, infections caused by Salmonellae that are resistant to antibiotics in both humans and animals, poor hygienic conditions, close contact and sharing between humans, and the consumption of raw or undercooked food of animal origin all increase the risk of infection.

Increase in microbial resistance reduces treatment success due to the emergence and spread of potentially more pathogenic microorganisms. The current state has led to the prohibition of subtherapeutic antibiotic use in poultry and livestock and to the avoidance of antibiotics employed in human medicine being used in veterinary medicine, to the extent possible. This approach highlights that the maximization of the benefits of antibacterial drugs in the long-term in both humans and animals heavily depends on the careful management of antibiotic use in the field of veterinary medicine.

To produce safe food products, the use of antibiotic alternatives, including probiotics, prebiotics, enzymes, organic acids, antioxidants and immunostimulants in poultry should be further investigated and the use of these alternative methods should be increased in a controlled manner.

Unless immediate actions are taken to extensify the use of antibiotic alternatives, improve and fully implement hygiene standards, provide training and education, and prevent the distribution and use of counterfeit products, consumers will continue to face major health threats.

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CHAPTER 4

TRICHOSTRONGYLOSIS

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Introduction

Trichostrongylosis disease in cattle and sheep is among the important nematode invasions that cause yield loss in cattle, sheep and goat breeding. It is not possible to diagnose the disease with a symptomatic diagnosis, and in subclinical cases, symptoms such as loss of live weight, decrease in milk yield, and developmental deficiencies due to decreased feed efficiency draw attention. The incidence and location of the disease may vary depending on different factors such as climatic conditions, production techniques, race, age, and herd management. *Trichostrongylus axe*i species, which is a disease agent in cattle, is used as a bioindicator parasite in the investigation of the negative effects of some nematodes and pesticides in the same family on environmental health (Sabo et al., 2009). Trichostrongylosis is caused by *T. colubriformis, T. rugatus, T. falculatus, T. probolurus, T. vitrinus, T. axei, T. skryabini, T. capricola* and *T. brevis* species in sheep and goats. (Kassai, 1999, Umur, 2011, Umur et al., 2011). The importance of the disease draws attention in terms of herd health.

1.Trichostrongylus

Trichostrongylus species are in the *Trichostrongylina* superfamily in the suborder *Trichostrongylina*, the largest group of helminths. *Trichostrongylus* species are small, slender, pale red-brown in color, lacking a mouth capsule or very small, no neck papillae. The evacuation hole is near the anterior end and appears as a small notch ventrally. Males have two prominent lateral lobes in the mating sac. The dorsal lobe is poorly developed and sometimes even obscured. The dorsal rib

is thin and divides into two branches with small lateral projections in the last third or fourth quarter. Spiculum is thick, brown and striated, with gubermaculum between them. In females, the vulva is located on the posterior half of the body and its edges are limited by the chitinous lips. The uterus is oppositely bidirectional, their eggs are oval and thin-shelled, and they carry a large number of blastomeres when excreted with feces. The general morphological features of females do not show significant differences according to the species. In males, on the other hand, morphological features vary according to the species. *Trichostrongylus* eggs are approximately 75-110 x 35-52 µm in size. (Umur et al., 2011). *T.axei* abomasum, which is one of the species found in, is found in the small intestines of other species. (Soulsby, 1986).

1.1.The Significance of Dıısease

Trichostrongylosis is caused by *T. colubriformis, T. rugatus, T falculatus, T. probolurus, T. vitrinus, T. axei, T. skryabini, T. capricola* and *T. brevis* species in sheep, goats and cattle is common in the world and in our country. It is one of the most important nematode infections. This disease, which progresses with different physio-pathological symptoms as well as loss of live weight, decrease in milk and meat yield due to decreased feed efficiency in infected animals, causes significant economic loss although it is not lethal. The economic importance of the disease draws attention especially in terms of herd health (Kassai, 1999, Umur, 2011, Umur et al., 2011).

1.2. Epidemiology

Trichostrongiylosis can be found at high rates in tropical, subtropical and similar climatic regions in the world, and at different rates in World depending on ecological and geographical differences, race, age, and herd management. (Kassai, 1999, Umur, 2011). In general, infective larvae develop in 4-6 days under ideal conditions at 27°C. The minimum temperature for larval development is 10-15°C. For this reason, larval development slows down in winter and increases in spring. The cold and heat resistance of the larvae varies according to the species and developmental periods. For example, the third instar larvae of *T. colubriformis* are perishable, and the survival time of the larvae in the pasture may vary according to temperature, precipitation and season. Another situation related to *Trichostrongylus* larvae is the inhibition feature, according to which it is reported that the larvae can be inhibited in old hosts and spend the winter as inhibited larvae (Umur et al., 2011). This situation is not permanent and development starts again when the conditions in which free periods can live in nature emerge (Umur, 2007).

2.Trichostrongylosis in cattle

2.1.Epidemiology of Disease

Trichostrongylosis is seen intensely in tropical, subtropical and similar climate regions in the world, and it is seen at different rates in different regions according to the seasons in Turkey.

2.1.1. Distribution of Trichostrongylosis in Turkey

T. axei, T. colubriformis, T. skrjabini species are reported to be disease agents in cattle in Turkey. In Kars region cattle, it is reported that *T. axei* 58%, *T. colubriformis* 8%, and *T. skrjabini* 6% are seen as the causative agent of trichostrongylosis (Umur, 1996). It is reported that *T. colubriformis* is encountered at a rate of 3.63% in cattle from Bursa region (Ergül, 1995), and *T. axei* at a rate of 1% in cattle from Konya region (Gökçen and Güçlü, 2002). *Trichostrongylus spp*. is found in 22% of cattle in the Southern Marmara region (Şenlik et al.,2010) and 4% in cattle in the Kayseri region (Yıldırım, 2000).

2.1.2. Distribution of Trichostrongylosis in the World

Parasites that cause Trichostrongylosis without specifying the species name, 42% in Belgium (Agneessens et al., 2000). It is reported to occur at a rate of 29% in the Netherlands while *T. axei* is reported to be seen in 52% of cattle in Africa Cote-d'Ivoire (Achi et al.,2003), and 60% in Germany (Rehbein et al.,2013), 20.43% in cattle (Iqbal et al., 2007), 4.5% in camels (Farooq et al., 2012), 11.2% in buffaloes (Islam et al., 1992) in Bangladesh is reported.

2.2. Life Cycle

There is no intermediate host in the development of *Strongylus* species, the development is direct. Thin-shelled eggs, containing blastomeres, released by the females, are dispersed to the pasture with feces. There are 16-32 blastomeres inside the eggs, and rhabdiform larvae with esophagus L1, then L2 with filariform structured esophagus and short-

tailed infective L3 are formed within a day under suitable environmental conditions. L3 taken with herbs develop in the digestive system of the host and become L4 after ecdysis. About three weeks after infection, eggs begin to appear in the stool. Depending on the eco-geographical conditions, the larvae can spend the winter in the pasture, and drought can cause the vitality to be lost in a short time. Inhibited larvae can be found at varying rates in older animals (Kaufmann, 1996, Mönnig, 1950, Urquhart et al., 2000).

2.3.Pathogenity

T. axei, which is the causative agent of this disease, enters the abomasum mucosa in cattle and causes catarhal gastritis. Other species invade the intestinal mucosa. Acetylcholinesterase, which is detected in the excretory secretions of the adults of the species in this genus, causes peristalsis and decreased mucus secretion in the intestinal tissues, and inhibition of the excretion of opiates due to immune response. In vitro experiments show that *T. colubriformis* can cause pathological disorders by disrupting cell repair in intestinal crypts at high doses. Plasma proteins leak into the galleries opened by T.vitrinus and T.colubriformis in the small intestinal epithelium, hypoalbuminemia, gastroenteropathies and yield loss occur oluşmaktadır (Drudge et al., 1955, Jones,1983, Angus and Coop, 1984, Jones ve Knox, 1990, Lee, 1996, Oppermann and Chan,1992).

2.4. Clinical Symptoms

There is a decrease in the number of erythrocytes, hemoglobin and hematocrit values in the blood. Death is directly related to the susceptibility of the animals and the severity of the infection, and ventral edema (bottle jaw) is mostly observed in sheep and goats.

2.5.Diagnosis of Disease

Diarrhea and anorexia can be seen in live animals due to pathological lesions in the intestines. Methods such as larval culture in stool and egg count are used in antemortem diagnosis. Changes in the small intestine are examined in postmortem diagnosis. Atrophy of small intestinal villi can be detected in acute cases, and lesions of the abomasum in T.axei infections. Depending on the susceptibility of young animals and the severity of the infection, gray nodules can be seen in the abomasum (Shapiro, 2010).

2.6. Protection and Control

Considering that animals usually get sick in the form of herd infection rather than individually, it is important to carry out an appropriate and meticulous sampling for stool examination, to fight according to EPG test results and epidemiological characteristics of the region, in controlling the disease. İt is reported that it is very beneficial not to bring animals into the polluted pastures, to dry the swamps, not to give fresh grass from these pastures, to collect the fertilizers in the barns frequently, to make piles of two meters wide and deep, to disinfect them with soil, to wait for a month, to keep animals around the manure. It is

important to divide the pasture into paddocks, graze for a week each time and return to the same part after four months, to put pebbles around the drinking water to prevent flooding, to use artificial fertilizers in the pastures to prevent animal feces from mixing with the water.It may be beneficial to graze young and old, ovine and bovine animals grazing in the same pasture in separate pastures and to spray them with appropriate helminths one week before a new animal enters the pasture. Examination of feces before and after the pasture, especially control of pregnant animals, and effective spraying at the appropriate time and dose are recommended as an important strategy to control the disease (Argun, 1951).

3. Trichostrongylus in Sheep and goat

3.1. Epidemiology of Disease

3.1.1. Distribution of Trichostrongylosis in Turkey

T. axei 32.5%, *T. colubriformis* 7.5%, *T. vitrinus* 25%, *T. capricola* 2.5%, *T. longispicularis* 2.5% were detected in South Marmara region sheep (Tınar et al.,2001). *T. axei* 42%, *T. vitrinus* 44%, *T. colubriformis* 35% in curly sheep in Thrace. *T. capricola* was found in 35%, and *T. probolurus* in 2% (Vuruşaner, 1996). *T. vitrinus* was found in18.8% and *T. capricola* 8.8% in Niğde region sheep (Akkaya et al., 2004). *T. probolurus* and *T. vitrinus* were detected at a rate of 2.08% in sheep from Konya region (Güçlü et al., 1996). It has been published that 38.9% of 7126 male individuals among 47.600 *Trichostrongylus* nematodes detected in 198 lambs in the Istanbul region are *T.*

colubriformis and the rest are *T. vitrinus* and *T. capricola* (Vural et al., 1979). *T. probulus* 83.06%, *T. colubriformis* 6.12%, *T. vitrinus* 4.77% and *T. capricola* 0.40% were found in sheep of different breeds brought to Ankara slaughterhouse from ten different cities (Güralp, 1995). *T. axei* 33%, *T. probolarus* 19% in sheep from Van region (Cengiz and Değer, 2009). *T. axei* 4%, *T. vitrinus* 42% and T. colubriformis 6% were detected in Burdur sheep (Umur and Yukarı, 2005). In sheep from Bardakçı village of Van region, *Trichostrongylus* spp. infection was found (Değer and Akgül, 1991). *T. probolurus* was found in 6% and *T. colubriformis* in 2% in Angora goats of Central Anatolia Region. T. vitrinus was detected at a rate of 13.25% in hair goats of Şanlıurfa region (Altaş et al., 2009).

3.1.2. Distribution of Trichostrongylosis in the World

T. axei 69%, *T. vitrinus* 27%, *T. colubriformis* 12% in sheep in Sicily region of Italy (Torina et al., 2004), *T. colubriformis* in sheep in African Cote-d'Ivoire 88%, *T. axei* 62% (Achi, 2003), *Trichostrongylus spp.* 33.9% (Tariq, 2008), while in Bangladesh *Trichostrongylus* sp. It is seen at a rate of 34.55% (Islam, and Taimur, 2008). *T. axei* 58%, *T. vitrinus* 42%, *T. colubriformis* 21% in goats in Sicily region of Italy, *T. colubriformis* 96%, *T. axei* in African Cote-d'Ivoire goats It is seen in 46% and 51.88% goats in Bangladesh (Barker, 1975).

3.2. Life Cycle

Trichostrongylus species evolve in monoxene. The prepatent period is approximately 20 days under ideal conditions, and eggs with thin shells

and blastomeres are scattered on the pasture with feces. The egg, which contains 16-32 blastomeres, develops and leaves the egg within a few days (L1) under suitable environmental conditions. This larva changes 2 coats in 4-6 days and becomes infective (L3). The (L3)s taken orally by sheep and goats become (L4) by changing the lining in the digestive system. Afterwards, they continue their development and reach the young adult (L5) stage after 15 days. The prepatent period is about 20 days, and it is reported that the first eggs start to be laid three weeks after infection (Mönnig, 1950, Kaufmann, 1996, Urquhart et al., 2000).

3.3. Pathogenıty

Trichostrongylus species parasitizing in small ruminants can show their pathological effects by invading the mucosa in the first three to four meters of the small intestine. *T. axei* causes catarrhal gastritis by invading the abomasum mucosa. In vitro experiments show that *T. colubriformis* can cause pathological abnormalities by disrupting cell repair in intestinal crypts at high doses. Plasma proteins leak into the galleries opened by *T. vitrinus* and *T. colubriformis* in the small intestinal epithelium, and hypoalbuminemia, gastroenteropathies, loss of appetite and productivity have been reported (Barker, 1975, Beveridge et al., 1945, Soulsby, 1986). It has been reported that there is a 20% decrease in feed consumption in lambs with trichostrongylosis, and in parallel, the rate of feed conversion decreases. It has been stated that especially the decrease in phosphorus ratio causes osteoporosis, decrease in calcium and phosphorus absorption causes hypophosphotemia, and decrease in selenium intake causes growth

retardation and disorders in the skeletal system. Although it has been suggested that an average of 2000 parasites should be present in one-year-old sheep for clinical symptoms to occur, this situation may vary according to the age and nutritional status of the animal. In necropsy, it is observed that the intestinal surface is covered with mucus, with swelling and edema in the small intestines, especially in the duodenum, and sometimes mild bleeding. In chronic cases, carcass weakness and fatty liver can be seen. Intestinal mucosa is thickened, inflamed and ulcerative, flattening, redness and focal foci are seen in some parts of the intestines, and villus atrophy is reported to be obvious in histopathological examination (Umur, 2011). It has been stated that acetylcholinesterase detected in the excretory secretions of the adults of the species in this genus causes a decrease in peristaltic and mucus secretion in the tissues, and inhibition of parasite excretion due to immune response (Opperman and chan 1992, Lee 1996).

3.4. Clinical Symptoms

Especially young animals such as kids and lambs are susceptible to the disease, there may be differences in sensitivity between sheep breeds. In case of ingestion of large amounts of parasites in a short time, acute infection occurs. In this case, although the animals are too weak to stand, death can occur in a short time before symptoms such as anemia and weakness occur. In chronic cases, loss of appetite, weakness, dry skin, diarrhea or constipation are observed. These parasites that cause black diarrhea in young merinos in Australia are called black diarrhea scours worm (Umur, 2011, Soulsby, 1986). There is a decrease in the

number of erythrocytes, hemoglobin and hematocrit values in the blood. Ventral edema (bottle jaw) is mostly observed in sheep and goats (Menzies, 2010).

3.5. Diagnosis of Disease

Diarrhea and anorexia due to pathological lesions in the intestines in live animals, and changes such as villus atrophy in the small intestine in postmortem examination and changes such as abomasum lesions (gray nodule) in *T.axei* infections raise suspicion of the disease. At necropsy, adult parasites can be seen by diluting the scraping taken from the intestinal mucosa with the help of a scalpel, in a petri dish or by examining it under a microscope between lamella and lamella. In stool examination, it is not possible to diagnose according to egg characteristics. For this reason, it is stated that the diagnosis can be made according to the 3rd instar sheathed larvae after stool culture (Umur 2011, Kaufmann, 1996, Urquhart 20003, Shapiro, 2010)

3.6. Protection and Control

Trichostrongylosis is seen as a herd infection and in prevention; It is recommended not to introduce animals to polluted pastures, to dry the swamps, not to give fresh grass obtained from these pastures, to comply with barn hygiene, and to store animal manure in a place away from barns and animals. Alternate grazing of animals in the pasture, not grazing the young and old together, not taking the newly joined animals to the pasture for a while, draining the puddles in the pasture and preventing the contamination of drinking water with feces are

recommended as other measures that can be taken. According to the seasons, fecal examination before the animals are taken to the pasture and at the end of the season, especially controlling the pregnant animals, and accordingly, effective spraying at the appropriate time and dose have been reported as other important methods and strategies in control (Argun 1951).

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CHAPTER 5

FUNCTIONAL FOODS

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1. INTRODUCTION

As a result of the rapid increase in consumption with the increasing world population and the use of less physical activity to reach food with the developing technology, chronic diseases that are difficult to diagnose and treat have begun to emerge. People want to improve their quality of life due to the increase in treatment costs, loss of workforce, prolongation of life expectancy, and the fact that a large percentage of the population is old (Margaoan et al., 2019).

Today, there is a change in the understanding of food production and consumption, and the development of functional foods has become an important sector in the food market. Foods that positively affect our well-being and quality of life, beyond basic nutritional properties such as value-added or health-focused products, are known as “functional foods”. This term highlights the positive correlation of bioactive compounds found in these products with health. (Barta et al., 2022).

The first studies on functional foods started in Japan in 1984, and in 1986, a "functional food forum" consisting of six experts was established in order to protect public health through functional foods in Japan. In line with the report of the said committee, the Ministry of Health of Japan concluded that it would be appropriate to use the term "Food for Specific Health Use" (FOSHU). Today, some academic circles prefer to use this term instead of the concept of functional food. Beneficial components for health that can be used in the production of functional food include dietary fibers, oligosaccharides, sugar alcohols, peptides and proteins, glucosides, alcohols, isoprenoids, cholines,

vitamins, minerals, lactic acid bacteria and polyunsaturated fatty acids (Vural, 2004).

2. FUNCTIONAL FOOD DEFINITION BY DIFFERENT AUTHORITIES

Table 1. Definition of Functional Foods by Different Autorities

Authorities	Definition of functional food	References
Functional Food Center (FFC)	"Natural or processed foods containing known or unknown biologically active compounds that provide a scientifically supported and established health benefit for the prevention, management, or treatment of chronic diseases is prescribed, appropriate, and non-toxic amounts"	Martirosyan and Pisarski, 2017
Food and Drug Administration (FDA)	"The word "functional foods," which is recently being used as a marketing idiom for the group, does not have a legal meaning"	Martirosyan and Sing, 2015
Institute of Food Technologists (IFT)	"Foods and food ingredients that have health benefits in addition to basic nutrition." These products provide necessary nutrients in amounts that are often more than what is needed for regular operation, health, and production, as well as other pharmacologically active components that have a positive effect on health."	MacAulay et al., 2005
International Life Sciences Institute (ILSI)	"Foods that by virtue of the presence of physiologically active food components provide health benefits beyond basic nutrition"	Crowe and Francis, 2013
International Food Information	Functional foods include a wide variety of foods and food components believed to improve overall health and well-being, reduce	International Food Informatio

Council	the risk of specific diseases, or minimize the effects of other health concerns.	n Council. 2009
European Food Safety Authority (EFSA)	"A food, which beneficially affects one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease. A functional food can be a natural food or a food to which a component has been added or removed by technological or biotechnological means, and it must demonstrate their effects in amounts that can normally be expected to be consumed in the diet"	Martirosyan and Singharaj, 2016
British Nutrition Foundation	a food modified in some way that may provide health benefits over and above the nutritional value of the food.	British Nutrition Foundation, 2023
Japanese Ministry of Health, Labour, and Welfare	FOSHU [food for specified health uses] refers to foods containing ingredient with functions for health and officially approved to claim its physiological effects on the human body. FOSHU is intended to be consumed for the maintenance / promotion of health or special health uses by people who wish to control health conditions, including blood pressure or blood cholesterol.	Japan MHLW, 2023
The European Commission Concerted Action on Functional Food Science in Europe (FUFOSE)	"Functional food is a food with certain beneficial effects on one or more target functions in the body beyond the basic nutritional effects with a result the improved health state and well being or reduction of risk of diseases. It is consumed as a part of a normal diet and is not used in the form of pill or capsule or any other form of dietary supplement"	The European Parliament and the Council of the European Union, 2006

Health Canada	A functional food is similar in appearance to, or may be, a conventional food, is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions.	Health Canada, 1998

A functional food may be a natural food, or a food to which an ingredient has been added or removed by technological or biotechnological means, and must exert its effects in quantities that would normally be expected to be consumed in the diet.

3. COMMON CHARACTERISTICS OF FUNCTIONAL FOODS

Functional foods are actually food and beverage products that can be consumed every day.

These are not medicines in powder, capsule or dragee form

The drug should not be in the form of capsules or any dietary supplement,

Its effects must be approved by the scientific world,

The nutritional components it contains should have a positive effect on health.

It should be natural

It should be safe in uncontrolled consumption as part of the diet

Its health benefits must be scientifically proven.

Should not show allergic effects, should be safe (Doğan, 2021).

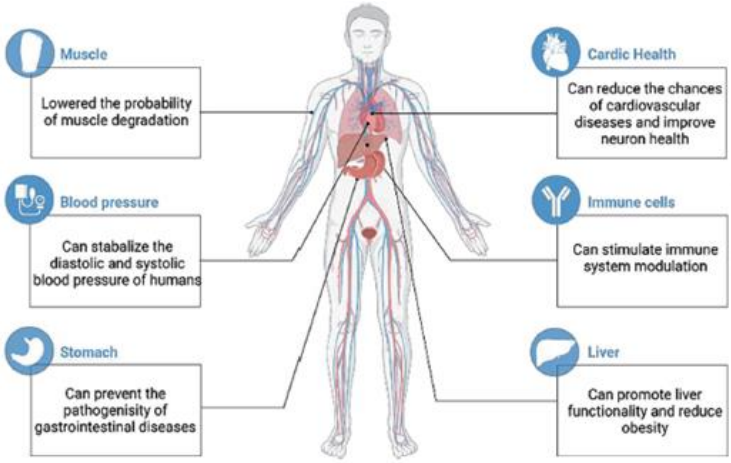

Figure 1. Aplications of functional foods (Gazanfar et al., 2022)

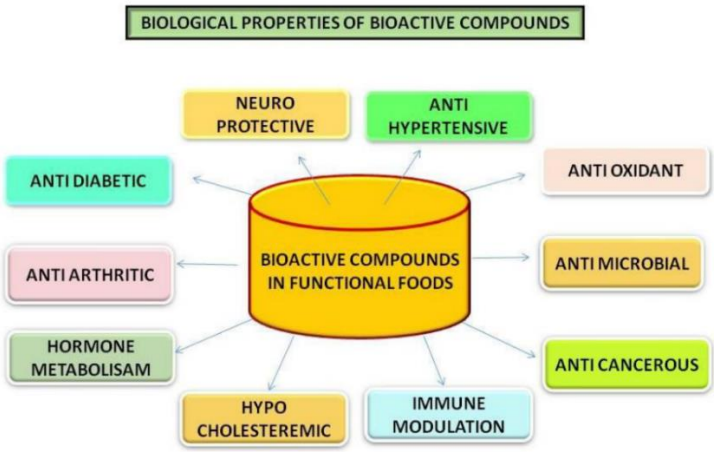

Figure 2. Biological Properties Of Bioactive Compounds İn Functional Foods (Soumya et al., 2021)

4. CLASSIFICATION OF FUNCTIONAL FOODS

Functional foods can be grouped according to the food group they belong to (eg dairy products, beverages, cereals, confectionery, oils and

fats), diseases that are expected to prevent or alleviate (e.g. diabetes, osteoporosis, colon cancer), physiological effects (eg, immunology, digestibility, anti-tumor activity), category of specific biologically active components (eg minerals, antioxidants, lipids, probiotics), physico-chemical and organoleptic properties (e.g. colour, solubility, texture) or processes used in its manufacture (e.g. chromatography, encapsulation, freezing) (Stein and Rodriguez-Cerezo, 2008).

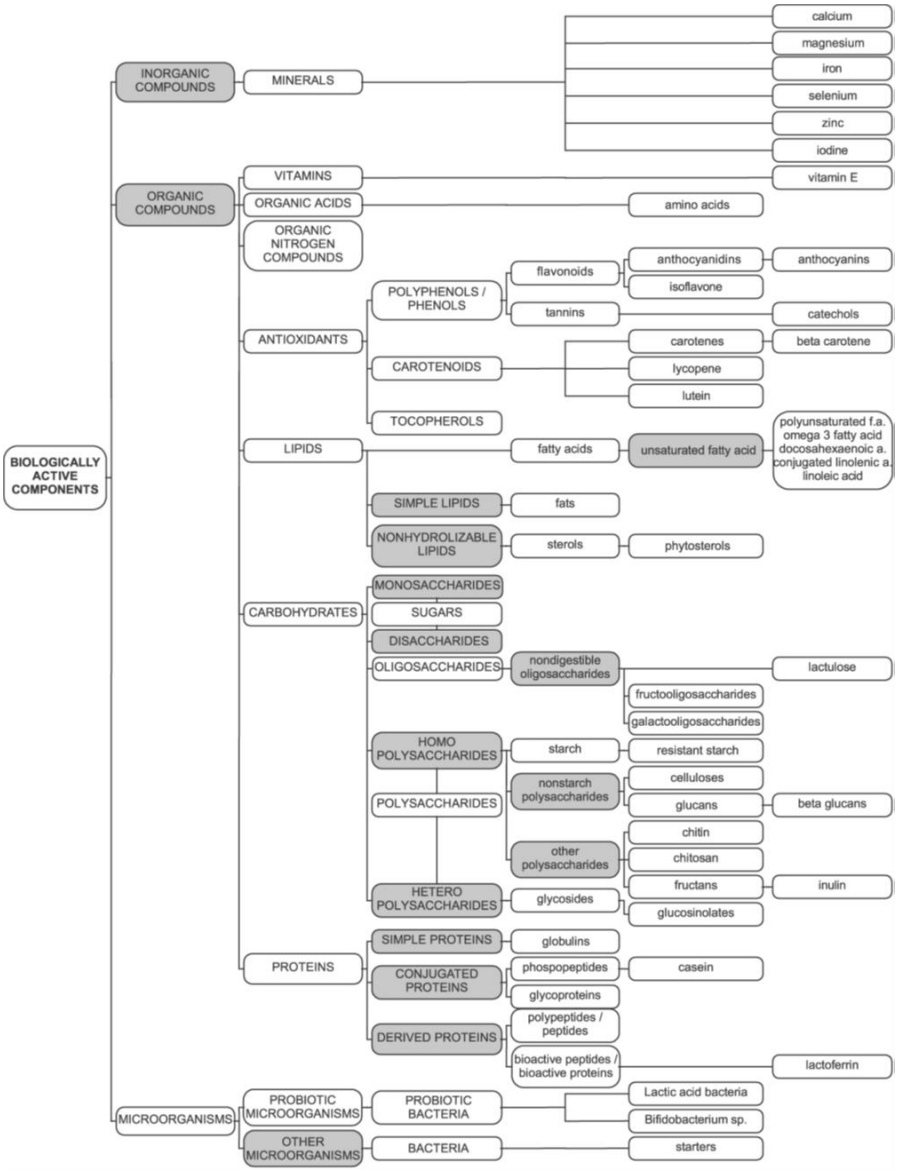

Figure 3. Biological Active Components in Functional Foods (Juvan et al., 2005)

The American Dietetic Association (ADA) qualifies all foods as functional because of their positive benefits to the body, such as growth and energy.

The ADA has made a classification of functional foods. According to this, functional foods are divided into four as conventional foods, modified foods (fortified or enriched), medical foods and those with special nutritional uses (Hasler and Brown, 2009).

Table 2. The Borderline Between Food And Medicine (Raspor, 2011)

	Functional food	Medicinal food	Medicine
Usage	Providing nutritional needs, weight management, supporting health of digestive system, skeleton, heart, reducing risk of development of certain diseases.	Food management of some diseases or certain medical conditions, in which there are specific nutritional needs (i.e. problems with swallowing, lost appetite, postoperative nutrition)	Curing disease or treating its symptoms
To be consumed	As wanted	As needed	As prescribed

Conventional functional Foods consist of natural or whole food ingredients that provide functional ingredients, while modified functional are foods or food products that add additional ingredients for specific health purposes. Plant-based foods such as fruits, vegetables, herbs, cereals, nuts and beans, vitamins, minerals, fibers, omega-3 fatty acids that play a functional role in the human body against chronic

diseases such as cancer, cardiovascular diseases and Gastro Intestinal System-related disease. Contains antioxidants and phenolic compounds. Some other foods or food products, such as juices, dairy products, fortified eggs, and seafood, are made up of functional ingredients. Fish contains omega-3 fatty acids (EPA and DHA), which play a functional role in heart health and brain development (Arshad et al., 2019)

4.1. Conventıonal Functional Foods

Traditional foods are natural, whole food ingredients rich in important nutrients such as vitamins, minerals, antioxidants and heart-healthy fats.

Unmodified whole foods or traditional foods such as fruits and vegetables represent the simplest form of a functional food. For example, tomatoes, raspberries, cabbage or broccoli are considered functional foods as they are rich in bioactive components such as lycopene, ellagic acid, lutein, and sulforaphane, respectively.

Experimental and epidemiological studies have reported that cruciferous vegetables reduce the risk of various types of cancer, lycopene-rich tomato products reduce the risk of prostate, ovarian, stomach and pancreatic cancers, and citrus fruits reduce the risk of gastric cancer. It has also been reported that dark chocolate improves endothelial function for heart health, and tree nuts and peanuts reduce the risk of sudden cardiac death, fermented milk products (probiotics)

can improve irritable bowel syndrome, and cranberry juice reduces bacteriuria in urinary tract infection. (ADA, 2009)

4.2. Modified Functional Foods

Functional foods may also include those that have been modified through fortification, fortification, or enhancement. Some foods today are fortified with additional ingredients such as vitamins, minerals, probiotics or fiber to increase the health benefits of the food.

It may include foods enriched with bioactive ingredients such as calcium-fortified orange juice (for bone health), folate-enriched breads (for proper fetal development), or margarines containing plant stanols or sterol esters (cholesterol-lowering), and beverages enriched with energy-supporting ingredients such as ginseng, guarana, or taurine. (ADA, 2009)

Table 3. Classification of functional foods (Crowe and Francis, 2013)

Classes	Description	Examples
Conventional food	whole, unmodified food that naturally contain bioactive components that confer health benefits	vegetables and fruits, fish, dairy, and grains

Modified foods	food items that have been enhanced, enriched, or fortified with functional food components	fruit juices with calcium, folate-enriched breads, beverages with plant extracts, and iodized salt
Synthetic food ingredients	Functional components that are synthesized in the laboratory	Inulin-typ

5. FUNCTIONAL FOODS ACCORDING TO THEIR SOURCES

Dairy products, bakery products, confectionery, soft drinks and baby foods are at the forefront of the food market segments where functional food products are predominantly launched.There are functional products of plant and animal origin designed to lower high blood pressure, cholesterol, blood sugar and osteoporosis (Kaur and Das, 2011).

The most prominent varieties are briefly presented below.

5.1. Milk-Based Products

Proteins, vitamins and minerals are the main functional components of dairy products, as well as hormones, cytokines and immunoglobulins. The amino acid sequences of peptides and proteins in dairy-based products can increase their health benefits by reducing cardiovascular diseases such as hypertension, myocardial infarction, stroke, which are the leading causes of death globally. Milk is one of the best sources of calcium, an essential nutrient that can prevent osteoporosis and possibly colon cancer. There are some products that have been modified by adding a range of functional Peptides, beta-lactoglobulin and glycomacropeptides with the VPP (valine-proline-proline) and IPP (isoleucine-proline-proline) sequences that have blood pressure lowering and enhanced protection against viral and bacterial infections. (Kaur and Das, 2011, Husseini et al., 2022).

Yogurt is a highly nutritious fermented milk-based product that contains adequate amounts of protein, vitamin B-12, vitamins and minerals such as vitamin D in fortified yogurts, riboflavin, calcium, magnesium, and conjugated linoleic acid (CLA). It is a potential source of probiotics as it contains beneficial bacterial cultures (Fernandez and Marette, 2017, Chandan, 2017).

Different types of cheese, such as cheddar, mozzarella, and gouda, are sources of probiotics. by creating a buffer against the highly acidic environment in the gastrointestinal tract, it creates an advantageous environment for the development of probiotics throughout the gastric passage. It is also an abundant source of calcium and phosphorus,

which helps maintain the strength of bones and teeth, making it more effective for people suffering from osteoporosis. (Walther et al., 2008, Gomes et al., 2009,)

5.2. Meat Based Products

Meat is an excellent source of important nutrients such as taurine, L-carnitine, creatine, conjugated linoleic acid (CLA) and endogenous antioxidants, which can be made more functional with some modifications.

An anti-carcinogenic fatty acid known as conjugated linoleic acid (CLA) was first isolated from grilled beef in 1987. Beef fat contains 3.1 to 8.5 mg of CLA/g fat, and its 9-cis and 11-trans isomers contribute 57-85% of total CLA. CLA is an effective anti-carcinogen in the range of 0.1-1% w/w in the diet, and is a powerful antioxidant and immunomodulator. Beef is also an important source of selenium for humans, and the selenium concentration in beef varies considerably between countries and regions. A peptide L-Carnitine is abundant in beef, which reduces cholesterol content, produces energy and maintains the body's stamina. (Bharti et al., 2015)

5.3. Seafood products

The marine world has an incredible biodiversity that includes creatures such as marine plants, microorganisms, sponges and fish. Therefore, the aquatic environment offers a wide variety of functional compounds, including omega 3 (ω3)- polyunsaturated fatty acids (PUFA), chitosan, chitosan oligosaccharides, glucosamine, carotenoids and xanthophylls,

marine enzymes and protein hydrolysates. Seafood is rich in ω-3 fatty acids, antioxidants and other bioactive sources, in addition to having high-quality protein. Various components of seaweed, such as its oil and polysaccharides, are natural sources of functional ingredients that provide a variety of health-beneficial effects, such as preventing CVD and acting as an antihypertensive, antioxidant, antiviral and anticancer agent (Kaur and Das, 2011, Hosseini et al., 2022).

Bioactive peptides isolated from fish protein hydrolysates as well as algal fucans, galactans and alginates have been shown to have anticoagulant, anticancer and hypocholesterolemic activities. Additionally, fish oils and marine bacteria are excellent sources of omega-3 fatty acids, while crustaceans and seaweeds contain powerful antioxidants such as carotenoids and phenolic compounds (Lordan et al., 2011).

5.4. Eggs and Products

Eggs are a natural functional food as they contain highly bioavailable carotenoids, lutein and zeaxanthin and are a good source of choline. Lutein and zeaxanthin are powerful antioxidants that have been shown to reduce systemic inflammation, fatty liver disease, and atherosclerosis in animal studies. Data document the role of lutein and zeaxanthin in protecting against age-related macular degeneration and reducing inflammatory markers in plasma. Choline has been reported to protect against hepatic steatosis. Also, choline has a neurotransmitter role and has been shown to enhance memory and protect against Alzheimer's disease. Additionally, eggs are an excellent source of protein, with all

essential amino acids proven to maintain muscle strength and reduce appetite (Fernandes and Lemos 2019)

Eggs with ω-3 polyunsaturated fatty acids have been developed because ω-3 is important in the prevention of heart disease, atherosclerosis, thrombosis, and blood pressure. In addition, it has been reported that eggs can be used as functional food after being enriched with antioxidants, vitamins D, E, B12 and folic acid, carotenoids, selenium and DHA. (, Surai and Sparks, 2001, Kaur an Das, 2011).

5.5. Fruits and vegetables

Fruits and vegetables have a wide spectrum of benefits due to the various phytochemicals present in large quantities. Fruits and vegetables contain a wide variety of substances that, with their antioxidant, anti-inflammatory and cardioprotective properties, have health-promoting effects and can reduce the risk of various diseases. Vegetables play an important role in human nutrition by providing essential nutrients that other food items lack. Vegetables provide a significant amount of vitamins and minerals to the diet and contain moderate amounts of carbohydrates and protein. Vegetables stimulate the appetite as well as taste and the fiber found in vegetables adds roughage for digestion and prevents constipation. They are important in neutralizing acidic substances produced during the digestion of meat, cheese and other foods.Various polyphenols, of which anthocyanins, flavanols and phenolic acids such as catechins, hydroxycinnamic acids, and tannins such as proanthocyanins and ellagitannins are more important because of their disease-preventing effects, are substances

found mainly in mulberry fruit, and lycopene is a carotenoid known largely to exist in tomatoes and is valuable as a functional food ingredient because it inhibits oxidative stress, hypertension, and atherosclerosis (Kaur and Das, 2011, Shahidi et al., 2011, Hosseini et al., 2022).

Polyphenols are a group of dietary antioxidants found naturally in fruits and vegetables. They primarily consist of flavonoids including flavanols, flavones, isoflavones, flavonols, flavonones and anthocyanins, and non-flavonoid polyphenolics including phenolic acids, lignans and stilbenes. Soluble fibres present in fruits may reduce risk of coronary heart disease. Proteins in the form of enzymes play a significant role in free radical scavenging. Vitamins may contribute to maintenance of healthy vision, immune function, bone health; cell integrity helps regulate calcium and phosphorus. Fruits are rich in antioxidant vitamins like C, A and E. Minerals play an important role in the normal functioning of cells and tissues.

Bioactive compounds found in vegetables are reported to be antioxidant, antimicrobial, antidiabetic and anticancer in nature; useful as anti-osteoporotic, antihypertensive, immunomodulatory, hypolipidemic and anti-obesity agents; and reduce cardiovascular complications. It is reported that a diet rich in vegetables reduces the risk of heart diseases, cancer, diabetes and neurodegenerative diseases. (Kaur and Kapoor 2000)

Brassica vegetables are a source of glucosinolates that contribute to the improvement of human health. Polyacetylenes found in Apiaceae

vegetables such as celery show cytotoxic activities against acute lymphoblastic leukemia, and phenolic acid in celery is reported to have antioxidant properties. Dill has antibacterial activity against Staphylococcus aureus and anti-yeast activity against Saccharomyces cerevisiae. Flavonoids in pepper and phenolics in Red pepper show good antioxidant activity, Capsanthine, capsorubin and cryptocapsin in pepper have high free radical scavenging activity. Chayote is a good source of bioactive substances with antidepressant and antiepileptic properties, anti-arteriosclerosis activity, and anti-inflammatory and cardiotonic properties. Artichoke polyphenolic extracts are reported to induce apoptosis and have anticancer activity against human breast cancer cell line due to the presence of potential chemopreventive and anticancer dietary compounds (Rashmi and Negi 2020).

Bananas are soft, easily digestible and rich in potassium, made up of simple sugars such as fructose and sucrose, which instantly replenish energy and revitalize the body when consumed. It is also extremely low in fat and protein and high in fiber, starch, antioxidants and minerals. Apple antioxidant phytonutrients are rich in flavonoids and polyphenolic compounds. The richest source of phenolic compounds is grapes. Grapes contain a polyphenolic compound called resveratrol and nutritional components such as anthocyanins. Resveratrol in red grapes has a lipid-modifying and antioxidant effect. Regular intake of grape juice can reduce free radicals in the body. Pears are rich in dietary fiber. Passion fruit is an antioxidant-rich fruit that provides great immunity. Pomegranate and Mangosteen are rich sources of antioxidants and

vitamins. Mango is an excellent summer fruit and is used medicinally to cure hiccups, sore throat, diarrhea and dysentery. Oranges and tangerines are excellent sources of vitamin C and carotene. Orange is a fruit rich in carotenoids, so it is important as an anticancer fruit, it also helps to reduce body weight, just like pomegranate. Peaches and nectarines contain a number of polyphenols. Peach helps to delay aging and cure various diseases. Pineapple is a source of vitamins, fiber and the digestive enzyme bromelain and is often recommended for digestive issues. Jackfruit is a good source of pectin and carotene. Jackfruit is another energy-rich product that replenishes energy loss in the body. Rambutan is an excellent source of vitamin C. Guava is a great source of antioxidants and pectin and is recommended for diarrhea and diabetes. Papaya is an immune booster and contains high amounts of potassium. Papaya is used in traditional medicine. Therefore, fruits play a vital role in maintaining a healthy and healthy life. Antioxidant-rich fruits help fight cancer by scavenging reactive oxygen species. Many are rich sources of iron, which helps to compensate for blood-related deficiencies (Joy et al., 2016).

5.6. Tea and Coffee

Tea has many different components such as polyphenols, caffeine, proteins, carbohydrates, lipids, vitamins (A, C, K, B vitamins), beta-carotene, fluoride and minerals, and these ingredients are very important in the effect of tea on health. Coffee theophylline, theobromine, xanthine alkaloids, phenolic acids ferulic, caffeic and vanillic acids, chlorogenic acid (caffeoylquinic acid), mannan

(polyholoside), nicotinic acid, oil, sugars, pentosans, atractilosides, coffeeol, essential oil, diterpene alcohol fatty acid esters It is a complex beverage containing components such as melanoidins and caffeine, and coffee has an effect on health with these content properties.

It has protective effects against diseases and regulating bone density for each individual by increasing antioxidant capacity with active substances such as polyphenols, flavonoids, catechins, theaflavins, amino acids, vitamins, and reducing the formation of free radicals that can damage body cells. Coffee consumption has an effect on cardiovascular diseases, Type 2 Diabetes, liver diseases, neurological diseases, osteoporosis and cancer (Özüpek and Aslan, 2021, Kaur and Das, 2011).

5.7. Cereal Based Products

Wheat, buckwheat, oats, barley, flaxseed, psyllium, brown rice, millet, sorghum, corn, and rye are the most well-known functional foods among possible grain foods. This is because grains provide humans with significant amounts of carbohydrates, energy, vitamins, antioxidants and minerals such as dietary fiber (β-glucan and arabinoxylan), protein, resistant starch and oligosaccharides (galacto- and fructo-oligosaccharides), which are essential for a healthy life. Epidemiological studies have shown that consuming grains regularly may be linked to a reduced risk of developing several chronic diseases such as cardiovascular disease, obesity, type 2 diabetes and certain types of cancer. It is also possible to process grains in both innovative and efficient ways to develop healthy products. Cereal functional

beverages, baked goods, and breakfast cereals can be prepared using grains (Ötleş and Çağındı, 2006).

5.8. Flaxseed

Derived from the annual flax plant, flaxseed (Linum Usitatissimum L.) is gaining a reputation as a versatile nutrient that can be easily incorporated into many foods because it contains proteins, dietary fiber, polysaccharides, polyphenolics, and essential fatty acids, and high levels of alpha- It is of interest as a functional food ingredient because it contains α- linolenic acid (ALA), lignans and fiber. Consumption of flaxseed in the diet helps prevent serious diseases such as heart disease, cancer, diabetes, obesity, gastrointestinal, kidney and bone problems (Kakkar et al., 2021).

5.9. Herbal Based Products

Herbs are sources of various functional ingredients that are beneficial when used in food in whole form or in extract form. Spices and herbs are used in foods for their flavor, pungency, and color. Herbs and spices also have antioxidant, antimicrobial, pharmaceutical and nutritional properties. Spices play an important role in the preservation of foods by delaying the deterioration of foods as well as giving flavor and taste. Antioxidants also play a role in the body's defense against cardiovascular disease, certain cancers (epithelial) and other conditions such as arthritis and asthma. Phenolic compounds such as flavonoids may help protect against cardiovascular disease and bowel cancer (black pepper, thyme, oregano and marjoram). Gingerol in ginger is

also an intestinal stimulant and promotes the bioactivity of drugs. Capsaicin found in pepper is an effective counter-irritant used in both medicine and cosmetics. Fenugreek, onions and garlic help lower cholesterol levels. Curcumin, a yellow polyphenolic pigment found in turmeric, can be found in Alzheimer's disease, Parkinson's disease, multiple sclerosis, epilepsy, brain damage, CVD, cancer, allergy, asthma, bronchitis, colitis, rheumatoid arthritis, renal ischemia, psoriasis, diabetes, obesity, depression. It has been shown to exhibit therapeutic potential in fatigue and AIDS (Bishnoi, 2020).

5.10. Honey

The most well-known functional properties of honey are its antioxidant and antimicrobial activities. Phenolic compounds present in honey promote high antioxidant effect by having the ability to minimize intracellular oxidative damage associated with cellular aging, apoptosis and neurodegenerative diseases. As a matter of fact, phenolic compounds, amino acids and reducing sugars are among the substances responsible for the antioxidant activity of honey. Many of the phenolic compounds also show antimicrobial activity against a number of pathogens and spoilage-causing microorganisms. The antimicrobial activity of honey is also due to the effect of enzymes. In addition, honey was found to contain lactic acid bacteria (LAB), which produce numerous active compounds that remain in variable amounts in mature honey. In addition, these antioxidant compounds may play an important role as prebiotics, protecting and stimulating the growth of probiotic bacteria. Oligosaccharides in honey are well-known prebiotic

substances that stimulate growth, activity and protect probiotic bacteria as they pass through the gastrointestinal tract and during storage of products. (Luchese et al., 2016).

5.11. Mushrooms

Mushrooms have become attractive as a functional food and source of drugs and nutraceuticals due to their antioxidant, antitumor and antimicrobial properties. In addition to their pharmacological properties, mushrooms are gaining more and more importance in our diet due to their nutritional value, high protein and low fat/energy content. Mushroom protein contains all nine essential amino acids necessary for humans. In addition to their good protein content, mushrooms are a relatively good source of other nutrients such as phosphorus, iron and vitamins, including thiamine, riboflavin, ascorbic acid, ergosterol and niacin. They are not only a source of nutrients, but have also been reported as therapeutic foods that are useful in preventing diseases such as hypertension, diabetes, hypercholesterolemia, and cancer. Fungi are sources of bioactive substances such as secondary metabolites (acids, terpenoids, polyphenols, sesquiterpenes, alkaloids, lactones, sterols, metal chelating agents, nucleotide analogues and vitamins), glycoproteins and polysaccharides, especially betaglucans. Due to the presence of biologically active compounds with medicinal value, they are used as anticancer, antiviral, hepatoprotective, immuno-enhancing and hypocholesterolemic agents. (Kumar, 2015).

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CHAPTER 6

BIOACTIVE COMPONENTS OF FUNCTIONAL FOODS: DEFINITIONS SOURCES AND HEALTH BENEFITS

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1. INTRODUCTION

Functional foods can be conceptualized as having two primary effects on health: enhancing physiological function and reducing disease risk and treatment. Therefore, functional food ingredients are potentially beneficial ingredients found naturally in foods or added to them as functional ingredients. Functional component groups include carotenoids, dietary fiber, fatty acids, flavonoids, isothiocyanates, phenolic acids, plant stanols and sterols, polyols, prebiotics and probiotics, phytoestrogens, soy protein, vitamins and minerals. Today, these substances are accepted to have a positive role in the pathogenesis of many diseases. The ever-expanding list and the thought that new food ingredients have special and specific beneficial effects on human health have led to an increased interest in these ingredients worldwide and therefore to many studies on their effects (Guine et al., 2010). Bioactive components in functional foods, their sources and their effects on health are shown in Table 2.

1.1. Vitamin Minerals and Trace Elements

Food supplementation with essential micronutrients, including vitamins A, D, and E, improves human health and improves quality of life and survival by providing adequate intake to avoid diseases (such as osteoporosis, osteoarthritis, a suppressed immune system, cancer, vision loss, and heart disease). Statistics of malnutrition in many populations, especially in developing countries, has increased the need for food supplements with lipophilic vitamins A, D and E. Foods often contain these vitamins, but in insufficient quantities and human body

absorption is insufficient to achieve optimal levels of health benefits. Some vitamins, such as A, C, and E, act as antioxidants. During processing, the oxidation process is initiated. These vitamins inhibit the oxidation process due to their antioxidant activity. When foods that enrich these vitamins are consumed, it may help in different chronic diseases (Arshad et al., 2021).

Folic acid supplementation helps prevent anemia, especially during pregnancy and in the elderly, as there is a significant loss of folic acid during cooking. For this reason, folic acid has been added to some foods, such as fortified breads, pastas, rice, and cereals.

Ascorbic acid (vitamin C), synthesized by most animals but not by humans, is one of the most important water-soluble antioxidants. Various molecular and biochemical mechanisms of ascorbate-mediated immunostimulation have also been proposed.

Vitamin E supplementation may help prevent Coronary Heart Disease due to at least two mechanisms: one mechanism is to protect blood lipoproteins from oxidation; the other is to prevent blood clotting, a process that plays a role in the onset of a heart attack. So both vitamin C and vitamin E are used to prevent CHD. It has been suggested that mortality from CHD is inversely related to a cumulative antioxidant index defined in terms of concentrations in plasma as follows, because alphatocopherol (vitamin E), l-ascorbic acid (vitamin C) and betacarotene (having vitamin A activity) are excellent antioxidants. Vitamin D (1,25-dihydroxyvitamin D3) has been recently identified as an immunoregulatory hormone that acts as an immunostimulating agent

of nonspecific immunity and exerts both stimulating and inhibitory effects on specific immune responses (Rincón-León, 2003).

1.2. Fats, Fatty Acids and Fatty Acid Composition

In recent years, awareness of the role of essential fatty acids in human health and disease prevention has been steadily increasing among people. Fish, fish oils and some vegetable oils are rich sources of essential fatty acids. Many studies have positively associated essential fatty acids with reduced cardiovascular morbidity and mortality, infant development, cancer prevention, optimal brain and vision function, arthritis, hypertension, diabetes mellitus, and neurological/neuropsychiatric disorders. The term essential fatty acids (EFA) refers to those polyunsaturated fatty acids (PUFA) that must be provided by foods because these cannot be synthesized in the body yet are necessary for health. There are two families of EFA, omega-3 (ω-3) and omega-6 (ω-6) (Kaur et al., 2014)

Omega-3 fatty acids are long-chain polyunsaturated fatty acids (PUFA) that are found in plants and marine organisms. The three main omega-3 fatty acids are docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), and alpha-linolenic acid (ALA) (Judge, 2018). α-linolenic acid is found in perilla oil, linseed oil, peony oil, sea buckthorn oil, Bama hemp oil, rapeseed oil, soybean oil, and grape oil (Su et al., 2018). Alpha linolenic acid is abundant in flax seed and is present in small quantities in hemp, walnut, soybean and canola oil It is mostly found in the chloroplast of green leafy vegetables (Hunter, 1990).

The second and third are derived from animals and fish, eicosapentaenoic acid seals (contains eicosapentaenoic acid, EPA, five unsaturated bonds) and docosahexaenoic acid (contains docosahexaenoic acid, DHA, six unsaturated bonds) (Abdelhamid et al., 2018; Shahidi and Ambigaipalan, 2018; Gutiérrez et al., 2019).

Awareness of the role of essential fatty acids in human health and disease prevention has been increasing among the population over the past decades. It is known that the positive correlation of essential fatty acid content with a decrease in cardiovascular morbidity and mortality, infant development, brain and vision functioning, arthritis, hypertension, diabetes mellitus, and neurological/neuropsychiatric disorders. Rich sources of essential fatty acids are fish, fish oil, and some vegetable oils (Mukhametov et al., 2022).

1.3. Carbohydrates and Dietary Fibers

Basically, these are structural and storage carbohydrates which are polymers of glucose molecules and other sugars including galactose, fructose, xylose, arabinose, etc., but are not starchy in nature (i.e. their sugar units are not linked by either α [1,4] or α [1,6] glycosidic bonds). Thus, they are not hydolysable by the human digestive enzymes but undergo fermentation by the probiotic microbes in the colon. There are several kinds of non-starchy carbohydrates including dietary fibre and fucoidan (Abuajah et al., 2015).

1.3.1. Non-starch polysaccharides

Non-starch polysaccharides (NSPs) or complex carbohydrates occur naturally in many foods. Nonstarch polysaccharides (NSPs) include all the plant polysaccharides other than starch. They are the key components of the cell walls of various grains and cover a great variety of biological functions and chemical structures. The major polysaccharides of NSP are cellulose, pectins, β-glucans, pentosans, heteroxylans, and xyloglucan which cannot be hydrolyzed by the endogenous enzymes of humans and monogastric animals. Non-starch polysachharides together form a major part of dietary fiber (DF) of grains and chemically DF is often defined as NSPs (Englyst, 1989).

The physicochemical and biological properties of these compounds correspond to dietary fiber. Non-starch polysaccharides exert a variety of physiological effects in the small and large intestine and therefore have important health implications for humans. Notable properties of dietary NSPs are water dispersibility, viscosity effect, bulk and fermentability to short chain fatty acids (SCFAs). These characteristics can lead to a reduced risk of serious nutrition-related diseases that are major problems in Western countries and emerging in more affluent developing countries. These conditions include coronary heart disease, colorectal cancer, inflammatory bowel disease, breast cancer, tumorigenesis, mineral-related abnormalities, and irregular laxation. Insoluble NSPs (cellulose and hemicellulose) are effective laxatives, whereas soluble NSPs (especially mixed-linked β-glucans) lower plasma cholesterol levels and helping to normalize blood sugar and

insulin levels, making such polysaccharides a part of diet plans to treat cardiovascular disease and Type 2 diabetes. Furthermore, the majority of dietary NSPs escape from the small intestine almost intact and are fermented into SCFAs by the commensal microflora found in the colon and caecum, promoting normal laxation. Short-chain fatty acids have a number of health-promoting effects and are particularly effective in supporting large bowel function. Some NSPs, through their fermented products, can promote the growth of specific beneficial colon bacteria that offer a prebiotic effect (Kumar et al., 2012).

Fucoidans is a complex series of sulfated polysaccharides commonly found in the cell walls of brown seaweeds. In particular, marine sources have been recognized as rich sources of structurally diverse biologically active compounds with great application potential in marine functional foods. Among them, fucoidants have been found to have various bioactivities such as antioxidant, anti-inflammatory, antiallergic, antitumor, antiobesity, anticoagulant, antiviral, antihepatopathy, antiuropathy and antirenalpathy (Vo and Kima, 2013).

1.3.2. Dietary Fiber

Fiber foods (dietary fibers) were the first commercial functional food ingredients to be marketed. The increasing interest in beverages with high fiber content in the late 1980s contributed to the formation of the functional food market both in Japan and around the world. In 1988, the first functional food, a soft drink called Fiber-mini, was produced in Japan. Water-soluble polydextrose is used in this beverage and is offered for sale as a gastro-intestinal regulator (Vural, 2004).

Not all nutrients in food can be digested by humans. The indigestible portion of food is known as dietary fiber. They are usually polysaccharides and may be soluble or insoluble in water. Soluble fiber is found in oat bran, barley, nuts, seeds, beans, lentils, peas and some fruits and vegetables, and includes mainly pectin, beta-Glucans and inulin. Insoluble fiber is found in foods such as wheat bran, vegetables, and whole grains and mainly includes cellulose, hemicellulose, and psyllium. Dietary fiber plays a variety of roles in the digestive system. It reduces energy intake by providing good toughness value. It increases bowel movement and prevents constipation. It acts as a nutrient for the intestinal microflora, which ferments it and produces short-chain fatty acids. These short-chain fatty acids are beneficial for gut health, which also helps lower body cholesterol. Dietary fiber consumption also absorbs glucose from the digestive tract, thus delaying its release into the bloodstream. This helps maintain the blood sugar level in the body. This can help with a sudden increase in the body glucose level of diabetic people. Today, dietary fiber consumption is encouraged and added to various recipes as a functional ingredient (Jahan et al., 2020).

1.4. Bioactive Proteins and Peptides

Bioactive peptides are specific protein fragments that are formed as a result of the binding of amino acids by peptide bonds, have a positive effect on body functions and can affect health. Some bioactive peptides occur freely in their natural sources. However, most of the known bioactive peptides are inactive in the structure of the main proteins and are released as a result of hydrolysis or fermentation with proteolytic

enzymes. Bioactive peptides affect the digestive, endocrine, cardiovascular, immune and nervous systems and thus human health. In vitro and in vivo studies have shown that they have antimicrobial, antithrombotic, antihypertensive, opioid, immunomodulatory, cholesterol-lowering, mineral-binding and antioxidative properties (Ünal et al., 2018).

Numerous bioactive peptides are found in foods of plant, animal and marine origin, and they occur during fermentation, enzymatic hydrolysis, chemical hydrolysis or gastrointestinal digestion processes (Cicero et al., 2017).

1.5. Other Food Ingredients

1.5.1. Antioxidants

Oxygen is essential for metabolism, but if not properly controlled, it can cause severe damage to both organisms and foods, such as lipid oxidation (or oxidative rancidity). Oxidative rancidity in foods is initiated by reactive oxygen species (ROS). ROS are also formed in living organisms as a result of metabolic activity with potentially side effects, but a certain physiological level of ROS is crucial for the regulation of cell functions. Oxidative stress is defined as the disruption of the prooxidant/antioxidant balance, and antioxidants of synthetic or natural origin may play an important role in maintaining this balance. Consumption of foods containing natural antioxidants such as fruits, herbs, legumes, oil seeds, whole grains and vegetables, as well as processed foods fortified with natural antioxidants such as vitamins C and E, carotenoids and polyphenols, contribute to the desired

antioxidant status, prevention of neurodegenerative and metabolic disorders (Carvalho et al., 2018).

In fact, it is noteworthy that antioxidants play a crucial role in reducing oxidative processes, and therefore neurodegenerative diseases and metabolic dysfunctions, both in food systems and in the human body. Natural antioxidants such as tocopherols, ascorbic acid, rosemary extracts, lycopene and some flavonoids can enhance the activity of endogenous antioxidant systems that provide extra protection against oxidative stress. Foods preserved by adding natural antioxidants can be considered as functional foods because they can provide better health conditions to the consumer (Alfonso Valenzuela et al., 2003).

Antioxidants help protect against oxidation and free radical damage in tissues by neutralizing excess free radicals that cause oxidative stress and degenerative diseases. Many antioxidants are affected by storage, transport and processing, while their combination can have additive or synergistic effects.

Health disorders associated with oxidative stress and free radicals include cardiovascular disease, stroke, atherosclerosis, organ ischemia and reperfusion injury, gastrointestinal dysfunctions, cancer, AIDS-related disorders, diabetes mellitus, obstructive sleep apnea, hemorrhagic shock, altered gene expression, hypertension , neurodegenerative diseases (Alzheimer's disease and Parkinson's disease), rheumatoid arthritis, osteoporosis, cataracts, and some functional declines associated with aging.

Nutritional biophenols are more effective antioxidants than antioxidant vitamins in vitro. The antioxidants in most functional foods (fruits, vegetables, grains, legumes, chocolate and beverages, such as tea, coffee or wine) are due to their phenolic compounds (Mohamed, 2015).

1.5.1.1. Effect Of Food Processing

As part of the US Department of Agriculture's (USDA) National Food and Nutrient Analysis Program, Halvorsen et al. studied the amount of antioxidants in raw (fresh) and various processing (eg boiled) foods in foods. According to the research results, the antioxidant contents of foods are well preserved during most types of processing, but some exceptions are shown in the Table 1. According to table the antioxidant content increased in products such as carrots, spinach, mushrooms, asparagus, broccoli, cabbage, red cabbage, green and red peppers, potatoes, and tomatoes during microwave cooking, steaming, or boiling (Table). Antioxidant values also increased after toasting or baking of bagels, French bread, wheat bread, whole-wheat bread, and pie crust. A decrease in antioxidant content was only observed after cooking by microwave, steaming, or boiling of corn grits, white rice, or spaghetti. Removing the peel from apples and cucumber decreased the antioxidant content to 33– 66% and 50% of the amount in the unpeeled products, respectively (Halvorsen et al., 2006).

Table 1. Effects of Processing on The Antioxidant Contents of Foods (Halvorsen et al., 2006)

Product	Type of processing	Antioxidant content	
		% of nonprocessed food	
		İncrease	Decrease
Carrots	Microwave cooking	113–1431	
Spinach	Microwave cooking	103–121	
Mushrooms	Microwave cooking	113	
Asparagus	Cooking by steaming	205	
Broccoli	Cooking by steaming	122–654	
Cabbage	Cooking by steaming	448	
Red cabbage	Cooking by steaming	270	
Carrots	Cooking by steaming	291	
Green pepper	Cooking by steaming	467	
Red pepper	Cooking by steaming	180	
Potatoes	Cooking by steaming	105–242	

Tomatoes	Cooking by steaming	112–164	
Corn grits	Boiling		27–29
Corn grits	Microwave cooking		21–32
White rice	Cooking by steaming		33–70
Spaghetti	Cooking by steaming		42–63
Carrots	Boiling	121–159	
Spinach	Boiling	84–114	
Sweet potatoes	Boiling	413	
Bagels	Toasting	134–367	
French bread	Toasting	177	
Wheat bread	Toasting	153–185	
Whole-wheat bread	Toasting	184–214	
Apple	Peeling		33– 66
Cucumber	Peeling		50
Pie crust	Baking	311–1450	

1.5.2. Carotenoids (e.g. lycopene, lutein)

Carotenoids are the general name for two types of pigments, hydrocarbon carotene and lutein, which are derivatives of other classes. They belong to four types of fungal compounds. They are red, orange and yellow pigments found in plants and seaweeds. They are also secondary metabolites of most plants and some microorganisms. Vitamin C not only has the function of curing scurvy, but also can help hematopoiesis, promote wound healing, enhance body immunity, detoxify, etc. Cabbage is rich in folic acid, which is an advantage of cabbage vegetables. Therefore, pregnant women and anemic patients should eat more cabbage. It is also an important beauty product. Recent research has shown that carotenoids can not only be used as important natural pigments in food, medicine, cosmetics and feed, but also play the role of anti-oxidation and scavenge free radicals in the body. Most carotenoids, mono-carotene and lycopene are effective antioxidants that can extinguishing O_2 and capture peroxy radicals to play an antioxidant role (Xiao and Li, 2020).

1.5.3. Polyphenols

Polyphenols produced by plants are very important functional nutrients in our diet. Due to their different chemical structures, they are subject to the main classification among themselves. The main groups of polyphenols; flavonoids, lignans, stilbenes and phenolic acids. In addition to the effects of polyphenols on many diseases such as anti-hypertensive, anti-microbial, anti-obesity, anti-diabetic in humans and animals; The most remarkable and well-known antioxidant effect, when

used in low doses, inhibits the formation of ROS and prevents many diseases such as cancer. However, high doses of some polyphenols may have pro-oxidant, cytotoxic and apoptotic effects, especially on cancer cells (Bayır et al., 2019).

1.5.4. Phytosterols

Phytosterols and phytastanols are compounds found naturally in vegetable oils, seeds and nuts, and some fruits and vegetables. These are powerful cholesterol-lowering agents. Various studies have shown a reduction of 8-17% in total cholesterol and 9-20% in LDL (low-density lipoprotein) cholesterol with the consumption of 2-3 g per day of phytosterols and phytastanols. Phytosterols and phytastanols reduce total and LDL cholesterol by inhibiting the absorption of cholesterol from the small intestine. In general, they are added to various foods such as mayonnaise, margarine, yoghurt, since it is difficult to get 2-3 g of phytosterol and phytastanol in the daily diet (Koca and Koca, 2006).

1.5.5. Organo-sulfur compounds

Organosulfur compounds are bioactive compounds or nutraceuticals derived from both plant and animal sources. They contain sulfur atoms attached to a cyanate group or to a carbon atom in a cyclic or non-cyclic configuration. Broccoli, cauliflower, cabbage, brussels sprouts, garlic, onions, meat, eggs and fish are the most common sources of OSC. Allicin, s-allyl cysteine, sulforaphane, cysteine, sulfonylureas, methionine and lipoic acid are the most common types of OSC isolated

from different plant sources. Different sources contain different types of OSC, and these compounds may have different health benefits. In addition, anti-platelet, immunomodulatory, fibrinolytic, anti-aging, anti-inflammatory, anti-microbial, anti-parasitic, anti-hypertensive, anti-hyperlipidemic, anti-atherosclerotic, and antiviral activities have also been reported in OSC. These activities are beneficial in the treatment of various pathological conditions such as neurodegenerative disorders, cardiovascular diseases, cancer and diabetes (Walag et al., 2020).

1.5.6. Prebiotics and Probiotic

The gut is an obvious target for the development of functional foods, as it is an interface between the diet and the body. The gut microbiota, together with the gastrointestinal immune system, forms the basis of an intestinal barrier that prevents pathogenic bacteria from invading the digestive tract and ultimately the blood and the whole organism. Therefore, it will be essential to preserve the number and composition of the gut microbiota. Three strategies of functional foods are considered to promote healthier microbiota: prebiotics, probiotics and synbiotics

1.5.6.1. Prebiotic

Prebiotics are non-digestible food ingredients, primarily oligosaccharides, that stimulate the growth of one or several bacterial species in the colon and/or alter their metabolic activity, potentially improving gut health. It should not be hydrolyzed or absorbed in the

upper part of the digestive tract, should be transported significantly to the colon and be a selective substrate of probiotic microorganisms (Tur and Bibiloni, 2016).

Prebiotics are short-chain carbohydrates that cannot be digested by digestive enzymes in humans and selectively increase the activity of certain groups of beneficial bacteria. In the gut, prebiotics are fermented by beneficial bacteria to produce short-chain fatty acids. Prebiotics also provide many other health benefits, such as reducing the risk of cancer in the large intestine and increasing the absorption of calcium and magnesium. Prebiotics are found in a variety of vegetables and fruits and are considered functional food ingredients that offer significant technological advantages. Their addition improves sensory properties such as taste and texture and increases the stability of foams, emulsions and mouthfeel in a wide variety of food applications such as dairy and bread (Al-Sheraji et al., 2013).

1.5.6.2. Probiotics

Probiotics are living microbial food components, primarily Lactobacillus and Bifidobacterium, combined or not, that, when taken in adequate quantities, have health benefits on consumers by acting directly or indirectly through interactions with the gut microbiota (Tur and Bibiloni, 2016).

Probiotics are live microbial food supplements that provide a variety of health benefits as they help maintain the excellent stability and composition of the gut microbiota and increase resistance to infections

caused by pathogens. Probiotics can be considered as potential functional foods, as they provide far more health benefits than traditional nutritious foods. The need for probiotic functional foods is growing rapidly and steadily due to the growing public awareness of the health impact of foods. Probiotics are now emerging as a promising category of dietary supplements worldwide. There is now a wealth of evidence, supported by high-quality, scientific clinical data, to argue that the incorporation of probiotics can indeed be successful in different types of diarrheal disease, modulation of immune function, prevention of colon cancer and other chronic gastrointestinal inflammatory disorders. The potential effectiveness of probiotics in treating or preventing neurological diseases is becoming a topic of great interest. In recent years, there has been great interest in exploring the functions and therapeutic effects of probiotics in a wide variety of neurological conditions (Begum et al., 2017).

Most commercially available probiotic products contain Lactobacillus and Bifidobacterium species, the main strains of Gram-positive bacteria currently considered probiotics (FAO/WHO, 2001).

Lactobacillus acidophilus, L. casei, L. johnsonii, L. rhamnosus, L. thermophilus, L. reuteri, L. delbrueckii subsp. bulgaricus, Bifidobacterium bifidum, B. longum, B. brevis, B. infantis and B. Animalis are used in the food industry. For example, Lactobacillus delbruecki spp. bulgaricus and Streptococcus thermophilus are found in some preparations such as traditional yogurts, frozen yogurts, and in some places desserts. In addition to other lactic acid bacteria such as

Enterococcus faecalis, E. faecium, Sporolactobacillus inulinus, non-lactic microorganisms such as Propionibacterium freudenreichii and Saccharomyces cerevisiae are also associated with probiotic activities, especially in pharmaceutical and animal products (Granato et al., 2010).

Its main health benefits are alleviation of lactose intolerance and immune stimulation to reduce the incidence of digestive infections as well as reduce the incidence of precancerous lesions. It has beneficial functions such as antimicrobial and antimutagenic activities, anticarcinogenic properties, antihypertension properties, especially bone stability, weakening of intestinal disease and Crohn's syndrome symptoms, reduction of food allergy symptoms and reduction of LDL-cholesterol levels and suppression of some pathogenic microorganisms. Probiotics are only temporary in the gut and do not become part of the gut microbiota. Therefore, regular consumption is necessary to maintain the positive effects (Granato et al., 2010,Tur and Bibiloni, 2016).

Synbiotics are mixtures of prebiotics plus probiotics intended to increase the survival of health-promoting bacteria in the gut. While probiotics are mainly applied – but not exclusively – in dairy foods, prebiotics can be found in dairy products, breads and baked goods, salad dressings and meat products (Tur and Bibiloni, 2016).

The postbiotics are the complex mixture of metabolic products secreted by probiotics in cell-free supernatants such as enzymes, secreted proteins, short chain fatty acids, vitamins, endo- and

exopolysaccharides, secreted biosurfactants, amino acids, peptides, organic acids, etc.

In other words postbiotics were defined as soluble compounds or metabolic by-products that are released by bacteria during their lives or after their lysis in the gastrointestinal tract. Some health benefits of postbiotics include the lowering of lowdensity lipoprotein cholesterol (LDL-C) and antioxidant, immunomodulatory, and antimicrobial effects (Aguilar-Toalá et al., 2018, Foo et al., 2019, Nataraj et al., 2020).

Table 2. List of foods and associated functional components (Granato et al., 2020, John and Singla, 2021)

Class/Components	Source	Potential Benefits
CAROTENOIDS		
Beta-carotene	carrots, pumpkin, sweet potatoes, cantaloupe, spinach, tomatoes	neutralizes free radicals, which may damage cells; bolsters cellular antioxidant defences; can be made into vitamin A in the body
Lutein, Zeaxanthin	kale, collards, spinach, corn, eggs, citrus fruits, asparagus, carrots, broccoli	supports the maintenance of eye health
Lycopene	tomatoes and processed tomato products, watermelon, red/pink grapefruit	supports the maintenance of prostate health
Insoluble fibre	wheat bran, corn bran, fruit skins	supports the maintenance of digestive health; may reduce the risk of cancer

Beta-glucan	oat bran, oatmeal, oat flour, barley, rye	may reduce the risk of coronary heart disease (CHD)
Soluble fibre	psyllium seed husk, peas, beans, apples, citrus fruits	may reduce the risk of CHD and some types of cancer
Whole grains	cereal grains, whole wheat bread, oatmeal, brown rice	may reduce risk of CHD and some types of cancers; supports the maintenance of healthy blood glucose levels
Curcumin	Turmeric /Curcuma longa	antioxidant, induce diabetus mellitus risk, CVD and inflammatory mediators,
FATTY ACIDS		
Monounsaturated fatty acids (MUFAs)	tree nuts, olive oil, canola oil	may reduce the risk of CHD
Polyunsaturated fatty acids (PUFAs) – Omega-3 fatty acids— ALA	walnuts, flaxseeds, flaxseed oil	supports the maintenance of heart and eye health; supports the maintenance of mental function
PUFAs – Omega-3 fatty acids— DHA/EPA	salmon, tuna, marine and other fish oils	may reduce risk of CHD; supports the maintenance of eye health and mental function
Conjugated linoleic acid (CLA)	beef and lamb; some cheese	supports the maintenance of desirable body composition and immune health
FLAVONOIDS		
Anthocyanins-cyanidin, Pelargonidin, Delphinidin, Malvidin	berries, cherries, red grapes	bolster cellular antioxidant defences; supports the maintenance of healthy brain function

Flavanols –Catechins, Epicatechins, Epigallocatechin	tea, cocoa, chocolate, apples, grapes	supports the maintenance of heart health
Procyanidins and Proanthocyanidins	cranberries, cocoa, apples, strawberries, grapes, red wine, peanuts, cinnamon, tea, chocolate	supports the maintenance of urinary tract health and heart health
Flavanones –Hesperetin, Naringenin	citrus fruits	neutralizes free radicals, which may damage cells; bolster cellular antioxidant defences
Flavonols – Quercetin, Kaempferol, Isorhamnetin, Myricetin	onions, apples, tea, broccoli	neutralizes free radicals, which may damage cells; bolster cellular antioxidant defences
ORGANOSULFUR COMPOUNDS		
Glucosinolates	Brassica family: Brussels sprouts, cabbage, cauliflower, etc.	İnduced risk of cancer, metastasis and chronic inflammatory diseases protect cells from redox imbalance,
Isothıocyanates/ Sulforaphane	cauliflower, broccoli, broccoli sprouts, cabbage, kale, horseradish	May enhance detoxification of undesirable compounds; bolsters cellular antioxidant defences
MINERALS		
Calcium	sardines, spinach, yoghurt, low-fat dairy products, fortified foods and beverages	may reduce the risk of osteoporosis
Magnesium	spinach, pumpkin seeds, whole-grain bread and cereals, halibut, almonds, brazil nuts, beans	supports the maintenance of normal muscle and nerve function, immune health, and bone health

Potassium	potatoes, low-fat dairy products, whole1grain bread and cereals, citrus juices, beans, banana, leafy greens	may reduce the risk of high blood pressure and stroke, in combination with a low sodium diet
Selenium	fish, red meat, whole grains, garlic, liver, eggs	neutralizes free radicals which may damage cells; supports the maintenance of immune and prostate health
PHENOLIC ACIDS		
Caffeic acid, Ferulic acid	apples, pears, citrus fruits, some vegetables, whole grains, coffee	bolsters cellular antioxidant defences; supports the maintenance of eye and heart health
PLANT STANOLS/STEROLS		
Free Stanols/Sterols	corn, soy, wheat, fortified foods and beverages	may reduce the risk of CHD
Stanol/Sterol esters stanol ester	dietary supplements, fortified foods and beverages, including table spreads	may reduce the risk of CHD
POLYOLS		
Sugar alcohols – Xylitol, Sorbitol, Mannitol, Lactitol	some chewing gums and other food applications	may reduce the risk of dental caries
PREBIOTICS		
Inulin, Fructooligosaccharides (FOS), Polydextrose	whole grains, onions, some fruits, garlic, honey, leeks, banana, fortified foods and beverages	supports the maintenance of digestive health; supports calcium absorption
PROBIOTICS		
Yeast, Lactobacilli, Bifidobacteria and other specific strains of beneficial bacteria	certain yoghurts and other cultured dairy and non-dairy applications	supports the maintenance of digestive and immune health; benefits are strain-specific

SYNBİOTİCS		
L. casei, L. acidophilus, B. lactis plus inulin, fructooligosaccharides, xylooligosaccharides	Foods supplemented with probiotics and prebiotic ingredients: ice creams, desserts, granolas, chocolates	Reduces the Inflammation markers, infection risk, hypertension and hyperglycemia increases the serum/plasma total antioxidant capacity, GSH levels in blood and NO
PHYTOESTROGENS		
Isoflavones – Daidzein, Genistein	soybeans and soy-based foods	supports the maintenance of bone and immune health, and healthy brain function; supports menopausal health of women
Lignans	flax seeds, rye, some vegetables, seeds and nuts, lentils, triticale	supports maintenance of heart and immune health
SOY PROTEIN		
Soy Protein	soybeans and soy-based foods like milk, yoghurt, cheese, tofu	may reduce the risk of CHD
SULFIDES/ THIOLS		
Diallyl sulphide, Allyl methyl trisulfide	garlic, onions, leeks, scallions	May enhance detoxification of undesirable compounds; supports maintenance of heart, immune, and digestive health

Dithiolthiones	cruciferous vegetables	May enhance detoxification of undesirable compounds; supports the maintenance of healthy immune function
VITAMINS		
Vitamin A	organ meats, milk, eggs, carrots, sweet potato, spinach	supports the maintenance of eye, immune and bone health; contributes to cell integrity
Thiamin (Vitamin B1)	lentils, peas, brown or enriched white rice, pistachios and certain fortified breakfast cereals	supports the maintenance of mental function; helps regulate metabolism
Riboflavin (Vitamin B2)	lean meats, eggs, green leafy vegetables, dairy products and certain fortified breakfast cereals	supports cell growth; helps regulate metabolism
Niacin (Vitamin B3)	dairy products, poultry, fish, nuts, eggs and certain fortified breakfast cereals	supports cell growth; helps regulate metabolism
Pantothenic acid (Vitamin B5)	sweet potato, organ meats, lobster, soybeans, lentils and certain fortified breakfast cereals	helps regulate metabolism and hormone synthesis
Pyridoxine (Vitamin B6)	beans, nuts, legumes, fish, meat, whole grains and certain fortified breakfast cereals	supports the maintenance of immune health; helps regulate metabolism

Folate or folic acid (Vitamin B9)	beans, legumes, citrus fruits, green leafy vegetables and fortified bread, cereals, pasta, rice	may reduce women's risk of having a child with a brain or spinal cord defect; supports the maintenance of immune health
B12 (Cobalamin)	eggs, meat, poultry, milk, and certain fortified breakfast cereals	supports the maintenance of mental function; helps regulate metabolism and supports blood cell formation
Biotin	liver, salmon, dairy, eggs, oysters, and certain fortified breakfast cereals	helps regulate metabolism and hormone synthesis
Vitamin C	guava, sweet red/green pepper, kiwi, citrus fruit, strawberries, fortified foods and beverages	neutralizes free radicals, which may damage cells; supports maintenance of bone and immune health
Vitamin D	fish, fortified foods such as yoghurts or cereals, and beverages, including milk and juices	may reduce the risk of osteoporosis; helps regulate calcium and phosphorus; supports immune health; helps support cell growth
Vitamin E	sunflower seeds, almonds, hazelnuts, turnip greens, fortified foods and beverages	neutralizes free radicals, which may damage cells; supports maintenance of immune and heart health

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CHAPTER 7

TRADITIONAL FARRIERY TOOLS

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Introduction

There are approximately 18 million million large animals in Turkey (Anonim, 2021). Farriery is crucial for maintaining especially working equines hoof welfare. With the domestication of the horse, claw health and the prevention of accompanying disorders have been one of the most important issues. Therefore, in order to increase horse welfare, the application of various protective measures have been applied throughout history (Mohite ve ark., 2019; İzci ve Gökşahin, 2021). In this chapter, traditional farrier tools used since 100 years in Türkiye and old restraining equipments to handle cows under field conditions are introduced.

There are several conditions where farm animals have to be restrained. The animals should be calm and permit intervention so that they can be treated effectively. Aggressive, agitated and stressed cows which reacts unpredictably, can cause injuries because of insufficient restraint methods. These situations are dangerous for both farriers, trimmers and animals. It is important to always bear this in mind, and to take all possible precautions to ensure personnel's safety. Many accidents involving cattle could be eliminated with better handling facilities (Grandin and Shivley, 2015; Sağlam, 2018; Anonim, 2022).

To be safe around cows, one must rely heavily on good and proper handling techniques. These techniques become even more imperative as your vet or farrier works on cattle. The mostly used method of handling in dairy cows is the halter. It is used in cattle to control the head after the animal is restrained in a mobile chute. Nose pliers are

useful for restraint and mouth examinations of cattle. There are useful methods to prevent the animal from kicking (cattle kicks with the hind limbs). The mostly used method to prevent kicking is lifting the tail (Fowler, 1995; Aslanbey, 2002; Matt, 2010; Sağlam, 2018; Anonim, 2022).

Equipments to handle cattle are used in beef and dairy operations such as trimming, shoeing and also various surgical procedures. The equipment should quickly and securely restrain the animal and should allow for the quick release of the animal following end of the procedure. With a chute, clinical examination of cows and hoof trimming is much easier and safer. However, the method of restraint of cattle is related with available resources under field conditions. With this aspect, traditional Turkish fixing set to cows in lateral recumbency under field allows many procedures safely.

Below, it has been presented original traditional farriery equipments.

A- Older Turkish Hoof trimming equipments

Fig. 1: Horse Trimming Equipments and Horseshoes' of Working Donkey, Horse and Cattle

Fig. 2: Old Horseshoeing Equipments

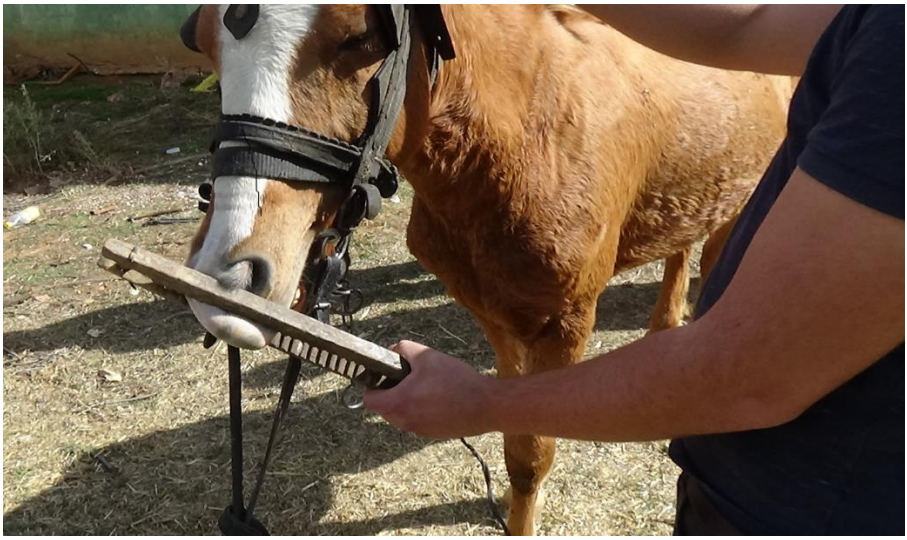

Fig. 3: Use of Horse Nose Twitch (Wooden)

Fig. 4: Another Old Version of Original Nose Twitch (Metallic)

Fig. 5: Turkish-based Hoof Knife

Fig. 6: Hoof Pliers Used for Trimming and Horseshoeing Procedures

Fig. 7: Hoof Knives for Trimming Hoof Base

Fig. 8: Shoeing Hammers

Fig. 9: Working Donkey Horseshoes

Fig. 10: Working Equine Horseshoes

Fig. 11: Original Wooden Chute for Restraining Working Equines, Made in 1950s

Fig. 12: Restraining Horse in Wooden Chute

Fig. 13: Use of Hoof Knife Before Horseshoeing. This Equipment's Turkish Name is "Sunturaç"

B. Original Turkish fixation set for cows in lateral recumbency

Fig. 14: Fixation Device with Rope Placement for Cows Under Field Conditions

Fig. 15: A Cow in Lateral Recumbency. This Allows Safer and Effective Trimming and Horseshoeing Procedures for Cows, Bulls

Fig. 16: Photo From Different Angle in a Cow Under Lateral Recumbency. The Animal is Ready for Trimming

Fig. 17: Farrier Association Take Parts in Ceremony of National Sovereignty and Children's Day in 23rd April, 1973, Afyonkarahisar-Turkey

Fig. 18: Turkish Farrier

Fig.19: Antique Equipments for Agriculture

Fig. 20: Thanks to Mr. Utku Özdogan, from Doganhisar – Konya - Turkey, for Supplying his Equipments.

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CHAPTER 8

CARE OF NEW BORN CALVES

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1. INTRODUCTION

In the literature, cattle at the age of 0-6 months are called calves. The survival of a newborn calf means two things to a business. One of these is the income obtained by selling the calf immediately, and the other is the breeding of animals to be used in herd renewal. In countries like Turkey, where beef maintains its importance, each calf is also a source of meat production (Anonymous1, 2022). In cattle breeding enterprises, the calf period is the weakest period in the whole life of the animal, and mortality can be reduced from 20% to 3-5% with good care and feeding (Özen et al., 2005). The purpose of calf rearing systems in dairy cattle is to achieve high performance in the most economical way. Therefore, the basic principle in calf rearing is to raise healthy and well-developed calves by minimizing losses. In addition, care and feeding at an early age is directly related to the well-developed and high performance of the animal in later ages. For this reason, since most of the calves born in dairy cattle farms will represent the herd in later ages, care and nutrition are emphasized. In particular, the underdeveloped immune system of newborn calves increases the risk of contracting the disease and the highest mortality rate is observed in this period (Ünlü et al., 2013).

New born calves need special care to adapt to new environmental conditions. Calves that survive the critical first few weeks after birth have a significantly higher chance of survival. For this reason, calf loss in the first three months increases up to 20% according to the conditions in the enterprises. In order to keep the calf loss at the lowest level, it is

necessary to know the needs and immunity level of the calves and to provide adequate care-feeding conditions (Erdem et al., 2020).

In order to obtain a healthy calf, the cow must be fed a balanced diet. In nutrient starvation during pregnancy, the mother has to meet the needs of the fetus from her own body. In this case, the calf cannot reach the average body weight and becomes susceptible to diseases. Giving heifers more than enough nutrients does not affect the calf's birth weight, but may lead to fattening of the mother (Ergün et al., 2011). Incorrect care and feeding practices affect the performance of calves at later ages. For example, when a male calf with faulty care and feeding is fattened at a later age, the time to reach maturity may be longer for several months compared to calves that are properly cared for and fed. Again, a malnourished female calf can give less milk when she is a cow (Anonymous2, 2022).

2. CARE OF NEW BORN CALVES

The purpose of livestock enterprises; to have a herd that is highly productive, highly skilled and economically productive. Calves in dairy cattle enterprises are important for the future of the enterprise. It is necessary to pay attention to the care and feeding of the calves, from whom we expect high yields in the future. Because the part that requires the most care in terms of care and feeding in a dairy cattle farm is calf rearing (Özhan, 2009). Since the calves cannot give a yield at this age, it may seem like there is no compensation for the maintenance and feeding expenses made by the producers. However, when the calves become a cow or a precious bull, they will give back to the producer

more than the expenses spent on them when they were puppies. In addition, it has a value of 1/5 of the monetary value of a calf mother. Let's not forget that calves are the cow or bull of the future. The way to a healthy, sustainable cattle herd is to raise good calves. Because in order to obtain a healthy calf from a 2-2.5 year old cow, that animal must be well reared during the calving period. There may be calf losses at young ages due to inadequate care and feeding conditions (Anonymous3, 2022). 65% of these deaths occur in the first 14 days, and 80% in the first 1 month. Calf deaths, which normally exceed 10%, indicate that this business is not well managed.

The following measures can be taken to prevent calf losses.

1. First of all, in order to prevent the calf from being harmed during birth, it should be waited for the birth to mature and early and unnecessary intervention should be avoided. If intervention is required, early intervention should be made by a specialist.

2. After birth, the mucous membranes of the mouth and nose of the calves should be cleaned and the calves should be allowed to breathe normally.

3. Calves that swallow liquid during birth should be helped to expel this liquid. For this, massage can be done by applying light circular pressure to the abdominal region of the calf.

4. The umbilical cord of calves after birth should be disinfected with disinfectants similar to batikon and tied. In addition, if the

umbilical cord is longer than necessary, the excess should be cut. In this way, infections that can pass through the umbilicus should be prevented.

5. At least 2 liters of colostrum should be given to the calves in the first half hour following the birth. For the first three days, colostrum should continue to be given to the calves twice a day.

6. Calves should be taken to a dry, clean and air-free compartment after birth. Calves should be kept in such a place until weaning.

7. The calves should be given daily milk at the level of 8-10% of their birth weight until weaning (Anonymous3, 2022).

2.1. Prenatal Care

A healthy calf rearing begins in the calf's womb. During this period, both the mother's own needs and the needs arising from pregnancy should be met in a balanced and adequate way. In this context, it is very important to dry pregnant cows two months before calving. Preventive vaccination of pregnant cows should be done on time. Especially septicemia (E. coli, Rota and Corona virus vaccines) and mastitis vaccines should not be neglected. Because these vaccines both protect calf health and have a positive effect on milk yield in the next lactation period of the mother. Birth weight of a calf; It is seriously affected by the insufficient and wrong feeding of its mother in the dry period. Because 65-70% of fetal weight gain takes place in the last two months of pregnancy, which we call the dry period (Anonymous3, 2022).

During this period, the weight of the fetus (calf) in the uterus increases significantly. While the weight of the 7-month-old fetus is 10 kg, it increases to 20 kg in the 8th month, and up to 35-40 kg in the 9th month, that is, at the time of delivery (Table 1).

Table 1. Development status of the calf in the uterus (Özhan, 2009).

Age (months)	Length (cm)	Weight	Age (months)	Length (cm)	Weight	Age (months)	Length (cm)	Weight
1	1	2 g	4	25	1,0 kg	7	60	10,0 kg
2	8	25 g	5	35	2,5 kg	8	75	15,0 kg
3	15	250 g	6	45	6,5 kg	9	80-100	40,0 kg

One of the most important findings confirming that malnutrition reduces fetal development is that calves born in autumn are 4-5 kg lower than the birth weights of calves born in spring in warm regions. The reason for the low birth weight in autumn-borns; This is due to the fact that the mother spent the dry period in the hot summer months, and she could not get enough nutrients in the dry period due to the heat stress she experienced. When the lactation yields of female calves born in different seasons were examined, it was determined that the milk yields of calves born in autumn were low, just like their birth weights. These two findings show us how important dry season feeding is. The race and gender of the calves also have an effect on the calf birth weight. For example, in our country, the birth weight of Holstein female calves is between 30-35 kg, while the birth weight of male calves is between 35-40 kg (Anonymous3, 2022; Yertürk et al., 2011).

2.2. Postnatal Care

For a successful breeding, it is necessary to pay attention to the following points in calf breeding.

In the First Month Following Birth: During this period, it should be noted that the calf does not have diarrhea. The following four factors that are effective against diarrhea in this age group should not be forgotten.

a) Umbilical cord disinfection must be done after birth.

b) Giving colostrum to calves immediately after birth and for three days following birth provides effective protection against microorganisms that cause diarrhea.

c) Calves; They should be kept in clean, ventilated and disinfected shelters to prevent them from being exposed to pathogenic microorganisms. If a problem arises in this regard, treatment should be applied immediately.

d) In calf diarrhea, electrolyte supplementation should be given both by serum and orally.

In the Period from the Second Month to the Eighth Month: Respiratory system infections may occur frequently in calves at this age. During this period, calves of the same age group should be kept together for protection. Small calves should not be kept together with larger ones. In addition, periodic vaccination of calves should be done on time without neglecting (Ergün et al., 2011).

2.2.1.Hypothermia

The body temperature of the calf remains below normal despite all protective measures after birth is called hypothermia. In hypothermia cases, the rectal temperature is as low as a few °C and continues to decrease until the death of the calf. Hypothermia is mentioned when the body temperature falls below 37 °C in calves.

Causes of hypothermia

Environmental temperature: Hypothermia occurs as a result of the sudden or continuous decrease in the environmental temperature and the body's inability to fully react to this decrease. The constant change in environmental temperature in the early neonatal period disrupts the temperature balance and may cause death. The critical environmental temperature for newborn calves is 9 °C in still air, and 17 °C when the wind speed is 2 m/s. In order to maintain normal body temperature in severe cold, thermal regulation of the calf and maximum spontaneous heat production are required. Since the feathers are wet after birth, thermal insulation decreases with the effect of the wind; It has been reported that even the maximum metabolic heat production is insufficient and causes hypothermia. It has been reported that calf deaths in winter months are higher than in summer months, and cold weather conditions with and without wind create stress on newborn calves, which increases the risk of hypothermia.

Delaying the delivery of colostrum: Giving colostrum within the first 2 hours of life is vital in preventing hypothermia, in order to provide

thermoregulation to meet the energy required by the increased metabolic rate immediately after birth.

Maternal malnutrition during pregnancy: Maternal malnutrition in the last stages of pregnancy limits the formation of subcutaneous brown adipose tissue of the calf and prevents its protection against cold. In addition, it causes a decrease in other resources required for heat production.

Prevention of Hypothermia

In the prevention of hypothermia, 3 issues should be emphasized, these are;

Calf warming: The outside of the animal's body should be heated. For this, the body of the calf should be wrapped, the calf should be moved to the warm room and if necessary, electric blankets, heating pads, heating lamps should be used. Or the calf should be given a warm water bath, the environmental conditions should be improved, and the litter should be changed. It is stated that the calves are warmed in specially prepared compartments with a 37-40 °C heat source, and it is recommended to continue the heating process until the body temperature of 37 °C is stabilized. The average time to warm the calf in warm water is reported as 47.1+3.5 minutes.

Giving colostrum: Hypothermia is usually caused by excessive heat loss due to wetness of newborn calves and depressed heat production due to starvation. Therefore, it has been reported that taking enough colostrum in the first 2 hours after birth will reduce the risk of hypothermia.

Glucose injection: Since hypothermia always progresses with hypoglycemia, glucose solutions are used for the treatment of hypothermia. For this purpose, 5-10% glucose solutions at body temperature can be used orally, subcutaneously or intraperitoneally at a dose of 750 mg/kg. In cases where clinical glucose measurements are not possible, parenteral glucose injections are reported to be an appropriate method when applying heat therapy to hypothermic calves (Örsan and Çetin, 2006).

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CHAPTER 9

NUTRITIONAL DISEASES OF CALVES

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1. INTRODUCTION

Stomach Structure and Its Development Over Time in Calves

Since the rumen has not yet developed in newborn calves, the abomasum has taken on the role of the main stomach. For healthy weaning of calves; It is necessary to consume enough roughage and concentrate feed daily and to ensure the development of the rumen at a level that can fully benefit from these feeds.

If the calves do not consume the forages consisting of roughage and concentrate and still continue to drink milk, a desired level of rumen development cannot be achieved. While the calves are drinking milk, the sulcus esophagus reflex is activated instantly and allows the milk to go directly to the abomasum. Sulcus esophagicus reflex is an important mechanism that protects milk from fermentation in the rumen (Koc and Yildiz, 2020).

The abomasum, also called the true stomach, is the largest and most functional part of the stomach structure, with a capacity of 60% of the total stomach volume at birth. Rumen and reticulum capacity increases depending on the diet of the calf (Ergün et al., 2020).

At birth, 60% of the total stomach structure consists of the abomasum and 20% of the rumen. The total stomach structure of a 3-4 month old calf consists of 60-65% rumen and 20% abomasum (Ergun et al., 2020).

Rumen development begins in a calf at about three months of age, and calves can now digest roughage and concentrate. Bacteria operating in

the rumen are also 9-13. It can become functional in weeks and reach the level of adult ruminants (Table 1) (Ergün et al., 2020).

Table 1. Developmental stages and periods of the digestive system in calves.

Term	Development Stages	Duration
1	Pre-ruminant Period	0-3 weeks
2	Transition Period	3-8 weeks
3	Ruminant Period	>8 weeks

In adult ruminants, the rumen rises to 80% of the total gastric capacity, while the abomasum decreases to 8-10% (Table 2) (Anonymous1, 2022).

Table 2. Percentage of digestive system parts in newborn calves.

Parts of the Digestive System	Adult Cow %	New Born Calf %
Rumen	55	29
Omasum	24	14
Abomasum	14	51
Reticulum	7	6

Until the rumen develops, calves' nutritional needs and digestive mechanisms are similar to monogastric animals. The rumen, which plays an important role in digestion and nutrient synthesis in adult ruminants, develops very slowly in calves. One-week-old calves should be fed more liquid foods depending on physiological and anatomical reasons.

The amount and length of the villi in the inner wall of the rumen are the most important indicators of rumen development. VFA (Volatile Fatty Acids) synthesized in the rumen positively affects the development of villi. Among these acids, butyric acid has the most effect, followed by propionic and acetic acid. In this respect, it is important to give the calves concentrated feed and good quality roughage after fifteen days. Rumen development is adversely affected in calves fed with milk continuously (Ergün et al., 2020). Since the stomach of calves is not like a full-grown ruminant until weaning, this issue should be taken into consideration when meeting their nutritional needs (Anonymous, 2022).

Table 3. Developmental status of rumen bacteria in calf stomachs.

Stage	Period	Rumen Bacteria Status
1	At birth	The rumen is sterile at birth, it does not contain bacteria.
2	After 24 hours	A large number of bacteria develop in the rumen.
3	3 months later	Rumen bacteria with roughage and concentrated feed consumption grows in number and variety.

Table 4. Development of rumen microorganisms in calves.

Type of Microorganism	First Appearance Time	Reaching the peak the time
E. Coli, Clostridium welchii,Streptococcus bovis	5-8 hours	4 days
Development of Lactobacillus	3-4 days	3 weeks

Growth of lactic-acid bacteria		3-4 days	5 weeks
Growth of amylolytic bacteria *B. ruminicola*		3-4 days	6 weeks
Growth of cellulolytic bacteria		1 weeks	6 - 10 weeks
Growth of methane	*Butyrvibrio*		1 weeks
	Ruminococcus		3 weeks
	Fibrobacter succinogenes		6 weeks
Growth of proteolytic bacteria		1 weeks	12 weeks
Development of protozoa		3 weeks	5 - 9 weeks
Development of normal microbial population			5 - 13 weeks

Although essential amino acids are met by microbial protein synthesis in the rumen in adult ruminants, these amino acids should be given to calves with diets. In this respect, the biological value of feed proteins is of great importance in the nutrition of the calf. Digestion of nutrients in calves is possible with enzymatic activity in the abomasum and small intestines, as in monogastric animals in the first weeks. The proteolytic effect, which is initially low in the small intestine, gradually increases. Although there is a high protoase activity in the real stomach from the first week, newborn calves cannot make good use of both vegetable proteins and animal proteins other than milk, since pepsin-HCl acid function is low. After birth, the calf has high lactase and low maltase activity in the digestive tract. Saccharase activity is not observed. Pancreatic amylase and lipase, which affect carbohydrate and fat

digestion, increase gradually from the first weeks. Therefore, in newborn calves, only glucose and galactose, which form milk sugar, can be evaluated. Esterase activity is found only in the stomach. Essential amino acids such as linoleic, linolenic and arahidonic acid are supplied by colostrum and milk fat. When Calf Starter Feed is given in addition to feeding with milk and dry grass in four-week-old calves; total stomach volume increases, rumen development is better. As the rumen walls are dark in color, the rumen papillae can reach a visible size. While rumination in calves starts in the second and third weeks in calves that consume milk as well as calf starter feed and a small amount of dry grass, it can be seen only in the 10th week in calves fed only milk. If six-week-old calves are fed only with milk; The rumen volume is smaller, its walls are light colored, and its papillae remain small. This indicates that rumen development is unhealthy. If six-week-old calves are fed only with dry grass; The rumen wall becomes dark in color, the size of its papillae remains small and thinner, and the number of papillae decreases. The rumen wall is also getting thinner (Kaplan, 2011; Tufan et al., 2018; Ergün et al., 2020).

2. NUTRITIONAL DISEASES

2.1 Water Intoxication

It occurs when the osmotic balance is disrupted in sudden excessive water consumption. It can be observed in calves at the age of 2 months. Diarrhea, paralysis, muscle tremors, incoordination and edema occur in these animals. The main reason is irregular and excessive water consumption. It has been observed that thirsty calves consume up to

about 30 liters of water. However, the kidneys cannot adapt to this situation. Free water consumption of sick animals should be prevented and physiological saline should be given as liquid (2-3 lt/IV of 5% solution in mild cases, 300 ml/IV of 10% solution in severe cases) (Ergün et al., 2020).

2.2 Calf Diarrhea

Neonatal calf diarrhea may be caused by one or more factors. Metabolic acidosis is common in calves with diarrhea. Calves that die from diarrhea usually have a low venous blood pH (6.50 to 7.05). One of the most important factors in reducing diarrhea-related death in calves is the use of appropriate oral or intravenous fluids. Oral electrolyte solutions containing acetate or propionate should be preferred instead of oral electrolyte solutions containing bicarbonate. Oral electrolyte solutions should be given to calves with diarrhea, albeit partially, with gastrointestinal system function (especially those with sucking reflex). Appropriate alkalizing agents should be used to correct systemic metabolic acidosis. Intravenous fluids containing bicarbonate are very effective in correcting severe acidemia, since it reacts directly with the H+ ion in the blood. Lactated ringer's or acetate ringer's solutions are preferred to correct mild to moderate metabolic acidosis. 1 to 4 liters of isotonic sodium bicarbonate solution is recommended for intravenous fluid treatment of calves with diarrhea. When the sucking reflex begins in calves, fluid therapy should be continued with oral electrolyte solution. Undiluted hypertonic sodium bicarbonate solutions should be

used with caution in calves with severe dehydrated diarrhea (Kaplan et al., 2010; Şen et al., 2013).

In the neonatal period, diarrhea of infectious origin (bacterial, viral and parasitic) comes to the fore. Among the infectious agents; It has been determined that especially *E. coli, Rotavirus and Coranaviruses* and *Criptosporidium* species protozoa have an important role. Although many methods are used in the diagnosis of infectious agents in calf diarrhea, it has been stated that immunochromatographic tests, which allow rapid etiological diagnosis from stool, can be easily applied in recent years (Altuğ et al., 2013).

2.3 Hypervitaminosis A (Hyena Disease)

Hyena disease, first reported in France in 1975, is defined as a skeletal developmental disorder localized especially in the pelvic extremities of young cattle. The cause of this disease, which causes cattle with short pelvic extremities to look like a hyena when viewed from the side, could not be clarified until the end of the 1990s, and many etiological hypotheses were put forward. Experimental studies in calves have revealed that the main cause of hyena disease is hypervitaminosis A, and this disease is similar to physeal obliteration in children due to the use of high doses of vitamin A. Although it has been reported that changes in bone tissue due to hypervitaminosis A in experimental animals can be corrected with specific antagonists to retinoic acid receptors, there is no prescribed treatment protocol for hyena disease. It is recommended that the affected calves be slaughtered after reaching one year of age (Avki et al., 2009).

2.4 Rumen Acidosis of Sucking Calves (Rumenic Acidosis in Calves Due to Pansentrinken)

The disease is defined as excessive acidification of the reticuloruminal contents due to fermentation of easily digestible carbohydrates to volatile fatty acids and lactic acid after non-physiological accumulation of milk or other beverages given to calves in the rumen. Although it has not been explained whether there is racial disposition in the disease, which is stated to be seen at the same rate in male and female calves, it is reported that Simental calves are dispositioned.

Etiology

Esophageal groove dysfunction: The most important cause of pansentrinken formation is various primary diseases (diarrhea of newborns, umbilical cord inflammation or lung diseases, as well as painful cough, inflammation of the vena jugularis, otitis media) It is esophageal groove dysfunction that occurs as a complication of calves (as well as some other diseases that impair the general condition of calves). Because these diseases can prevent the reflex formation required for esophageal groove closure. Due to inadequate closure of the esophageal groove, beverages (large quantities of milk replacer feed, oral rehydration fluids or diet drinks, empiric drugs containing flaxseed) reach the anterior stomach rather than the abomasum in most cases.

Forced (compulsory) drinking: When milk or formula is given to calves with weak sucking reflexes by using a tube, drain or tube, almost

all of the drinks reach the fore stomach. For this reason, the disease picture is expressed as “mandatory pansentrinken”.

Abomaso-ruminal reflux: It is the return of the contents of the abomasum to the fore stomachs. Under normal conditions, very little of the milk sucked by the calf is refluxed into the fore stomachs, which contributes positively to the formation of the first rumen flora. Here, as a result of exceeding the filling capacity of the abomasum, the milk returns to the fore stomachs. During the first two weeks of life, the amount of milk that young calves will drink at each meal is less than 2 liters. If young calves take more than 2 liters of milk at each meal, the pH value of the rumen content drops significantly within 1-2 hours due to the reflux of some of the beverage from the abomasum to the fore stomachs. In studies on the etiology of Pansentrinken, it has been stated that its importance is negligible.

Measures to be taken:

Stimulation of the sucking reflex before drinking: In case of weakness of the sucking reflex, compulsory drinking should be abandoned. Stimulation of the sucking reflex is recommended before drinking, as it is formed and strengthened by the stimulation of the esophageal groove sucking reflex. To this end; If the calf is healthy, it should be allowed to drink milk by guiding it with the finger to stimulate the sucking reflex.

Supportive measures in calves with weak drinking: Improvement of beverage intake can be achieved with brotizolam (I.V. before drinking

at a dose of 0.2 mg/100 kg bw), especially in calves with primary drinking weakness whose spontaneous sucking reflex cannot be stimulated. Calves with weak sucking reflexes can be injected with vitamin E and selenium (150 IU vitamin E and 3 mg Se, S.C. per 50 kg body weight) preparations (Gül et al., 2011).

2.5. Abomasum Ulcer

Abomasum erosions and ulcers are observed in cattle of all ages, but it has been noted that they are more common in young cattle. These lesions are mostly subclinical and are seen at autopsy or after slaughter. Ulcers resulting in death due to bleeding or perforation are rarely encountered. Although the etiology of abomasum ulcers is not known exactly, it has been suggested that some trace element deficiencies, bacteria and fungi may play a role in calves. It has been stated that the lack of mucus may lead to ulceration. It has also been noted that ulcers mostly occur under stress situations such as weaning or transport of calves, and the frequency of ulcers increases after switching to roughage (Sönmez et al., 1996).

2.6. Pica

Pica; It is a metabolic disease characterized by the symptoms of eating or licking non-food foreign materials such as bones, hair, feathers, walls, cloths and rags. Pica occurs in many animal species. Various causes play a role in the etiology of pica. The main reasons are; Inadequacy of some proteins and amino acids, decrease in the body's alkaline reserve, insufficiency of some vitamins and trace elements,

unbalanced calcium-phosphorus ratio in the diet and phosphorus deficiency. Although soil eating habit is accepted as a different form of pica in mammals, it is thought to occur due to the deficiency of some elements such as phosphorus, sodium, magnesium, sulfur, copper, cobalt and manganese.

As a matter of fact, in experimental studies, it has been observed that soil eating habits and white muscle disease occur in the offspring of cows and sheep that are not given enough mineral substances during their pregnancy. In addition, it was determined that the serum mineral level was low in the pregnant animals themselves and their offspring exposed to heat and cold. The scarcity of minerals in soil and plants causes animals to eat soil. While the blood serum levels of Na, Ca, Fe, Zn and Cu are normal in soil-eating cattle in Nigeria, the phosphorus level is quite low and it is thought that soil eating habits are due to the deficiency of this mineral (Aytekin and Kalınbacak, 2008; Kaplan, 2022). According to the results of a study conducted in the Afyon region, it was observed that the serum levels of phosphorus and copper minerals were significantly low, while the values of calcium, magnesium, zinc and iron were at normal levels in the serum of calves with soil eating habits, which is an important problem.

Thanks to the mineral substance supplements, the symptom of soil eating has regressed and disappeared, and the phosphorus and copper values have increased significantly. There was no significant change in trace element values without deficiency (Aytekin and Kalınbacak, 2008).

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CHAPTER 10

THE PAST AND PRESENT, DIAGNOSIS AND PREVENTATION METHODS OF YERSINIA PESTIS

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Introduction

Y. pestis is a species of the genus *Yersinia*, which is included in the *Enterobacteriaceae* family and includes approximately 11 species. *Y. pestis* is defined as an asporous, gram-negative, single or paired plague-causing bacterium (Pien et al., 2006). *Y. pestis* takes its name from a member of French Colonial Public Health, Alexandre Yersin, who was sent to Hong Kong in 1894 (Willamson and Oyston, 2012). *Y. pestis* is divided into three different biovars, Antiqua, Medievalis and Orientalis, based on small phenotypic differences. It is assumed by epidemiologists that *Y. pestis* Antiqua of African-origin caused the first pandemic while Medievalis of Asian-origin caused the second pandemic (Achtman et al. 1999).

The History of Plague:

Plague caused by *Y. pestis* is quite old in human history. Studies on the DNA of the disease-causing bacteria show that the cause dates back to the late neolithic ages (Constantin and Căluian, 2021). The first pandemic caused by *Y. pestis* lasted from 541 A.D. to the middle of the 8th century and caused a series of serious epidemics. The first epidemic, defined as the Plague of Justinian, is estimated to have spread from Constantinople to the United Kingdom (Larkin and Fraconi, 2022). It is stated that three major plague epidemics occurred in recorded history. While the first pandemic caused by *Y. pestis* was named as Justinian Plague in the middle of the 6th century, the second pandemic, called the Black Death, was recorded in the middle of the 14th century, and the

Bombay Plague was recorded towards the end of the 19th century. The disease of plague was noticed in the last period of medieval Islamic history and sufficient drawings and writings about the course of the disease were documented by Arab doctors. Information based on real medical observations only began to emerge until the second epidemic, named as Black Death (Dols, 1979). Although the course of the plague has been sufficiently written and drawn by the Muslim community, the disease has been regarded as a mercy from God to Muslims and a punishment for unbelievers by the Muslim community.

According to this superstition, since the disease was providential, there was no such thing as contagion, a Muslim individual should not have entered and fled from a plague-ridden country (Dols, 1977). The isolation and identification of the cause of the disease is assumed to be the modern history of the plague, which first began with Alexsandre Yersin isolating the causative bacterium in 1894 and examining it under the microscope.

Discovery of the plague's cause

As a result of the outbreak of the plague epidemic in Hong Kong, the Japanese government appointed a commission, including Shibasarubo Kitasato. The commission sent by Japan corresponded to the same date as Alexandre Yersin, who was assigned by France to investigate the cause of plague. Both researchers arrived in Hong Kong in 1894, but the commission appointed by Japan arrived a few days earlier. It

coincided with the same date when both researchers discovered new types of bacteria from the organs of rats that died of the plague.

Kitasato had the advantage of a few more days and sent a note, dated August, the 25th to the Lancet. Contrary to Yersin's findings, Kitasato described the bacteria as gram-positive and mobile. In the same period, Kitasato was known both as a senior and more famous than Yersin, and at the same time had more advantages due to knowing English. It was possible to access the autopsies of people who died of the plague. Although Yersin was not allowed to access the same materials for a certain period of time, he was more disadvantageous than Kitasato (Zietz and Dumkelberg, 2004).

At a meeting where the two were introduced, Yersin realized through the translator that Kitasato was examining blood samples instead of bubons and stated that bubons should be examined as well as blood samples. By examining the bubons, both Yersin and Kitasato found the same cause, but Kitasato later made a series of contradictory statements.

Yersin told his colleagues in Paris about his observations on the isolation of gram-negative bacilli from the fluid taken from bubons and their deaths by injection into animal tissues. Yersin's findings were found to be more consistent than Kitasato's, and as a result, the award for the discovery of the plague’s cause was given to Yersin (Buttler, 2014; Hagwood 2008).

Evolution of *Y. pestis*

The evolution of an environmental or commensal bacterium into a human or animal pathogen is associated with phage transduction of genetic materials over time, horizontal gene transfer, plasmid uptake, natural transformation and DNA conjugation (McNally et al., 2016). The genus *Yersinia* includes 15 species and it is stated that only 3 species, *Y. peudotuberculasis, Y. enterocolitica* and *Y. pestis* can infect humans and other mammals. It is estimated that the differentiation of *Y. pestis* and *Y. pseudotuberculsis* from *Y. enterocolitica* was 41 to 186 million years ago, and the differentiation of *Y. pestis* from *Y. pseudotuberculosis* dated back between 1500 and 20000 years ago. In the researches conducted, the genetic similarity between *Y. pseudotuberculosis*, which is the cause of a non-fatal food-borne gastrointestinal disease in mammals and *Y. enterocolitica*, was found to be quite high while the genetic similarity between *Y. pestis*, which is a cause of plague, and *Y. Pseudotuberculos* was found to be high (Zohu and Yang, 2009; Atchman et al., 1999). Strong molecular evidences to date support that *Y. pseudotuberculosis* that is responsible for yersiniosis in animals and humans is a recent ancestor of *Y. pestis* caused by bubonic and pneumonic plague (Chain et al., 2004).

Modes of transmission:

The plague's cause, *Y. pestis* is transmitted to humans by the bite of infected fleas or by breathing in droplets from infected individuals (Spinner et al., 2014). It is stated that the mortality rate in untreated

bubonic plague patients is between 40-50%, whereas the mortality rate approaches 100% in septicemic and pneumonic plague cases. Plague, which is caused by *Y. pestis*, can be fatal not only for humans, but also for many animal species bitten by carnivores that feed on rodents and fleas carrying the cause (Eisen et al., 2015).

Y. pestis makes a peculiar progress that leads to infection by fleas. In the first week after the cause is taken by the fleas, the bacteria form dense clusters and multiply in the lumen of the intestine. In some fleas, proliferation is also seen in the proventriculus, a valve that connects the midgut to the esophagus (Jarret et al., 2004). Recent studies have shown that genetic factors are necessary in order for *Y. pestis* to be transmitted by fleas. It has been stated that the first of these genetic factors is dependent on the plasmid-encoded phospholipase D, which prevents the survival, reproduction and degradation of the cause in the midgut of fleas, and the other is dependent on the hemin storage (hms) gene products, which are necessary for colonization and blockage in stomach (Hinesbusch et al., 1996).

It has been known for a long time that the plague's cause, *Y. pestis* is transmitted by fleas. When fleas suck blood from sick rodents, they take the current cause with the blood and infect this animal while sucking the blood of another animal to feed, thus an uninterrupted chain of transmission emerges between animals (Cui et al., 2020). Plague can also be transmitted through animal carcasses, animal bites, consumption of infected meat and contact with infected animals. In studies, it is stated that it can also be transmitted from the carcasses of

animals such as jackals, camels, mountain lions, mountain rabbits or by inhalation of droplets as a result of necropsies of infected animals (Barbieri et al., 2020).

In a study on how long human pathogen gram-negative bacteria can survive on environmental surfaces by McDade and Hall (1964), it was shown that bacteria can survive for 7 days in the presence of 1% humidity. It is stated that *Y. pestis*, which is a deadly plague cause in humans and animals, can survive for 24 days in contaminated soil under suitable natural conditions, but which mechanism this bacterium uses to survive has not been understood yet (Eisen et al., 2008). In a study on the survival times of avirulant *Y. pestis* A1122 and virulent *Y. pestis* Harbin strains on glass, steel, paper and polyethylene surfaces, it was stated that both strains were able to survive on all the surfaces for 5 hours. In the same study, it was stated that the avirulent *Y. pestis* A1122 strain could survive on paper for 48 hours while the virulent Harbin strain was shown to survive only on paper for 48 hours (Rose et al., 2003).

Symptoms of the disease:

It is noted that plague disease clinically has three different clinical pictures as bubonic, septicemic and pneumonic. If bubonic plague is not recognized and treated early, it can turn into septicemic plague or pneumonic plague with a very high mortality rate (Riedel S., 2005). With initial symptoms, plague presents a picture that is similar to flu symptoms such as malaise, high fever, headache and chills. It is

reported that the first step to suspect the plague is the patient's history of contact with other plague-stricken patients or dead animals. In areas where the disease is endemic, it is reported that the first symptoms are an important clue to suspect plague if the person has come into contact with rodents or other wild animals. The incubation period is usually between 2 and 3 days, sometimes up to 6 days (Wong et al., 2009). If the patient is infected by the cause through the respiratory tract, the symptoms can manifest themselves quickly in the incubation period of 1 or less days. In cases of bubonic plague, symptoms of the disease are seen with pain at the site of animal bite, spreading of a dry and hot area and swelling of the lymph nodes (Wang et al., 2011).

Laboratory diagnosis of *Y. pestis*:

The classical laboratory diagnosis of *Y. pestis* is based on bacteriological or serological tests. Samples for laboratory diagnosis may include bubon aspirates, sputum, cerebrospinal fluid and skin scraping. Although Gram, Giemsa, Wright or Wayson stains can be used for prediagnosis, they are not sufficient for definitive diagnosis. For the definitive diagnosis of the plague cause, it is necessary to isolate the cause of the plague. *Y. pestis* multiplies easily on most media such as brain heart infusion agar, sheep blood agar, McConkey agar, which are routinely used in the bacteriology laboratory, but two days are required for the formation of visible colonies. Colony morphology is opaque, smooth with irregular borders (Perry and Fertherson, 1997); (Dennis et al., 1999).

In recent studies, it has been reported that selective media should be used when it is necessary to work with samples with high contamination potential such as sputum and swap samples taken from skin lesions. McConkey agar is often recommended by WHO for selectivity, but it is reported that its selectivity is limited since it was developed for the isolation of enteric bacteria, causing the growth of many gram-negative bacteria in the environment. It is noted that the medium of cefsulodin-irgasan-novobiocin (CIN) agar developed for *Y. enterocolitica* more recently produces good selectivity for the isolation of *Y. pestis*. It has been reported that *Y. pestis* grows slowly on CIN agar, and the newly developed selective medium abbreviated as BIN is more advantageous than CIN agar (Aftalion et al., 2021); (Ber et al., 2003).

Due to the slow growth feature of *Y. pestis*, rapid biochemical tests cannot be useful in laboratory diagnosis, but specific lytic bacteriophages can be used for definitive diagnosis. ELISA tests are used to measure F1 antigen or antibody levels in serum, but it is stated that they are not useful in laboratory diagnosis because they give incorrect results in F1 antigen deficiency in some strains. Recently, molecular techniques such as conventional or real time PCR can be used using primers targeting gene sequences of *Y. pestis*, since its growth in the medium has been slow. In the studies conducted, it is emphasized that molecular techniques are faster, more specific, and at the same time, laboratory accidents and the risk of contamination as a result of these accidents are less than traditional methods (Perry et al., 1997; Zaho, 2018).

Plague at the present time

In the current century, lots of infectious diseases have been newly discovered, and some of them may cause epidemics again. The history of plague, caused by *Y. pestis* and transmitted by rodent flea bites, dates back to ancient times (Femollar and Mediannikov, 2018; Buttler, 2013). It is reported that the plague, which was observed to disappear pretty well in Madagascar after the 1930s, re-emerged in the 1990s, has caused more than 200 cases since then and causes epidemics in the same way every year (Chanteu et al., 1998).

It was reported by the health unit in Ituri province of the Democratic People's Republic of Congo that bubonic plague cases started to be seen again on April 4, 2022, 15 of 31 cases were tested and 2 resulted in death. It has been announced that 9 plague epidemics have occurred in the same country recently, including the cases, dated 4 April 2022 (www.ifrc.org).

In the United States, in April 2015, a total of 11 cases of plague were reported in 6 states, 2 in Arizona, 1 in California, 4 in Colorado, 1 in Georgia, 2 in New Mexico, and 1 in Oregon. It was noted that 3 resulted in death (Kwit et al., 2015).

In their letter to the editor, Gupta and Sharma (2007) noted that a laboratory-confirmed pneumonic plague epidemic occurred in India in 1966, the small epidemic that occurred in 1983 and resulted in 17 deaths suggested plague, but could not be confirmed by the laboratory. In the same presentation, they reported that 16 cases of plague were detected

in the Pradesh state of North India during February, 2002 and 25% of these cases resulted in death.

In a study by Shi et al. (2018), it was reported that the third plague epidemic that occurred in the 19th century originated in China. In the same study, they reported that the last human plague epidemic occurred in Yunnan between 1986 and 2005, but in 2016, a human exposed to a dead mus died of primary septicemic plague.

Preventation:

Although there are effective vaccine trials on experimental animals using avirulent strains of *Y. pestis* in some countries, it is reported that there is no commercial vaccine available today. Doxycycline, streptomycin and chloramphenicol are used for treatment against the cause of plague (Dennis and Staples, 2009).

Result:

Although the cause of plague, which has caused great epidemics throughout history, has not been seen for years, it can re-emerge endemically in world countries and still continues to threaten human health. Antibiotics used for therapeutic purposes lead to the emergence of more resistant strains and the necessity of vaccination studies against *Y. pestis* maintains its importance. It has been shown in many studies that *Y. pestis* differs from *Y. enterecolitica*, which does not cause fatal diseases. Causes of infectious disease that do not cause serious diseases today may differentiate over time and cause fatal diseases in the future.

Similarly, it can be said that causes inducing fatal diseases may lose their ability to cause disease, and infectious diseases that have disappeared may reappear.

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CHAPTER 11

SHOULD WE FEED THE GOATS AD LIBITUM OR RESTRICTED?

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INTRODUCTION

Ad Libitum or Free Feeding: Ad libitum in Latin, “libitum” means unlimited and in English it means optional, full and spontaneous in music. Abbreviation for “ad lib.” as (1). To say “ad libitum” in the field of veterinary animal nutrition; It means that animals can consume the feed freely at all times, eat as much as they want and constantly have feed in front of them. Long-term ad libitum feeding or access to food 24 hours/day for monogastric animals such as horses, donkeys, rabbits, cats, dogs, mice, rats; It causes an increase in overweight, heart and respiratory diseases, foot and reproductive problems and cancer formation (2). Regardless of the type, age, gender and physiological periods of our animals, monogastric or ruminant, excessive or excessive consumption of nutrients such as energy and protein can also cause reproductive problems, especially during the growth period of female sheep from which we get milk and offspring. For female goats, ad libitum feeding of roughage such as meadow and pasture and dry grass (excluding corn silage) is recommended for reproductive health and cheapness. As feed intake increases, Live Weight (LW), Daily Body Weight Gain (ADG) and Feed Utilization Ratio (FCR) gains may not increase linearly or linearly (3).

Restricted / Limited / Scheduled Feeding: It can be ensured that the animals receive pre-calculated amounts of feed in order to meet the parameters such as LW, ADG, FCR, milk yield, egg production. For this purpose, NRC (National Research Council, USA), INRA (Institut national de la recherche Agronomique, France), ARC (Agricultural

Research Council, UK), FEDNA (Fundación Española para el Desarrollo de la Nutrición Animal, Spain), which collects and compiles data for this purpose, CVB (Centraal Veevoederbureau; Central Bureau for Livestock Feeding, Germany), TNS (Trouw Nutrition Spain, Spain), Rhône-Poulenc, Adisseo, Degussa, Evonik, etc. Tables containing daily nutrient needs for goats recommended by some public and private institutions and related researchers in the world such as goats can be used. If these tables are followed, animals neither become obese by feeding ad libitum nor show signs of hunger, and their productivity will be high. In these daily nutrient requirement tables; programmed, restricted or restricted can be listed as follows: 1-Feeding Time: For example; Giving the opportunity to access food for 16 hours/day, 2-Amount Adjustment by Feed Type: Determining or restricting the daily feeding amounts of all roughage or concentrated feeds separately, 3-Restriction with some Feed Elements: For example, Dry Matter (DM) of the ration, Metabolic Energy (ME), Net Energy (NE), Crude Protein (CP), minerals and vitamins can be restricted or given in desired amounts separately or together (4,5). Since the digestive tract is not constantly filled with restricted feeding, the digestibility of the feeds increases, and problems related to the energy content of the diet such as liver abscess may decrease. While low quality roughage can be given to ruminants ad libitum periodically, energy, protein, vitamins and minerals can be restricted in some periods. Thus, while the problems caused by hunger are reduced, other health and reproductive problems are prevented. In ruminants, tongue movements increase, cortisol increases, glucose and insulin decrease, NEFA and β-hydroxy butyrate

increase in fasting states. While young immature female goats can be fed ad libitum with low energy content, non-greasy and cheaper roughage in certain physiological periods; concentrated feeds may be restricted. Likewise, when male goats are given concentrated feeds with high energy content during their growth period, their survival rate, energy and protein needs are reduced and they use more nutrients for muscle development. Well; Instead of giving roughage ad libitum to fattening male sheep, it is necessary to give feeds with high energy content (3,4,5).

Suryanarayana et al. (5), giving limited feed to sheep instead of ad libitum increases DM and CP digestibility, less feces are excreted due to the increase in the degree of digestibility, when the feeds remain in the rumen more, they are more adhered to by microorganisms and their digestibility will increase, if the amount of cellulose in the rumen is high, DM intake will decrease. the utilization rate (FCR) decreased, the visceral organs especially and firstly, the size of the liver decreased or the liver did not enlarge due to starvation with restricted feeding, lack of activity due to feeding; reported that the survival rate of the animal also reduced the need for ME, the amount of fat in the carcass decreased and the cost of feed decreased. Researchers also recommend that all restrictions be no more than 30% ad libitum for sheep.

Loor et al. (6), ad libitum administration of corn silage and alfalfa silage weighted rations with a net energy value of 1.6 Mcal per kg/DM during the 60-day dry period of dairy cows consumed 14.4 kg of DM feed per day, and those fed restricted diets (at a level of 80% of Net Energy

needs) They determined that they consumed 7.3 kg of DM feed. The researchers suggested that 140% of the net energy requirement does not cause obesity in cows, but it has negative effects on genomic markers in liver hepatocytes (Figure 1), increases the risk of ketosis, and should be fed moderately instead of ad libitum feeding.

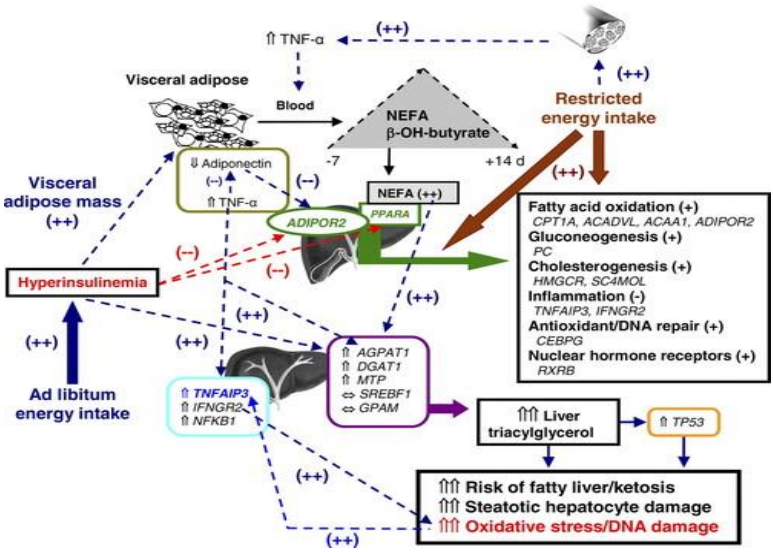

Figure 1. Effects of ad libitum feeding on organs in ruminants (6)

MATERIAL AND METHOD

Ad libitum or restricted feeding for kids

Banon et al. (7), in their study on Murciano-Granadina breed female-male kids with a daily milk yield of 1.8 liters and a lactation period of 180-200 days, completely natural breastfed group including colostrum and milk replacer containing 64% skimmed milk powder (SIH: 90%). DM, 35.4% carbohydrate, 23.7% CP and 24.2% EE) were fed with automatic feeding by diluting 100 g of SRW powder to 1 liter. Milk

varieties and concentrated feeds were offered ad libitum to all experimental kids. Kids in both groups were weaned at approximately 35 days and 8 kg LW. The researchers found that between natural breastfeeding, FR and giving milk to kids; They report that meat has no negative effect on parameters such as CP value and intramuscular fat amounts, ash, collagen, cholesterol, pH and color pigment (Haem) in the first 24 hours, except for some fatty acids. They even stated that the administration of MR increased the amount of unsaturated fatty acids in meat.

Alam et al. (8), in their study on Black Bengal kids, used SRI after sucking their mothers for the first 3 days and used MR for the first 3 days. 180 g/day at weeks 7-8. They consumed 380 g/day SDF by drinking 3 meals a day for weeks. During the experiment, concentrated feeds were given ad libitum from the first week and fresh meadow grass after the 15th day. At the end of the 20-week trial, more LW and ADG were obtained in the MR group compared to those who were naturally breastfed.

Bélanger and Vasseur (9), in their review published in 2021, in which necessary information is given for practical goat breeding; Caprine Arthritis Encephalitis (CAE) and Johne's Disease (Mycobacterium avium ssp. paratuberculosis) are the most common diseases with an average rate of 55-83% in kids in Canada, France and the USA, and these diseases are transmitted by placenta, colostrum, milk, water and feed, Newborn kids should be well dried with towels, they should be kept at least 0.5 m2/head in a place separate from goats in the range of

10-20 °C, colostrum or commercial colostrum of their mothers, other sheep and cows within 24 hours at the latest, especially in the first 6 hours after birth, or commercial colostrum according to kg birth weight. 150-200 ml should be taken, colostrums should be negative for CAE and Johne's Disease, if positive, colostrum should be heated for 1 hour at 56 oC despite the decrease in Ig and proteins, at least 50 g Ig G/liter in quality colostrum or at least 21% in Brix refractometer. Keep the milk or MR (20-28% CP and 16-24% EE) in the 20-30% range of the whey concentrate to avoid diarrhea. a) for the first week for kids; 0.5-1 liter/day 1.5 liters/day for the 2nd week and 1.8-2 liters/day from the 3rd week to weaning is appropriate, 10-15 cm long nipple or teat length is sufficient for 15-20 kids in automatic milking machines , that milk or SR and kid starter feeds with 18-20% CP can be given ad libitum, consuming at least 200-300 g of starter feed or 400-500 g of solid feed (starter + dry grass) per day for weaning for kids , It is necessary to reach 14-15 kg LW or 3 times their birth weight, Vitamin E (42 IU / kg LW) and Se (0.3 mg / kg LW) can be given to newborn kids by injection or orally for protection from White Muscle disease, Enterotoxemia and Tetanus vaccines can be given. last 3-4 days of pregnancy. pregnant goats and 3-4 weeks. After weeks, it should be done to kids, anticoccidial drugs should be started after the 15th day, and the kids should be blinded with a 19-25 mm copper-tipped cautery (caustic like sodium hydroxide can get into the eyes, so it is not recommended for kids) with a few shallow strokes for 2-3 seconds. 15. It can be done between days and days, mating can be done at least at the age of 1, the serum IgG ratios and viability of kids with a birth weight of less than 3

kg are low, and although it varies depending on the breeds, in general; They reported that kids should aim for at least 10 kg LW on the 30th day, 16 kg LW on the 60th day, and 150-200 g/day of ADG.

Rincon (10), in his doctoral thesis, examined the effects of ad libitum administration of SRW, starter feed and dry grass (after 15th day) at 6, 8 and 10 weeks in Alpine dairy kids. The investigator reported that those weaned at week 10 provided more ADG after weaning and reached more LW (27.44 kg) at week 10, but LW was unaffected after weaning. The researcher also recommends that 15 kg of LW or milk or MR can be given up to the 45th day for Alpin and Saanen kids.

Hernández et al. (11), in their study on Canarian female-male lambs with a daily milk yield of 1.8 liters and a lactation period of 180-200 days, the completely natural breastfed group including colostrum, pasteurized colostrum + milk replacer at 63 °C (MR: % 3 groups: the group fed with 95.5 DM, 23.6% CP and 22.7% EE) and the group fed with light pasteurized colostrum at 63 °C + full-fat cow's milk powder (97% DM, 27% CP, 28% EE) formed a trial design. Milk varieties and concentrated feeds were offered ad libitum to all trial lambs. At approximately 30 days, LW (15.28 kg) was low in the naturally breastfed group, while higher LW (mean 17 kg) was observed in the other groups. Researchers report that if cow's milk powdered for human consumption is cheap, it is a cheaper and safer alternative to both sheep's milk and lamb's SFAs, without negative consequences on the immune system and body weight.

Busato et al. (12) examined the effects of giving ad libitum and 25% and 50% of ad libitum dry matter for 90 days to 15 kg LW or 4-month-old male kids in a Boer cross breed called Canindé, and Moxotó; In the group given ad libitum (0.76 min./g), rumination was higher than in the group given 50% (0.29 min/g), the roughage: concentrate feed ratio of 40:60 is appropriate, the kids consume 3.5-4% DM according to LW. determined that ADG and LW were higher in the ad libitum fed group, but DM, OM, CP, NDF, ADF and TDN digestibility were higher in the 25% restricted group.

Gomes et al. (13) examined the effects of giving 18 female and 18 male kids a TMR ration starting from 30 kg LW, ad libitum, 30% and 60% of ad libitum, 13.7% CP and 3923 kcal Gross Energy in DM; They found 1442 g/day DM and 35.97 kg LW in the ad libitum group, 759 g/day DM and 32.42 kg LW in the 30% restricted feed group, and 443 g/day DM and 27.54 kg LW (-1.71 kg weight loss) in the 60% restricted group. . Researchers have recommended ad libitum administration of concentrate and roughage up to 36 kg LW in male and female Saanen goats.

Ad libitum or restricted feeding to replacement goats

Milk production depends on the number of secretory cells in the udder. Giving excessively concentrated feeds or high-energy diets to prepubertal female ewes reduces the growth of later sprouting mammary alveolar epithelial tissue and thus life-long milk yield. Because the udder parenchyma in sheep develops in the first 5 months or 20 weeks. For this reason, approximately 65-75% of the ration they

receive ad libitum should be given to the first 5 months old female sheep. The negative effects of high-energy diets in female sheep become more evident at the age of 4-6 years. Concentrated feed is not given excessively before puberty, and if the fat pads between the alveoli in the mammary glands increase, milk yield decreases at the same rate. After 5 months, this effect is less (14).

Panzuti et al. (15), on the 32nd day, to female kids of the Alpine race with an average LW of 10 kg, a constant 730 g DM/day for the control group, 365 g DM/day for the low group and 1090 g DM/day for the high group. and roughage ad libitum until the age of 235. The researchers cut half of the female kids they used in the experiment before puberty or on the 208th day, and the other half on the 70th day of pregnancy or at the 308th day of gestation to examine the mammary parenchyma. Keeping the concentrated feed high increased breast weight, prolactin hormone and IGF-I concentration, but protein expiration of breast tissue was similar in all 3 groups. As a result, the researchers concluded that weaning on the 32nd day had no negative effects on the development of the mammary parenchyma, the amount of unwanted fat in the mammary gland, which reduces milk yield, was 68% higher and the udder weight 55% higher due to the ad libitum feeding of concentrated feed, and that the udder development in female kids was 25% higher. -7. They report that it develops between months or 15-35 kg LW.

In their studies, in which Alpine female young goats were given concentrate and roughage ad libitum for the first 130 days after birth

and restricted feeding between 130-200 days, it was determined that at least 100 ml/head colostrum was given to the newborn kids, and that the kids of dairy breeds were given at least 14 kg LW'. They reported that they were weaned when they reached the age of age and at least 30 days, rams can be added at the age of 200-270 days for Alpine female goats, the first oestrus is seen at the age of 230 days and their first birth occurs on the 380th day. The investigators started from day 30 and fed all kids as a constant 730 g DM/day concentrated feed (19.4% CP and 11.3 MJ/kg DM ME) for the control group, 365 g/ DM/day for the low group and 1090 g/ DM/day for the high group. They gave concentrated feed until the 210th day of age. Roughage was offered ad libitum. Concentrated and roughage were consumed similarly in total in all 3 groups, and the ratios of FCR (average 7) were similarly similar. While LW and ADG were determined to be high in the group given high concentrated feed, 100-day milk yield (average 310 kg), daily milk yield (average 3 kg) and birth weight of kids did not change in all groups (16).

Wang et al. (17) to female young goats of Alpine breed with an average of 25.3 kg LW and Katahdin breed with 28.3 kg LW; investigated the effects of ad libitum administration of 75% alfalfa + 25% maize concentrate feed up to approximately 40 kg LW. They reported that daily DM consumption was 1600 g/day or 4% of LW, ADG produced 159 g/day and 1284 kjoule/day methane gas per day.

Goetsch (18) reported that dairy goats should be weaned or slaughtered within 40-60 days in his article containing the latest developments in

goat nutrition published in 2019. The researcher stated that for kids, taking feed from the ground causes DM intake 20 cm above the ground or lower than the head level. It is reported that a ration with 300-400 mEq/kg DM Cation-Anion Difference (CAD) can be given between weeks and weeks, and that a CAD value higher than this can increase water consumption in goats and the amount of water in the body, but it does not affect milk yield and milk components.

Ad libitum or restricted feeding for pregnant goats

Broux et al. (19). Ad libitum and 50% of ad libitum between the last 8-4 weeks, and 50% of the last 5-4 weeks in pregnant goats of Alpine and Saanen breeds at 8 weeks to birth. 60% between weeks and the last 4-3. examined the effects of giving a TMR ration of 70% per week and 80% in the last 2 weeks. Plasma glucose, β-hydroxybutyrate (BHB), non-esterified fatty acids (NEFA) were higher in all restricted groups compared to the group given ad libitum. Mobility due to foraging was observed more in the restricted feed group.

Costa et al. (20), in the first half of their pregnancy (between the first 8-84th days), 50% of the daily amount of DM, TDN and CP that the goats should receive is given and in the remaining 2nd half (from the 85th day to birth) 100% is given 1 In their studies examining the effects of Group 2, who received 100% in the first half and 50% in the second half; reported that they did not see a negative effect on myogenic, adipogenic, and fibrogenic markers (except HKII gene expiration) in the skeletal muscles of the offspring.

Firozi et al. (21) in their study examining the performances of Sistani goats in the last 28 days of pregnancy and the first 28 days of the kids born; Four cross-groups were formed in which the energy and protein in the diet were low (2146 kcal/kg DM ME and CP 9.9%) and high (2355 kcal/kg DM ME and CP 10.61%, respectively). The researchers did not see a statistical difference in the 28-day LW of the mother goats and kids before calving. Daily DM consumption was the highest with 1282 g in the group with low ME and high CP in the main goats, and the lowest was 893 g in the group with low CP and ME. Total colostrum (mean 4.8 kg) and 28-day milk yields (mean 20 kg) for the first 28 days were similar in all groups. Likewise, kid's birth weights (3.08 kg) were similar in 4 groups. The researchers concluded that rations with 2200 kcal/kg DM ME and at least 11% protein in the last 28 days of pregnancy and the first 28 days after birth are sufficient for the main animals and kids.

Garcia et al. (22) French Alpine breed goats in the last 50 days of pregnancy alfalfa ad libitum (group 1), alfalfa ad libitum + 150 g concentrated feed (2750 kcal/kg DM ME and 17% CP) (group 2) and alfalfa In their studies where they examined the effects of ad libitum + 300 g concentrated feed (3rd group); reported that the birth weight of the kids (average 3.6 kg), the rectal temperature of the mother goat was 38.5 oC, and the respiratory rate (mean 75 rpm) was similar. As a result, the researchers did not see a positive effect of increasing the concentrated feed to 300 g/day in the last 50 days of pregnant goats.

Ahmadzadeh and Hosseinkhani (23) found that the survival rate and energy requirement of pregnant Ghezel sheep increased by 50-120%, especially in the last 50 days, that the alveoli in the mammary glands began to proliferate after the 90th day of pregnancy, and that 40% of the ad libitum ration given in the last 50 days of pregnancy is adversely affected. They reported that its effects could only be possible with the administration of different additives (propylene glycol, 67 g/day, monensin sodium 30 mg/day and rumen protected choline 6 g/day), and even increased milk yield, milk protein and milk solids content.

RESULTS

Based on the literature in this review, the following conclusions can be drawn:

1-Generally, 8-10% of LW for 5-10 weeks or milk or MR can be given ad libitum for kids. However, this period can be reduced up to the 30th day. Cow's milk can also be used instead of Capricorn MR.

2-Capricorn starter feeds can be given from the first week. Quality, low stem content, thornless and soft textured fresh meadow or pasture grasses (except fresh clover and clover) or fresh or dry roughage such as hay must be started after the 15th day. In general, between 15-40 kg of LW in young female-male goats, 3.5-4% of LW is consumed. All roughage and concentrated feeds should be offered to kids and goats in mangers that are at least 20 cm above the ground.

3- Newborn male-female kids can be given concentrate and roughage up to 36 LW ad libitum. However, in terms of nutrient digestibility and cost, after 30 kg LW, 25% less feed can be given to male-female goats instead of ad libitum feeding. Restricted feeding should be avoided for goats in the last 2 months of pregnancy, but especially concentrated feeds for obesity should not be given ad libitum during this period. In general, after 30 kg of LW, instead of ad libitum feeding, feeding the goats according to the daily nutrient needs calculated for those goat breeds in the feeding tables of organizations such as NRC or researchers would be sufficient, convenient and cheap in practice.

4-Additives (propylene glycol, 67 g/day, monensin sodium 30 mg/day and rumen protected choline 6 g/day) can be used to eliminate the negative effects of restricting up to 30-40% of the ration given ad libitum in goats and sheep.

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CHAPTER 12

SHOULD WE FEED SHEEP AD LIBITUM OR RESTRICTED?

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INTRODUCTION

Ad Libitum or Free Feeding: Ad libitum in Latin, “libitum” means unlimited and it means optional, full and spontaneous at music in English (1). To say “ad libitum” in the field of veterinary animal nutrition; It means that animals can consume the feed freely at all times, eat as much as they want and constantly have feed in front of them. Long-term ad libitum feeding or access to feed 24 hours/day for monogastric animals such as horses, donkeys, rabbits, cats, dogs, mice, rats; It causes an increase in overweight, heart and respiratory diseases, foot and reproductive problems and cancer formation (2). Regardless of the type, age, sex and physiological periods of monogastric or ruminant animals, excessive or excessive consumption of nutrients such as energy and protein can also cause reproductive problems, especially during the growth period of replacement ewes sheep from which we get milk and lambs. In general, it is recommended to give roughage such as meadow and pasture and dry grass (except corn silage) to replacement ewes ad libitum in terms of reproductive health and cheapness. As feed intake increases, Live Weight (LW), Average Daily Gain (ADG) and Feed Conversion Ratio (FCR) gains may not increase linearly or linearly (3).

Restricted / Limited / Scheduled Feeding: It can be ensured that the animals receive pre-calculated amounts of feed in order to meet the parameters such as LW, ADG, FCR, milk yield, egg production. For this purpose, NRC (National Research Council, USA), INRA (Institut national de la recherche Agronomique, France), ARC (Agricultural

Research Council, UK), FEDNA (Fundación Española para el Desarrollo de la Nutrición Animal, Spain), CVB (Centraal Veevoederbureau; Central Bureau for Livestock Feeding, Germany), TNS (Trouw Nutrition Spain, Spain), Rhône-Poulenc, Adisseo, Degussa, Evonik, etc. which collects and compiles data for this purpose. Tables containing daily nutritional needs for sheep recommended by some public and private institutions and relevant researchers in the world, such as if these tables are followed, animals neither become obese by feeding ad libitum nor show signs of hunger, and their productivity will be high. In these daily nutrient requirement tables; programmed, restricted or restricted can be listed as follows: 1-Feeding Time: For example; Giving the opportunity to access food for 16 hours/day. 2-Amount Adjustment by Feed Type: Determining or restricting the daily feeding amounts of all roughage or concentrated feeds separately. 3-Restriction with some Feed Elements: For example, Dry Matter (DM) of the diet, Metabolizable Energy (ME), Net Energy (NE), Crude Protein (CP), minerals and vitamins can be restricted or given in desired amounts separately or together (4,5). Since the digestive tract is not constantly filled with restricted feeding, the digestibility of the feeds increases, and problems related to the energy content of the diet such as liver abscess may decrease. While low quality roughage can be given to ruminants ad libitum periodically, energy, protein, vitamins and minerals can be restricted in some periods. Thus, while the problems caused by hunger are reduced, other health and reproductive problems are prevented. In ruminants, tongue movements increase, cortisol increases, glucose and insulin decrease,

NEFA and β-hydroxy butyrate increase in fasting states. While roughage, which has low energy content, does not make fat and is cheaper, can be given ad libitum to young replacement ewes in certain physiological periods; concentrated feeds may be restricted. Likewise, when male sheep are given concentrated feeds with high energy content during their growth period, their survival rate, energy and protein needs are reduced and they use more nutrients for muscle development. Well; Instead of giving roughage ad libitum to fattening male sheep, it is necessary to give feeds with high energy content (3,4,5).

Suryanarayana et al. (5), giving limited feed to sheep instead of ad libitum increases DM and CP digestibility, less feces are excreted due to the increase in the degree of digestibility, when the feeds remain in the rumen more, they are more adhered to by microorganisms and their digestibility will increase, if the amount of cellulose in the rumen is high, DM intake will decrease. the utilization rate (FCR) decreased, the visceral organs especially and firstly, the size of the liver decreased or the liver did not enlarge due to starvation with restricted feeding, the lack of activity caused by feeding; reported that the survival rate of the animal also reduced the need for ME, the amount of fat in the carcass decreased and the cost of feed decreased. Researchers also recommend that all restrictions for sheep be no more than 30% ad libitum.

Loor et al. (6), ad libitum administration of corn silage and alfalfa silage weighted diets with a net energy value of 1.6 Mcal per kg/DM during the 60-day dry period of dairy cows consumed 14.4 kg of DM feed per day, and those fed restricted diets (at a level of 80% of Net Energy

needs) They determined that they consumed 7.3 kg of DM feed. The researchers suggested that 140% of the net energy requirement does not cause obesity in cows, but it has negative effects on genomic markers in liver hepatocytes (Figure 1), increases the risk of ketosis, and should be fed moderately instead of ad libitum feeding.

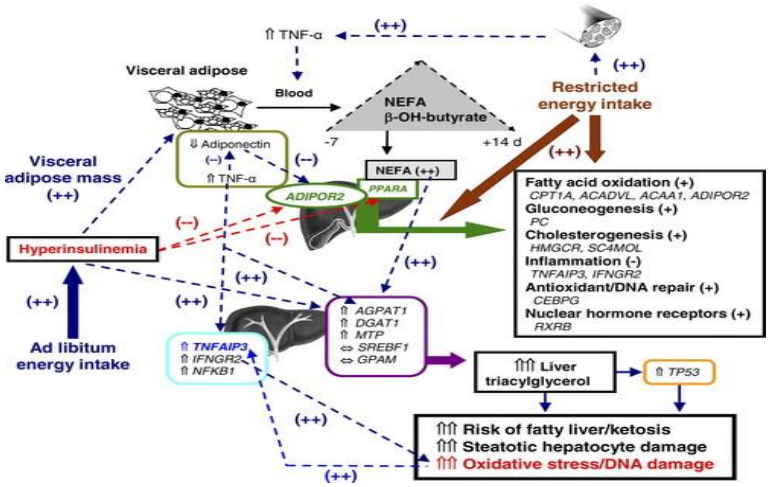

Figure 1. Effects of ad libitum feeding on organs in ruminants (6)

MATERIAL AND METHOD

Ad libitum or restricted feeding for lambs

Mariano et al. (7) in their 3-group study on male lambs of 3-year-old Comisana dairy sheep with an average live weight of 50 kg at birth and consuming an average of 1.6 kg of vetch/oat/alfalfa hay mixture + 0.9 kg of concentrated feed; All groups gave breast milk to the lambs by breastfeeding twice, at 07:00 in the morning and at 17:00 in the evening for 15 days. Investigators after the 15th day; 1. To the Group; Until the 63rd day or until the slaughter, they gave only breast milk as

breastfeeding twice a day. 2. To the Group; 15.-30. Between days, breast milk (breastfeeding once in the morning) + concentrated feed (1817 kcal/kg DM Net Energy) + alfalfa hay ad libitum. To the 3rd Group; 15.-30. Between days of breast milk (feeding once in the morning) + concentrated feed + alfalfa hay ad libitum and from the 31st to the 63rd day or until the slaughter, concentrated + alfalfa hay ad libitum without giving milk. Researchers; Until the slaughter day, that is, until the 63rd day, the main ewes in the 2nd Group produced 22.7 kg of milk on average and the main ewes in the 3rd Group produced 41.6 kg of milk. (mean 18 kg) and ADG did not differ statistically in all groups (mean 200 g/day). In conclusion; emphasized that not giving breast milk after the first 30 days did not cause any decrease in live weight, hot and cold carcass and Longissimus muscle on the slaughter day. Here; We can say that the nutrient deficit that can come from milk is closed with the consumption of nutrients in concentrate and roughage.

Santos et al. (8) To female lambs of Assaf breed with an average birth weight of 4.70 kg, to which they gave colostrum for the first 2 days, starting from the 3rd day, 23% CP containing 50% milk powder, 26% HY and 5089 kcal/kg powder DM, Milk Replacers (MR) were given ad libitum for lambs. The lambs were fed ad libitum by taking the ADG of 250 g/day or by taking 2.5 times the daily metabolic energy requirement. 62.5% of this ad libitum group, i.e. 100-120 g/day according to ADG or 1.5 times the daily metabolic energy requirement for survival, were given to female lambs in 2 groups as 3 meals a day.

Starting from the 3rd day, starter feed and barley straw + alfalfa hay mixture was given freely to both groups for 42 days. After that, TMR with 12% CP and 2303 kcal/kg ME (Barley 36%, alfalfa hay 16%, barley straw 15.7%, vetch 13.3%, molasses 5%, corn 5%, sunflower 4.3%, soybean meal. They gave 3% and vitamin+mineral 1.7% diet ad libitum for 7.5 months. When we look at the test results; While weaning occurred on the 47th day in the group given ad libitum, weaning took place on the 66th day in the group given 62.5% of the ad libitum MR. A similar increase in ADG was obtained after weaning in the group given limited MR, which experienced a decrease in ADG until weaning. In addition, FCR (Feed Conversion Rate = Daily Dry Matter Intake g/day / ADG g/day) was found to be similar in both groups (10.1 and 10.4), respectively. In conclusion; Although 62.5% restricted MR administration to lambs causes a decrease in ADG until weaning, it has been stated that it does not cause a problem after weaning and in total.

Abouheif et al. (9), in their study on Najdi breeds with an average LW of 26.6 kg, and 3.5-month-old male lambs up to 30 kg of LW, roughage + concentrated feed was given ad libitum to all groups. After the body weight exceeded 30 kg, 3 groups were arranged, roughage and concentrated feeds were allowed ad libitum in the 1st Group, 75% of the 1st Group in the 2nd Group and 60% of the 1st Group in the 3rd Group. Researchers; while recommending ad libitum feeding for male lambs up to 5 months old and up to 7 months old; ad libitum feeding 75% of DM or approximately 1600 g/day DM consumption; They

reported that LW, ADG and FCR values were positively affected by ad libitum feeding.

Jaborek et al. (10) fed female and male Dorset x Hampshire crossbred lambs at an average of 30 kg LW with whole corn up to 62 kg LW ad libitum and 85% of this as limited. Researchers; they observed a decrease in daily feed consumption and ADG between the group containing 85% whole corn and given ad libitum and the group containing 80% whole corn and 85% ad libitum DM. They found that the ad libitum group reached 62.2 kg LW in 87.5 days and the group that was restricted by 85% of the ad libitum feed amount reached 62 kg LW in 104.8 days. However, when looking at FCRs, they also reported that the 85% group achieved more live weight gain with less feed. Murpy et al. (11) also stated that they found a similar result; In their study on lambs, the diet given 70% less DM instead of ad libitum; They reported that they saw a linear improvement in dry matter (DM), organic matter (OM), acid detergent fiber (ADF), crude protein (CP), starch digestibility and total cost.

Ding et al. (12), in a 90-day study of small-tailed Han breed at 24 kg LW and restricting dietary DM consumption by 85%, 75%, and 60%, TMR was determined by fermented flax straw 40%, whole corn 20%, wheat bran 10%, and wheat bran 10%. restricting a diet with 30% flaxseed meal from 24 kg LW to an average of 42 kg LW by 75%; They reported that there was no negative effect on LW, ADG and FCR.

Teixeria et al. (13), in their study in which they restricted male lambs of Dorper x Santa Ines breed with an average of 23 kg LW to 60% and

30% of DM intake for 64 days, and then fed them for 42 days for compensatory purposes; With the restriction of daily DM intake, 100, 200 and 287 kcal $ME^{0.75}$ energy according to Metabolic Live Weight were given to the lambs daily in the control group, respectively. With compensatory growth, the 60% restrained group reached 36.7 kg LW, while this value reached the highest value as 41.2 kg LW in the 30% restrained group. ADG was similar in both groups at 276 g/day. Here, the daily DM consumption of the 30% group with low ME was 1406 g/day, while it was 1267 g/day in the 60% group and 1158 g/day in the control group. Well; Low ME in the diet was tried to be compensated by excessive feed consumption. Therefore, researchers; They said that diets with medium ME content or about 2600 kcal/kg should be used in lamb fattening, so excessive feed wastage can be prevented and it will not cause any negative effects on live weight.

Glimp et al. (14), in their study in which they examined the reduction of concentrated feed by 45%, 27.5% and 10% compared to ad libitum, despite the free feed of Rambouillet bred ewes and lambs, the highest ADG was found in the group with 27.5% restricted and 10% They reported that the restriction in the amount of feed resulted in 20% improvement in FCR and reduction in carcass fat.

Ad libitum or restricted feeding to replacement ewes

Milk production depends on the number of secretory cells in the udder. Giving excessively concentrated feeds or high-energy diets to prepubertal female ewes reduces the growth of later sprouting mammary alveolar epithelial tissue and thus life-long milk yield.

Because the udder parenchyma in sheep develops in the first 5 months or 20 weeks. Therefore, the first 5 months old female sheep should receive approximately 65-75% of their ad libitum intake. The negative effects of high-energy diets in female sheep become more evident at the age of 4-6 years. Concentrated feed is not given excessively before puberty, and if the fat pads between the alveoli in the mammary glands increase, milk yield decreases at the same rate. After 5 months, this effects is less (15).

Thomas and Berger (16) gave Lacaune x East Friesian weaned young female sheep ad libitum and 75% of this concentrate (73% less) + roughage (91%). They fed the sheep for about 100 days from the 50th day to the 148th day and mated them in the 7th month. During these 100 days, ADG was higher (217 g/day) in the restricted feed group and lower (158 g/day) in the ad libitum group. Likewise, no difference was observed in both groups between lactation periods (average 183 days), lactation milk yields (average 275 kg), milk fat, protein ratio and yield. Lambing weights, conception rates and fertility rates of ewes were higher in the restricted feed group. As a result, researchers; recommended that for young female ewes, concentrate feed should be given as 73% of those given ad libitum as reproductive health and yield.

Villeneuve et al. (17), in their study in which they examined the effects of prepubertal restricted feeding on reproduction, lactation and lamb growth performance in Dorset breed female sheep during two breeding seasons; Three diets were administered to 41 weaned Dorset sheep. 1st Diet: Ad libitum group containing medium quality roughage +

concentrated forage (CP: 13.3%, ME: 1810 kcal/kgDM and ADF: 42.8%). 2nd Diet: A restricted diet group containing the same forage as the 1st diet but with less concentrated feed (CP: 16% and ME: 2620 kcal/kgDM). 3rd Diet: High CP and ME group (CP: 14.8%, ME: 2150 kcal/kgDM, and ADF: 34.7%). These 3 diets were offered for 75 days after weaning to cover the allometric phase of mammary gland development. If we look at the test results; Second diet or restricted diet; It did not affect pregnancy rate, number of lambs born, twinning rate, lamb birth weights (4.7, 5.4 kg and 4.7 kg), respectively, body weight (72.8, 71.5 kg and 70.4 kg) and body condition scores of lambs in lambing (P>0.10). The diets in Groups 2 and 3 produced more milk in their first and second lactations than those in Group 1. In fact, Group 2 or restricted group produced more milk than Group 3 (P<0.05). Milk fat and protein content were similar in all 3 groups (P>0.10). Lamb birth weights and weaning weights were not affected by restrictions on prepubertal feeding in their mothers (P>0.10). Researchers; They found that limited feeding before puberty did not impair future reproductive performance, but positively affected lactation yields and growth performances of lambs.

Ad libitum or restricted feeding for pregnant ewes

Nørgaard et al. (18) applied different feeding programs in 2 groups to Shropshire sheep in the last 6 weeks of pregnancy. Researchers as 1st Group; 54.7% DM, 14.6% CP and 382 calories of meadow silage ad libitum + 300 g/day concentrate feed. As 2nd group; Silage and concentrate feed half of the NEL value of the 1st group diet. Sheep in

Group 1 with ad libitum had an average of 89.3 kg of pregnant sheep LW + Fetus 16 days before birth, and 81.9 kg in Group 2 with 50% energy restriction and 7.4 kg lower LW + Fetus was obtained with restriction. The amount of colostrum was produced less in the same order (616 g and 294 g). However, lamb birth weights (4.17 kg and 3.78 kg), milk yields on the 5th and 30th days (320 g/day and 278 g/day, 301 g/day and 153 g/day), epithelial cells, stroma and lumen, respectively. Parenchymal breast tissue development, breast tissue leptin hormone, α-lactalbumin and insulin-like growth factor (IGF-I) levels were not affected by energy restriction. Researchers have reached the following conclusions: The development and growth of the fetus and mammary gland take priority over other tissues of the body. Therefore, feed restriction in the last 6 weeks of pregnancy did not affect the milk production of the mother except for the amount of colostrum. In pregnant ewes, body tissues are mobilized in response to feed restriction, compensating for reduced nutrient absorption, and are able to maintain near-normal levels of both fetal growth and udder regrowth. Here; It should be noted that the energy restriction of the 50% diet is too much for pregnant sheep and this level should not be more than 30%.

Luzardo et al. (19), pregnancies 48-106. investigated in 2 groups by giving 60% and 100% of the daily ME need to pregnant sheep with an average of 44 kg LW with single and twin fetuses. Sheep that were not restrained at the end of the trial had 7.5 kg more LW. However, milk production is in the same order (1.33 kg/day and 1.41 kg/day), lamb

birth weights (4.15 kg and 4.30 kg), milk intake amounts of lambs, weaning weights, final slaughter weights of male lambs and hot and cold carcasses and lambs. FCR values (6.99 and 6.81); gender was not effective in singles and twins and was observed to be similar in both groups. Twin lambs were more advantageous in terms of FCR against single borns and birth weights of male lambs were recorded as higher. Researchers; Restricted feeding as much as 60% of the diet ME resulted in pregnancy in sheep 48-106. They reported that it did not affect their performance and the parameters of the lambs they gave birth to.

RESULTS

Based on the literature in this review, the following conclusions be drawn:

1-Generally, 8-10% of LW can be given for lambs for 6-8 weeks. However, this period can be reduced up to the 30th day.

2-Lamb starter feeds can be given from the first week. After the 15th day, lambs can be fed with high quality, low stalk, thornless and soft textured fresh meadow or pasture grasses (except fresh alfalfa and clover) or fresh or dry roughage such as hay.

3- Giving 30% less feed or nutrient content to newborn lambs, replacement ewes and pregnant ewes instead of ad libitum feeding does not cause negative results and even increases reproductive parameters and milk yield. Instead of ad libitum feeding, feeding sheep according to the daily nutrient needs

calculated for those breeds in the feeding tables of organizations such as NRC or researchers would be sufficient, convenient and cheap in practice.

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CHAPTER 13

PROFITABLE MILK PRODUCTION IN GOAT BREEDING

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INTRODUCTION

Goat breeding is an important livestock branch in terms of economic, cultural, and social aspects in Türkiye. Goat husbandry activities in livestock have been an important economically important place for a long time. Goat breeding systems in Türkiye vary according to various factors. Among these factors; there are factors such as the natural and socio-economic conditions of the regions, the availability of feed resources, their connection with plant production and the consumption habits of population (Güney and Kaymakçı, 1997).

With the increase in the world population, the need for food for a balanced diet is increasing. Milk is one of the most important animal products in human nutrition. One of the most important products obtained from goats is milk. In fact, the milk produced by goats to feed their young until a certain age is of great importance as human food. Today, goat milk production is generally carried out under very difficult conditions. Although these difficult conditions have changed until today, they are generally similar in nature. As a result, despite high labor costs, goat milk production remains low. Therefore, profitability in goat milk production remains low in Türkiye. From this point, it is obligatory to determine the economic efficiency level in terms of milk yield in goats according to the enterprises. The level of efficiency that will cover the costs of the yield obtained is roughly known as the economic efficiency level.

Türkiye hair goat breeds are oriented in combined yield and their progeny yields are not high. Although the meat yield of our hair goats

is not as high as in advanced countries, it has the feature of being the primary yield. Although the milk yield is low compared to other species, its good adaptation to harsh climate, rough terrain and malnutrition conditions provides an advantage in terms of preference of goats. The breeders also state that goats are easy and inexpensive compared to other breeds, resistant to environmental conditions, lack of land assets and being a forest village among the reasons for goat breeding (Soysal et al., 2005).

The main theme of this review study is to reveal information about profitability of goat milk production in Türkiye. The results indicated that solving the problems of milk producers in goat husbandry is very important to a sustainable stockbreeding of goats and to benefit breeders economically.

DAIRY GOAT HUSBANDRY IN TURKEY

In Türkiye, Eastern Anatolia, Central Anatolia and Southeastern Anatolia regions attract attention as the areas where animal husbandry is most intense. Among these regions, the Eastern Anatolia Region has a high potential for animal husbandry in terms of the suitability of its geographical features, and it has approximately 24% of the cattle and 34% of the sheep and goats in our country (Akpınar et al., 2012).

Hair goats constitute the majority of the goat population in Türkiye. However, there are also local dairy breeds, which constitute a very small part of the goat population apart from the mohair yield, and which are generally found around the big cities in Western Anatolia and

Southeastern Anatolia. Maltese goat and its crosses and Kilis goat can be counted among these breeds (Kaymakçı et al., 2005). In Eastern Anatolia, Norduz female goat (Figure 1, 2) in the Gürpınar district of Van province has come to the fore in terms of milk yield (Aygün and Mert, 2007). It has been reported that the averages of lactation milk yield and lactation period of Norduz goats are similar to the yields of other dairy goat breeds (Aygün, 2006). Eastern Anatolia Region has a different character from other regions in terms of climatic conditions. During the winter months, when severe storms settle in this region, extreme cold occurs. However, even at short intervals during the winter period, warm air masses coming from the Black Sea may occupy the plateau area (Tunçdilek, 1978).

As in the whole world, dairy goat breeding has a special place and importance in livestock sector. Dairy goat husbandry is one of the most important livestock activities in Türkiye, especially in Western Anatolia and Southeastern Anatolia Regions. The cultural, social and economic structure, climate and topographic characteristics of the region played a role in the importance of goat breeding.

Figure 1. Norduz buck (Photographer, Turgut Aygün).

Figure 2. Norduz female goats (Photographer, Turgut Aygün).

FEEDING OF DAIRY GOATS

There are plateaus in most of the dormitories where high mountain ranges are located, and there are nomads of different qualities who constantly benefit from these plateaus. Large plateaus where nomads are concentrated are in Eastern and Southeastern Anatolia. The dominance of animal production in these parts of our country is due to the existence of high plateaus that contain plant flora of superior value.

It is understood that the traditional cultivation system in the plateau and pastures, the storage energy in the body is used better than the dietary energy in milk production. It also appears to be a good choice in the early phase of lactation where the quality of the grazed feed is sufficient to maintain high levels of lactation (Kharrat and Bocquier, 2010).

There may be many reasons for this insufficient profitability in goat milk production. The domestic goat breeds in the country have low milk yields and are small in size. Hereditary capacity of these breeds is limited in increasing milk yield. There may be negligence in the feeding of animals. The nutrition that should be made in terms of basic proteins is insufficient. Especially at the beginning of lactation, the feeding level is not done adequately.

The best use of coarse and concentrated feed is a very important issue in dairy goat breeding. The secret of success in goat milk production is to know how to use roughage and concentrate feeds on time and in the right composition. It is very important that the goats are fed with fresh grass with high nutritional value during the period when their needs are the highest.

Nutrient requirements of dairy goats are determined by the functions that must be fulfilled in the physiology of the animals. This varies according to the reproductive cycles of animals (Şengonca, 1989).

In the period when the needs of the goats are low, it is sufficient to feed them with roughage with low nutritional value. Concentrate feeds can be used as a supplement, that is, as a supplement, depending on the quality and amount of roughage. In addition, it is necessary to close the

gap between the needs of the animals in their special periods and the energy level provided by the roughage and to eliminate the nutrient deficiency in the roughage. Goats should be provided with adequate nutrients during the prenatal one month period, throughout the lactation, and for one month before and after breeding. The energy values of some feedstuffs are as follows (Table 1).

Table 1. Energy values of some feedstuffs (Kaymakçı, 1986).

Feed ingredient	Metabolized energy values per kg dry matter
Barley	13.0
Corn	13.5
Soybean meal	12.3
Dry weed	7.5-10.0
Green silage	9-11.5

In cases where roughage is insufficient, it would be more positive to give these feeds to mature goats that will make better use of these feeds compared to young kids. The best remedy for young kids is their early weaning and feeding or fattening with concentrate feed containing grain feed supplemented with protein source (Şengonca, 1989).

SELECTION OF MILKING SYSTEMS IN DAIRY GOAT BREEDING

Luteotropic hormone (LTH) secreted from the pituitary gland starts the lactation period by affecting the mammary glands as a result of the disappearance of estrogenic hormones together with the placenta that

prevent milk secretion after parturition. In the first 3-5 days of lactation, colostrum is secreted from the goat. During this period, the colostrum should definitely be sucked into the kids.

One of the most important jobs in dairy goat breeding is milking. The milking time, the method, the number of milking per day, and the milking one are the most important factors affecting the milk yield and the milk quality in dairy goat breeding. One of the most important issues in milking is hygiene. Goats are milked from the side or from the back. It is very important that milking is done in private milking parlors. This should be done especially in order to prevent the smell of barn and manure from permeating the milk (Şengonca, 1989).

Goats are milked in two ways in dairy goat breeding: the hand milking and the machine milking. In countries advanced in dairy farming, the milking has mostly been done by machine. In Türkiye, goats are generally milked by hand. Machine milking is used in a small part of the herds (Kaymakçı, 1986).

BREED SELECTION IN DAIRY GOAT BREEDING

Choosing the right breed is the most important step at the beginning in goat farms for milk production. There are many breeds known as dairy goat breeds in the world. These are Saanen, Toggenburg, Alpine, Appenzell, Grison, Verzasca, Pied German Noble Goat, Malta, Aleppo etc. Dairy goat breeds bred in Türkiye are Saanen and Saanen' crosses, Kilis and Maltız goat breeds.

Choosing the right breed is essential for successful breeding. The following points should be considered when choosing a breed:

- Determination of the capacity and production level of the enterprise.
- To reveal the possibilities of the pasture, the roughage and the concentrated feed to be used in the feeding of animals.
- Health status and disease should be control. It should be monitored for disease. Because breeds with high milk yield are more susceptible to the diseases and the stress problems. They need more management-feeding and care.
- In selection studies on milk yield, mastitis disease should also be emphasized.

In domestic dairy goats, it is most appropriate to increase milk yield through selection. This is important for the protection of our gene resources.

One of the ways of genetic breeding is crossing method. Instead of bringing a pure culture goat breed from outside to an enterprise, crossbreeding with a local breed can be preferred. Pure culture goat breeds to be imported from abroad are extremely susceptible to local diseases. Thus, there may be animal losses as these imported pure breeds are not immune to certain diseases. The breeder should pay attention to an issue when genetic breeding in goats is carried out by crossbreeding method. Will the goat breeder focus only on milk yield or will breeder does consider milk and meat yield together? If the goat

breeder aims at milk yield, breeder should select the best herd from the domestic goat breeds and cross them with the rams of a high-yielding imported culture breed. The resulting hybrid females form the basis of the breeding population. Hybrid male kids can be fattened and marketed in order to bring profit to the business.

OVERVIEW OF DAIRY GOAT BREEDS AND FARMERS

Families who make their living by breeding sheep and goats have difficulties in choosing the plateaus and winter quarters where they will take their animals, and in providing the necessary conditions for stockbreeding.

Although the number of true dairy goat breeders in Türkiye has decreased, it can be mentioned that there are enterprises that continue their dairy goat breeding activities.

One of the most important problems of the dairy goat breeders in country is undoubtedly related to the fattening of animals. Another problem is the training of breeders about animal feeding and management.

Daily, monthly and lactation milk yield and lactation period are among the important measures that determine milk yield, which is one of the most important incomes of goat breeding. The total amount of milk that is milked or calculated to be milked from the goat during the lactation period consists of the amount of sucked and milked milk. The lactation period starts on the third day of birth and continues until 50 ml of milk is produced in one milking.

Lactation milk yield and lactation period in Maltese goats were determined as 167.1-226.0 kg and 171.8-172.5 days, respectively (Sönmez et al., 1971). It was determined that milk yield and lactation period as the average of seven lactations in Kilis goats were 326.8 kg and 260 days, respectively (Eker et al., 1975). It is seen that the lactation milk yield of Kilis goats is 247.8 kg and the lactation period is 195.6 days under the conditions of the Aegean Region (Sönmez et al., 1970).

The variation among and within the breeds of goats producing milk in Türkiye is large. By taking advantage of this variation, it will be possible to increase the milk yield characteristics of dairy goats to sufficient levels. It is extremely important to consider the business and regional conditions in scientific studies that consider milk yield characteristics in dairy goat populations.

CONCLUSION AND SUGGESTIONS

Goat milk has a special place and importance in community nutrition and health. Goat milk is easier to digest due to its fat and protein properties. The ability of goat's milk to be digested easily is important in the nutrition of infants, as well as in the treatment of ketosis and liver diseases, as well as some digestive diseases (such as peptic ulcer and pyloric stenosis). Goat milk can be used in the feeding of babies who are allergic to cow's milk. On the other hand, when given diluted, goat milk shows a similar structure to breast milk. Goat milk generally contains less microorganisms and pesticides than other milks (Güney and Kaymakçı, 1997).

Domestic dairy breeds constitute the smallest group goat population in Türkiye. Maltese and its crosses have spread in the Aegean coastline and the Marmara Region, and Kilis goats have spread in the Southeastern Anatolia Region. It is emphasized that Maltese and Kilis goats have an important place in Turkish dairy goats and they should be protected (Kaymakçı et al., 2005). Goat milk is not given special importance throughout Türkiye and this food, which is extremely valuable in terms of human health (especially infant health), is not processed systematically within the framework of the understanding of cooperatives. The cheeses produced are locally produced under primitive conditions and evaluated without being reflected on the market. In the country, there are no integrated production enterprises that process goat milk within the framework of the cooperative system.

Unfortunately, sufficient progress has not been made in terms of product evaluation and marketing for export, which is a part of intensive dairy goat farming in Türkiye, and what has been done has remained at a limited level. In countries where goat milk is produced, it is known that goat milk is processed into cheese, ice cream, butter and milk powder and partially used as drinking milk. There are significant differences in the marketing of goat milk on the basis of countries and regions. In most of the countries that practice modern dairy goat milk, goat milk is generally evaluated by means of cheese making in terms of technology, and important contributions are made to the national economy with the export of these products. These countries are France, Norway, Italy, Greece and Switzerland. The most important factor revealing the economic value of goat milk is that cheeses made from

goat's milk can be sold at prices up to 3 times higher than those made from cow's milk when dry matter is taken into account in these countries (Güney and Darcan, 2001).

To give some suggestions to the companies producing goat milk;

- A solution should be found for the marketing of milk and dairy products from goats.
- Ways of making the production and marketing of goat milk in a more organized way with cooperatives or various livestock organizations should be sought by the breeders.
- Rather than direct marketing of their own products, especially to small family businesses, more economical production will be achieved with the merger of the businesses and perhaps the market problem will be overcome more easily.

Within the framework of the protection of local gene resources, which are thought to be important for our country; It is important to provide breeder organizations in terms of both raising the living standards of the people of the region and raising the awareness of the breeders. Finally, opportunities to benefit from goat milk should be increased and goat milk should be used more economically and marketing should be done in a way that would contribute to the family economy.

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CHAPTER 14

NOMADIC AND HIGHLAND SMALL RUMINANT ACTIVITIES IN EASTERN ANATOLIA

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INTRODUCTION

Animal husbandry activities in agriculture have been an important economically important place for a long time. Among animal husbandry activities, sheep and goat breeding is of particular importance for the Eastern Anatolia Region. Sheep and goat breeding systems in Turkey vary according to various factors. Among these factors; There are factors such as the natural and socio-economic conditions of the regions, the availability of feed resources, their connection with plant production and the consumption habits of the population. The main breeding systems in the country are stockbreeding, transhumance, and nomadic livestock systems. In general, with the warming of the weather, it was desired to give information about the life cultures and livestock activities of the nomadic tribes coming from the south to the east (Aygün, 2017).

The main theme of this study is to reveal information about livestock activities, which are the main source of income for tribes of different ethnic origins. One of the most important issues to be considered for sustainable small cattle breeding in the region is undoubtedly the nomadic life culture in which the tribes present this culture and breeding system. Some researchers have emphasized that the culture of the communities consists of some narrow-scoped cultures and the national culture consists of many local, regional or subcultural backgrounds. To identify this culture known as nomadic living culture is necessary for sustainable nomadic life (Aygün, 2019). In addition, solving the

problems of nomadic and semi-nomadic families is vitally important to sustain stockbreeding of sheep.

In this review, nomadic culture and the sheep husbandry of its integral part in the Eastern Anatolia Region were discussed. The results indicated that solving the problems of nomadic and semi-nomadic families is very important to sustain stockbreeding of sheep and goats, and to benefit breeders economically.

SMALL RUMINANT HUSBANDRY IN EASTERN ANATOLIA

Eastern Anatolia Region has a different character from other regions in terms of climatic conditions. During the winter months, when severe storms settle in this region, extreme cold occurs. However, even at short intervals during the winter period, warm air masses coming from the Black Sea may occupy the plateau area. At this time, as the plateaus warm up, it is possible for them to receive winter precipitation. Despite all this, snow cover can remain on the ground for months in Eastern Anatolia. Under these conditions, the winter period becomes a dead period for Eastern Anatolia. Due to the strong continentality in Eastern Anatolia, it is almost a sudden transition from winter to summer. As the cold air wave from Siberia begins to lose its effect, spring precipitation begins then the snow melts and the air heats up fast (Tunçdilek, 1978).

As in the whole world, small ruminant husbandry has a special place and importance in livestock breeding. Sheep breeding is one of the most important livestock activities in Türkiye, especially in the Eastern and Southeastern Anatolia Regions. The cultural, social and economic structure, climate and topographic characteristics of the region played

a role in the importance of sheep breeding. According to the researches carried out in the region, mostly pasture-based livestock and accordingly sheep breeding dominate (Aygün, 2021).

It can be said that sheep breeding in the form of herd rather than the logic of management at the enterprise level has an important effect on the spread of highland and nomadic sheep breeding with the effect of structural differences. This situation is more evident in the Eastern and Southeastern Anatolia Regions. In this sense, since sheep breeding is mostly done by nomadic families or tribes, it is important to compile information about this group and to determine the general characteristics of nomadic families.

TRIBES AND NOMADIC LIFE

Livestock activities, which have always had an important place in agriculture in terms of economy, have been characterized by the prominence of different practices in a way that has adapted to the regional differences of our country. At the beginning of these changes are the breeding systems called settled (sedentary) and nomadic (nomadic) livestock. The climate and vegetation that Türkiye is under the influence of geographically topographic features have directly affected the continuation of animal husbandry activities in the form of nomadic sheep and goats in some regions.

Nomadic sheep-breeding tribes, "without being tied to a fixed residence and land, engaged in agricultural activities only with sheep and goats, migrated from the plateaus to the steppes, from the steppes to the plateaus according to the season and vegetation in order to find better

pastures for their animals, and always lived in tents, to a more or less closed economy. It can be defined as a traditional group with a low level of literacy and culture, who always prefer to be connected to a chief, who are tied to each other by ties such as blood kinship and sense of unity (Beşikçi, 1992).

The majority of the communities that maintain nomadic and semi-nomadic sheep breeding type are traditional communities represented by a tribal order based on more than one family or wider kinship base in this land. In these tribes, nomadic or semi-nomadic sheep breeding is a common economic activity. Nomadic sheep and goat husbandry carried out with traditional production in these communities is not only a type of economy but also a social and traditional institution with a set of stereotyped processes clustered around it.

There are many nomadic tribes moving in various regions of Eastern Anatolia. These nomadic tribes have social organization, value systems, etc. They are different from the Yoruks in the Aegean region and the Turkmens wandering in the Toros Mountains due to these factors (Sezgin, 2006).

It is also possible to talk about nomadism when nomads start to live in fixed residences near cultivated fields during a certain period of the year, mostly in winter, and spend their other times in the plateaus and tents with migration. In some of the eastern provinces, there are also families that have adopted the semi-nomadic lifestyle, which has started to settle down by breaking away from the nomads in the region, which is described as semi-nomadic.

MIGRANT SHEEP HUSBANDRY IN THE EASTERN ANATOLIA REGION

Nomadic small ruminant breeding is an agricultural activity that makes the best use of rural areas and is one of the ways to add these values to the economy as a plus, and is always of great importance.

Nomadic small ruminant breeding, which is defined as a profitable livestock business in the livestock sector, continues its existence today despite all the negative conditions it is in. This definitely shows us the fact that nomadic sheep farming will not end in the future. When we can associate this traditionally dominant institution with modern animal husbandry, the efficiency we mentioned will increase its superiority. However, while doing this, it will be necessary to take into account the tendencies, practices, attitudes and behaviors, knowledge and skills of the nomadic communities in this regard, and the points where the traditional and the modern conflict or converge. (Kutlu, 1987).

Figure 1. A flock of sheep-goat on the highland road (Photographer, Turgut Aygün).

In a study done in this region, Sevinç (1972) said that nomadic sheep and goat farming is the most productive animal husbandry business that provides the highest output against the lowest input in Türkiye, and that it will maintain its productivity superiority if it turns into a scientific and modern animal management in the highlands of Austria and Switzerland.

Contrary to sedentary animal husbandry, nomadic sheep and goats are described as periodically taking their herds to pastures that are away from the main settlement in certain seasons, but which are used for a certain part of the year (Sözer, 1972). Nomadic sheep and goat farming, which varies more or less according to the characteristics of the region, is an important type of animal husbandry in our country (Kutlu, 1987). Nomads make about 60% of the sheep breeding in Eastern and Southeastern Anatolia (Sevinç, 1981). Although sheep and goat farming are carried out in the form of village breeding in Eastern Anatolia today, livestock activities carried out by nomadic tribes should not be underestimated. Although the average number of sheep and goats owned by the families living in the village is 20, this number is around 160 in the tribes (Beşikçi, 1992).

There are plateaus in most of the dormitories where high mountain ranges are located, and there are nomads of different qualities who constantly benefit from these plateaus. Large plateaus where nomads are concentrated are in Eastern and Southeastern Anatolia. The dominance of animal production in these parts of our country is due to the existence of high plateaus that contain plant flora of superior value.

Figure 2. A flock of sheep-goat and shepherd on the highland (Photographer, Turgut Aygün).

Nomadic families migrate from the regions they live in, from cities such as Batman, Mardin, Diyarbakır and Siirt, to the northern and eastern provinces with the warmer weather, to continue their sheep breeding activities in the highlands of these provinces for 5-6 months. These provinces include Ağrı, Bitlis, Erzurum, Hakkari, Muş and Van (Aygün and Demir, 2014). In this context, it is necessary to solve the current problems of the nomadic sheep-goat breeders in terms of the continuation of small ruminant breeding in the eastern provinces and the economic benefit to be provided to the Region.

Figure 3. A flock of sheep-goat and shepherd on the highland (Photographer, Turgut Aygün).

OVERVIEW OF GENERAL PROBLEMS OF MIGRATIONS

Families who make their living by breeding sheep and goats have difficulties in choosing the plateaus and winter quarters where they will take their animals, and in providing the necessary conditions for stockbreeding. There has been a decrease in the population of the provinces with high springs, especially due to the terror that has started in the last 15-20 years; people living in rural areas had to leave the area. However, as a result of the decrease in terrorist activities with the latest developments in Türkiye, the pastures and highlands in the Eastern provinces will gain great importance for the tribes engaged in nomadic sheep and goats and they will find the opportunity to benefit again.

Although the number of true nomadic groups in Türkiye has decreased and this lifestyle has gradually disappeared, it can be mentioned that there are semi-nomadic and transhumance groups that continue their nomadic sheep and goat breeding activities. It is always possible to come across examples of these types in all of the geographical regions extending from the west to the east of Türkiye. Highland and winter quarters are among the movement areas of nomadic animal husbandry, which is mostly done in the Eastern and Southeastern Anatolia regions.

Nomadic sheep and goat movements are not under control and movement areas are not organized. In this case, in a region such as the Van Lake basin and Southeastern Anatolia, which is geographically very rough, the road condition is not good, and therefore not equipped with good tools and equipment, nomadic movements significantly affect the security of the region (Beşikçi, 1992). The inability of the nomadic sheep and goat husbandry families to take preventive and remedial measures for animal health in a timely manner reduces the productivity of the animals more than expected (Sevinç, 1972). In some cases, people become quite stressed. When this stress is too severe, homeostatic processes come under abnormal pressure and behavior becomes disordered and pathological effects can occur.

Figure 4. Preparation for milking on the highland (Photographer, Turgut Aygün).

One of the most important problems of the nomads in the region is undoubtedly related to the education of our children, especially our girls, whose importance is emphasized on every platform for the future of the country. Children, who contribute to the livelihood of their families by staying in tents on the plateau, take part in fulfilling the necessities of life in all conditions of nomadic life. They can always start their education life one step behind. On the other hand, in this way of life, girls do not even have such a chance.

CONCLUSION

It is now understood by the state that the nomads, who have been neglected in many ways for years, are people who produce a significant amount of animal husbandry for the country's livestock. It is seen that

socio-economic problems occur in big cities with the migration of the population in rural areas to big cities in Türkiye. The necessary socio-economic programs should be applied to these people. Various measures need to be taken to accommodate the population in rural areas where they are located and to stop the economic deterioration. Otherwise, both agricultural areas in rural areas will disappear and the problems in big cities will deepen.

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Publishing House

ISBN: 978-625-6404-47-2