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RESEARCH ON THE IMPACT OF FEED TECHNOLOGIES ON THE WELFARE AND PRODUCTIVE PERFORMANCES OBTAINED IN ORGANIC FARMING OF SHEEP AND GOATS

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Abstract

The growth rate and productive performance of animals depends on various factors among which the feeding system is one of the most important factors. The nutritional needs of animals on organic farms can be covered through three sources: grazing, food produced within the own holding and the purchase of additional feed. The purpose of the work is to follow the effect of sheep and goat feeding technologies through the installation according to the requirements of ecological agriculture of cultivated pastures, which can be used both for animal grazing and for obtaining fodder, either dry or fermented. A maximum production of fodder obtained in one's own holding must be one of the main objectives of the breeder, so the selected crops must be determined according to the real needs of the holding. To achieve these goals, farmers who practice organic farming rely on recognized agricultural practices, such as maintaining the welfare and health of the animal herd through free-range systems and modern knowledge, such as monitoring nutrient levels to track the optimal growth of animals at different stages of development.

***Key words**: leguminous fodder, milk production, organic farms, pasture, sheep and goats, welfare.*

INTRODUCTION

Organic animal production as an integral part of organic agriculture, the purpose of which is to create and maintain independent relationships between soil-plants, plants-animals and animals-soil, with the ultimate goal of creating a sustainable agro-ecological system that it is based on natural resources and the integrated functionality of this system, maintaining a harmonious relationship between plant and animal production. The organic breeding system is based on the use of pastures, taking into account the natural grazing behavior of animals. Grazing-based animal husbandry improves the productivity and sustainability of pastures. This livestock raising is done by considering the type of vegetation in the region, soil structure, climate, geography, prevailing winds, altitudes, direction, animal species and breeds, water resources and animal welfare (Arsoy, 2017). A livestock rearing system to be sustainable must be technically possible, ecologically acceptable and economically viable (Hessle et al., 2017).
There is a growing interest in sustainable forms of organic livestock production systems that will ensure a balanced relationship between environmental, socio-cultural and economic factors. For the development of ecological agriculture, a strong harmonization of rules and legislation at international and national level is necessary. Harmonization of rules and development of technical assistance at the farm level can contribute to the sustainable growth of organic agriculture by applying new technologies to improve sustainability in organic small ruminant production systems, especially in terms of disease prevention and feeding management (Nardone et al., 2004).
Organic farming is based on combinations of general prevention methods (risk control and identification), multifunctional pasture management, non-chemical treatments (homeopathic herbal preparations) and new animal husbandry

technology approaches (i.e. biological control and bioactive feed) (Ronchi & Nardone, 2003a). According to available data, animals raised in ecological systems are concentrated in Europe and North America: 70% of cattle, 80% of sheep and 77% of pigs exist in Europe. The most important European countries producing sheep and goats in an ecological system are Italy, Great Britain, Germany, France and Greece. It is expected that the number of organic animals will continue to grow in the future. In many European countries, animal products such as milk and eggs already account for 10 to 20% of the total market and continue to grow significantly. However, studies on ecological animals are still scarce and major data gaps exist (FAO, 2014).

The aim of this paper is to provide an integrated analysis of various ecological feeding systems of small dairy ruminants on the chemical composition and quality characteristics of the milk produced (fatty acid profile, protein, antioxidants, vitamins). Since milk from sheep and goats is mostly used for cheese production, and its yield depends on the composition of the milk, the main objectives of sheep and goat farmers are to improve the quality of milk by increasing the percentage of milk solids and stabilizing the milk in fat and protein through adequate nutrition.

In order to increase consumer confidence in organic dairy products, it was intended to identify nutritional alternatives based on the use of vegetable raw materials with a rich protein content of high biological value, food sources that can be an effective alternative to improve the quality of milk regarding the content of nutrients, of particular importance being essential omega-3 fatty acids, vitamins (vitamins E and A), as well as various antioxidants.

MATERIALS AND METHODS

In order to write this paper, a detailed study of various published works was carried out with topics on the effects of feeding technologies on the welfare and productive performance, the quantity and quality of milk produced by sheep and goats raised in an ecological system.

Scientific articles and papers were selected from Science Direct, PubMed, Google Scholar, Web of Science databases using multiple search keywords related to organic sheep and goat farming. Eligible articles were selected on the effects of organic feeding systems on the quantity and quality of milk produced in organic sheep and goat farms, on animal welfare and health. The selected articles were analyzed for their eligibility and to extract the data necessary for the creation of this paper.

RESULTS AND DISCUSSIONS

The growth rate and productive performance of animals depends on various factors, among which the feeding system is one of the most important factors. The nutritional needs of animals on organic farms can be met through three sources: grazing, feed produced within the own holding and the purchase of additional feed. The higher the percentage of feed produced within own holdings, the lower the dependency on purchasing feed and the better the growing conditions within the holding.

Livestock grazing – important food source in the ecological growth of small ruminants

To increase the sustainability of small ruminant organic farming systems, the pasture-based mode of production is proposed, with particular emphasis on the organization of a farm forage system to meet the nutritional requirements of animals (Ronchi & Nardone, 2003b).

Due to the climatic, geological and topographical variability in some areas where it is not possible to graze on natural pastures, pastures cultivated with annual leguminous fodder can be organized (Figure 1).

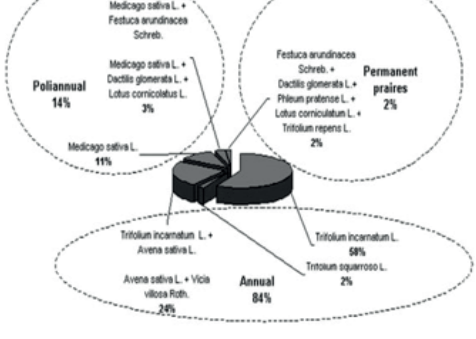

Figure 1. Forage sources for dairy sheep farming (Ronchi & Nardone, 2003a)

The choice of appropriate forage plant species, grown ecologically on technical pastures, is one of the main strategies to meet the nutritional requirements of animals through low-cost sources of energy and nutrients. Knowing the quality of the fodder obtained on the meadows is an essential condition, both for ensuring a rational feeding of the animals, and for the choice and promotion of those crop technologies, which allow satisfying the nutritional requirements in order to achieve the highest possible animal production (Amiri et al., 2012).

One of the basic objectives in planning and using pastures to achieve the productive performance of animals is to determine the nutritional needs of animals in terms of energy, protein, minerals and vitamins. This is possible only when the quality of the fodder plants on the pastures is known in terms of chemical composition. Therefore, knowledge of the quality of the forage grown should be considered for the proper use of pastures. Determining the nutritional value of forages is important in animal nutrition because the actual production of animals is related to the amount of nutrients in the forage (Schut et al., 2010). Total digestible nutrient (TDN), crude protein α (CP) and metabolizable energy (ME) are often used as indicators of forage quality.

For this purpose, the use of optimal forage composition using different plant species has been proposed, such as mixtures of orchard grass and forage legumes, combinations of grass and clover or grass and lucerne (Puckridge & French, 1983). Studies have shown that legumes have a higher nutritional value than grass species, so mixtures with higher amounts of forage legumes can improve forage quality (Tsiplakou et al., 2013).

Changes in milk fat content and its fatty acid profile using growth and nutrition strategies to increase the biosynthesis of conjugated linoleic acid (CLA) have been and continue to be important goals of the dairy industry. Similar to other grazing systems, livestock production on pastures is based not only on the quantity, but also on the quality of the forage. A negative energy balance due to undernutrition mainly in grazing causes decreased milk yield and protein content, but increased milk fat. One of the most important ways to improve the milk of small ruminants with beneficial fatty acids is to increase the supply of ω-3 polyunsaturated fatty acids in the animal diet.It was found that the milk produced by sheep and goats raised with grazing feeding systems is enriched in substances of natural origin such as phenolic compounds, fat-soluble vitamins, bioactive lipid components, unsaturated fatty acids compared to the milk of those fed with concentrated feed (Zervas & Tsiplakou, 2011).

The variability of protein and energy intake from pastures during the summer season is a primary factor that can influence milk production and composition of milk produced by ruminants, as there can be seasonal nutritional fluctuations in nutrient quantity and quality, either due to grazing excessively, either due to the natural degradation of the meadows. Studies on grazing feeding systems of dairy cows on organic farms have evaluated the effects of changing the crude protein (CP) content of food supplements provided in the summer grazing season as a useful mechanism for maintaining milk production and the composition of the milk produced. of these (Ayers et al., 2022).

Various studies have highlighted the major role of grazing management practices in improving certain nutritional, technological and sensory characteristics of livestock products. It was found that the pasture feeding system with fresh grass compared to the on-farm feeding system with silage and concentrate fodder resulted in obtaining dairy products and meat products with specific traits (Cabiddu et al., 2022). Animal products obtained being rich in carotenoids, vitamins A and E (Nozière et al., 2006a; Prache et al., 2020), volatile organic compounds (VOCs) and fatty acids (FA) favorable for human consumption, for example acids monounsaturated fats (MUFA), polyunsaturated fatty acids (PUFA) and n-3FA (Cabiddu et al., 2019; Coppa et al., 2019) with specific sensory characteristics, preferred by consumers (Martin et al., 2005). Animal diet containing green forage mixtures increased the content of all carotenoids in milk and meat compared to the silage diet (Table 1). This may be because carotenoids in grasses are photodegraded during forage harvesting and drying (Nozière et al., 2006b).

Table 1. Effect of feeding fresh herbage instead of conserved forage and/or concentrates on the carotenoids, fat-soluble vitamins, and terpene content, colour and pH of different animal products (Cabiddu et al., 2022)

Item	Product	Animal species	n[1]	Fresh Herbage group	Conserved Forages group	SEM[2]	Significance [3]
Carotenoids and vitamins (mg/kg fat)							
α-Tocopherol	Dairy	Cattle	20	23.39	17.95	1.458	**
		Goat	3	37.20	6.37	0.306	***
	Meat	Sheep	3	5.88	3.39	0.155	**
Retinol	Dairy	Cattle	7	6.88	5.91	0.977	ns
		Goat	3	9.17	7.20	0.503	*
β-Carotene	Dairy	Cattle	18	6.20	4.40	0.579	**
Lutein	Dairy	Cattle	8	0.67	0.41	0.101	*
Zeaxanthin	Dairy	Cattle	7	0.10	0.07	0.023	†
Terpenes tot (In arbitrary area unit)	Dairy	Cattle	3	12.48	11.32	2.419	ns
		Sheep	5	18.84	17.88	0.289	*
Monoterpenes tot (In arbitrary area unit)	Dairy	Cattle	3	11.22	10.34	2.937	†
		Sheep	5	17.99	16.36	0.33	**
Sesquiterpenes tot (In arbitrary area unit)	Dairy	Cattle	3	11.73	9.67	1.820	ns
		Sheep	5	18.85	10.38	5.170	ns

[1]n - number od date; [2]SEM - standard error of the mean; AUU - arbitrary area units; [3]*** - p<0.001; **- p<0.01; * - p<0.05; ns - not significant, p>0.05.

Use of forage silage in organic farming of small ruminants

Another alternative method of feeding small ruminants, as a potential solution during the rainy and cool season when grazing is not possible, is the introduction of easily fermentable forages into the diet of animals to promote the progressive use of cultivated protein forages. Promoting this form of nutrition improves rumen fermentation, increases dry matter intake, growth rate and milk production (Supapong & Cherdthong, 2023).

The introduction of silage in the animal ration can improve the digestion of nutrients, it can allow exercising as much control as possible over the ratio of concentration of fermented feed, at the same time it is possible to control the amount of nutrients consumed by each animal. Forage particle size, moisture content, mixing method and ensiling time are factors that can influence the quality of ensiled forage, especially to avoid increasing the concentration of butyric acid, an undesirable product of clostridial fermentation, so as to avoid various cases of digestive and metabolic disorders.

Ensiling of cultivated forages can be done at various moisture levels (45%, 55%, 65%), requiring a longer period of ensiling, as the amount of cultivated forages subjected to fermentation at farm level is generally high. Various studies have shown that forage ensiling at 45% moisture increased milk production (Meenongyai et al., 2017). However, silage with a moisture content of 60%, but more shredded, improves consumption and nutritional digestibility, leading to an increase in milk fat percentage (Nha & Pattarajinda, 2019). It was also found that feeding with silage protein fodder improves feed consumption, digestibility of dry matter and crude protein increasing milk production (Naadland et al., 2017). Increasing the percentage of clover in grass silage increased dry matter intake and through following milk production (Bertilsson & Murphy, 2003).

Consumption of both red and white clover silages produced higher levels of polyunsaturated fatty acids (FA) in the milk of dairy cows, particularly alpha-linolenic acid, than grass silage consumption (Steinshamn & Thuen, 2008).

Although the total digestibility of legume and maize silages is often lower than that of grass silages, the milk yields obtained are usually higher. Another benefit of feeding legume silage is the reduction of milk fat concentration and the increase of polyunsaturated fatty acid levels. The high protein content and high degradability of most legume silages are associated with a low efficiency of conversion of dietary nitrogen into nitrogen milk, with a concomitant increase in urinary nitrogen. However, when the mixture with legume silages includes maize silages, the reduction in urinary nitrogen is significant without a loss in production potential (Dewhurst, 2013).

The level of nutrition is a main factor affecting milk production and the composition of the milk produced, especially the levels of fat and protein (Francois & Caja, 2004), parameters that greatly influence the yield of cheese production. The use of ensiled cultivated fodder in animal feed, especially in the rainy months when grazing is not possible, led to a significant increase in the percentage of milk fat and protein compared to feeding through a grazing system with cultivated plants (Atti et al., 2010).

The use of leguminous forage plants in the feeding of small ruminants in organic farms

Incorporating legumes into agricultural systems provides many beneficial effects and has an important role in the management and sustainability of ecological small ruminant farming systems (Howieson et al., 2000) (Table 2). The most important benefits being the provision of nutritious animal feed rich in protein, the supply of N, the most important nutrient, after carbon and water, for plant growth (Vance, 1997), crop productivity, (Peoples et al., 1995) and not lastly in the control of diseases and pests of cereal crops.

Table 2. Importance of legumes into small ruminants organic farming system (adapted from Howieson et al., 2000)

	Specific legume value[a]		
	Pasture	Grain	Legumes
N_2 fixation	***		**
Increased soil fertility and stability	***	*	
Capacity for nutrient recycling	*		**
Control of weed species	**		**
Break disease and pest life cycles	**		***
High protein animal feed	***		***
Cash crop	*		***
Biodiversity and landscape quality	***	*	
Operational flexibility	**		***

[a] Increasing,*, **, *** applicable value.

In order to improve the productive parameters and reduce the production costs in the ecological breeding of sheep and goats, a sustainable solution is to replace feed rich in imported proteins (soy and its derivatives) with alternative protein feeds obtained by the local cultivation of cereal legumes (lupin, lentils, chickpeas, peas, beans, soybeans, beans) and various varieties of herbaceous legumes (alfalfa and clover), as main components of cultivated meadows or as fodder after cutting (Bay-Larsen et al., 2018). The importance of legumes for grains lies, first of all, in the high protein content of the seeds, giving them a high nutritional value to meet the high requirements of plant proteins in animal husbandry. The protein content of leguminous grain is 2-4 times higher than that of cereals, and in some species (soy, lupine), the protein exceeds carbohydrates. The ratio between crude protein and non-protein components is: soy and lupine of 1/1.7; peas 1/2.8; beans 1/2.4 etc. So, leguminous grains represent fodder concentrated in protein. It is also worth noting the high protein value of the grains, equivalent in some species to proteins of animal origin, containing essential amino acids.

Cereal legumes, as alternative protein sources, such as lupine (*Lupinus albus*), peas (*Pisum sativum*), beans (*Vicia faba*), vetiver (*Vicia sativa*) are forages with high nutritional value that could be used as alternative sources to replace soybean meal or soybeans in the diet of dairy sheep without effects on nutrient digestibility (Zagorakis et al., 2018), without compromising productivity, providing a high energy and protein intake to meet maintenance and milk production requirements (Vouraki et al., 2023a) (Table 3).

Table 3. Chemical composition of the four studied legumes (Vouraki et al., 2023b)

Parameter	Lupin	Pea	Vetch	Faba Bean
DM [1] (g/kg)	920	900	900	900
Starch (g/kg DM)	-	410	379	428
Crude Fat (g/kg DM)	87	15	10	11
Crude Fiber (g/kg DM)	128	93	43	64
Crude Ash (g/kg DM)	35	41	36	36
Crude Protein (g/kg DM)	392	271	315	276
UFL [2] (/kg DM)	1.31	1.16	1.19	1.19
PDIN [3] (g/kg DM)	250	173	203	173
PDIE [4] (g/kg DM)	136	108	122	99
NDF [5] (g/kg DM)	199.90	149.35	149.84	140.74
ADF [6] (g/kg DM)	133.46	75.97	60.93	97.52
ADL [7] (g/kg DM)	6.18	5.57	5.06	2.45
Parameter	**Lupin**	**Pea**	**Vetch**	**Faba Bean**
TP [1] (g GAE [5] /kg)	3.77	4.33	3.81	5.21
TN [2] (g GAE [5] /kg)	2.98	2.84	2.91	3.28

[1] DM = dry matter; [2] UFL = units for lactation (net energy for lactation (kcal/kg)/1760) [37]; [3] PDIN = true protein digested in the small intestine when fermentable N is limiting [37]; [4] PDIE = true protein digested in the small intestine when fermentable energy is limiting [37]; [5] NDF = neutral detergent fiber; [6] ADF = acid detergent fiber; [7] ADL = acid detergent lignin.

The digestibility of protein found in leguminous grains is notably high, estimated at around 90%. Unlike certain animal proteins, it doesn't lead to the formation of uric acid, whose buildup in the body can pose health risks.

The enhanced digestibility of forage legume species in contrast to grass species can be ascribed to the configuration and composition of their leaves (Pontes et al., 2007). Legumes offer superior forage quality compared to grasses due to their lower fiber content, promoting increased consumption over herbs. Thus, one of the notable advantages of grazing animals on pasture is the ability to enhance forage quality and fulfill the daily protein needs of grazing animals by incorporating combinations of legume and grass species (Amiri et al., 2012).

The use of natural extracts in the ecological breeding of small ruminants

With the ban on the use of antibiotics as growth factors, there has been a need to find ways to meet consumer demand for safe food and to protect public health, but also to ensure farmers' incomes and animal yields (Iwu et al., 2020). Improvements in the management of animal production facilities are considered necessary to reduce stress on animals and to minimize their contamination with micro-organisms.

Compliance with animal welfare rules could partially replace the absence of antibiotics in animal feed. These improvements should be accompanied by changes in the feeding strategy of productive animals to neutralize possible negative effects on production, due to not covering the nutritional needs of animals (Lu, 2011). However, we should look for natural growth substances as an alternative to antibiotics. Examples of such substances are essential oils or extracts of aromatic/medicinal plants (PAM), dry feed of PAM added to feed, enzymes, probiotics, prebiotics and organic acids or acidifiers and their salts. Although most of these substances have already been used in combination with antibiotics to improve animal performance, their effectiveness now needs to be investigated when they are the only growth factor added to animal feed.

Ecological animal feeding systems are based on the use of feed free of drugs and chemicals, so it becomes absolutely necessary to investigate the use of natural substances, such as essential oils or plant extracts, which have antioxidant, antibacterial and antifungal properties, thanks to a variety large amount of phenolic substances contained in them (Jin et al., 2023).

The impact of various rearing technologies on the welfare and health of organically raised sheep and goats

Perhaps the most important for organic farms is the relationship between the health and vitality of an animal on the one hand and the conditions in which that animal is raised on the other. Many researchers and observers have shown that a large part of the contemporary diseases and syndromes are related to the maintenance and feeding conditions or to the breeding methods that have been adopted to increase production and economic efficiency. Thus, new problems have arisen that require new solutions from nutritionists and animal husbandry specialists.

Given their renowned hardiness, sheep and goats' capacity to withstand challenging environmental conditions and suboptimal management practices directly influences both their welfare and productivity. Extreme climatic conditions and seasonal fluctuations in the quantity and quality of pastures can be important causes of reduced welfare status in extensive production systems, which can affect the efficiency of grazing livestock production and dramatically affect the welfare and health status of sheep and goats. Animals reared on pasture can encounter a number of compromises in terms of their well-being, but mainly those related to nutritional stress, inadequate water supply, extreme climatic conditions, parasitic diseases.

In extensive production systems, animals roam freely in habitats conducive to fulfilling their physiological and behavioral needs. Nonetheless, grazing practices can sometimes compromise animal welfare, mainly due to fluctuations in pasture quantity and quality throughout seasons, leading to temporary nutritional stress. Notably, if this nutritional stress coincides with the mating season, it may diminish the fertility of sheep and goats (Rassu et al., 2004).

Thus, animals raised on pasture during the summer, when grass availability and palatability are diminished, may encounter a nutritional imbalance during this period. This, coupled with alterations in rumen fermentation and protein synthesis, can jeopardize their well-being and adversely impact milk fat and protein content. Grazing sheep and goats on low-quality pastures with overly fibrous vegetation, adverse weather conditions, and restricted grass intake time can lead to decreased milk production. Short-term dietary restrictions notably reduce milk yield and elevate milk fat content, consequently affecting the milk's fatty acid composition due to body fat mobilization (Pulina et al., 2012). Ewes experiencing undernourishment exhibited elevated somatic cell counts (SCC) in their milk, signaling metabolic stress in both the animal and its mammary gland. Research on non-lactating, non-pregnant ewes revealed that shifting their diet from extremely high to very low nutritional levels, and vice versa, emphasized the importance of avoiding both food restriction and overnutrition. Doing so is crucial to prevent metabolic disruptions and minimize the expenses associated with excessive fattening and maintaining surplus body weight (Caldeira et al., 2007).

An inadequate supply of water during grazing can cause stress in sheep and goats, a reduction in feed consumption, respiratory rate, a decrease in blood sugar, an increase in urea in blood and milk (Hamadeh et al., 2006). Stress can cause an alteration of the metabolic profile and often a reduction in weight.

Sheep and goats are renowned for their resilience in harsh climates. In sheep, the usual decrease in milk production during late lactation in summer often conceals or partly offsets the adverse effects of high temperatures on their well-being, milk yield, and immune function, along with notable mineral imbalances, particularly magnesium, potassium, calcium, and phosphorus. Exposure of dairy ewes to average daily temperatures of 35°C, even briefly, or prolonged exposure to average ambient temperatures of 30°C, has been observed to result in a significant rise in rectal temperature, metabolic changes, and a decline in milk production (Sevi et al., 2001; Sevi et al., 2002). Providing shade during the hottest hours and adjusting grazing schedules to late afternoon can effectively mitigate the effects of high summer temperatures on dairy sheep and goats during grazing.

Preventing and managing endoparasitic diseases are key concerns for maintaining the health and welfare of small ruminants in ecological breeding systems. This involves employing rational grazing strategies, incorporating plant extracts and homeopathic remedies, cultivating specific fodder crops and enhancing pasture species, optimizing diet formulations, breeding animals with resistance to parasites, and implementing biological control methods, such as utilizing natural enemies to combat nematode parasites.

Utilizing natural pastures encourages the proliferation of endoparasites, leading to significant declines in animal weight gain, milk yield, and reproductive functions. Sheep afflicted by parasites exhibit diminished grazing durations, reduced activity levels, and consume less grass compared to their uninfected counterparts (Gordon et al., 2000). Early stages of endoparasitic infections manifest in behavioral disruptions among sheep and goats, characterized by restlessness and altered resting behavior. As the infestation advances, affected sheep become progressively agitated due to allergen presence.

Grazing management strategies to combat helminth infections encompass several approaches: preventive measures involve introducing uninfected animals to parasite-free grazing zones, evasive tactics entail introducing already infected animals to vermin-free areas, and finally, alternative grazing methods involving a mix of small ruminants and cattle can also be employed.

Nutrition can influence the host's response to parasitism and its capacity to mitigate and potentially overcome parasitic challenges in three key ways. Firstly, it can enhance the host's resilience, bolstering its ability to withstand the negative impacts of parasitic infections. Secondly, nutrition can bolster the host's resistance, aiding in the control and eventual suppression of parasitic infestations by impeding parasite establishment, growth rate, fecundity, and persistence within the host population. Lastly, nutrition can exert a direct influence on the parasite population itself through various mechanisms, including the ingestion of anti-parasitic compounds, manipulation of grassland management practices, and dietary interventions such as protein supplementation or the inclusion of tanniferous plants in grazing regimes, offering sustainable alternatives for parasite control (Coop & Kyriazakis, 2001). Long-term immune response and resistance to endoparasites can result after feeding sheep a supplemental protein ration prior to grazing, increasing weight ratio and productive parameters, and having a lower number of nematode eggs in faeces when subsequently grazed on infected pastures. Grazing of herbaceous legumes containing ~10% dry matter tannins has been shown to have beneficial consequences on herbivores exposed to either natural or artificial nematode infections.

The inherent anti-parasitic, anti-fungal, and anti-bacterial attributes found in natural plant secondary compounds not only directly combat pathogens by disrupting their cellular functions and metabolic processes but also offer herbivores indirect health benefits. These compounds possess probiotic and immunomodulatory properties, which can fortify the herbivores' immune systems and promote beneficial gut bacteria. This dual action not only aids in disease prevention but also reduces the necessity for treatment after infection occurs (Provenza & Villalba, 2010).

A promising approach in animal husbandry, particularly for grazing animals, involves incorporating blends of diverse plants with bioactive properties. This integration aims to enhance animal health while maintaining optimal levels of production and welfare. By utilizing selected bioactive feeds, we can positively impact the management of parasitic diseases while also enhancing the quality and flavor of animal products (Ronchi & Nardone, 2003b).

Creating preventive strategies aimed at bolstering animals' resistance to diseases represents a more cost-effective, environmentally sustainable, and socially impactful long-term healthcare approach compared to treating diseases reactively.

CONCLUSIONS

Studying the impact of different feeding technologies on the nutritional quality of forages can help ensure that organic sheep and goats receive balanced diets that meet their nutritional requirements for growth, reproduction and overall health. Evaluating the efficiency of alternative feed use through various feed technologies can help optimize feed conversion ratios and reduce wastage, ultimately improving the economic viability of organic sheep and goat farming.

Monitoring the impact of feed technologies on productive parameters such as growth rates, milk production, wool quality and reproductive efficiency can provide insights into optimizing the productivity of organic sheep and goats while maintaining high welfare standards.

Investigating how feed technologies affect animal welfare parameters such as behavior, stress levels and general health can ensure that organic farming practices align with principles of animal welfare and ethical treatment.

Evaluating the economic consequences of adopting different feed technologies, including their costs and benefits, can help organic farmers make important decisions to maximize profitability while meeting organic standards. By conducting research in these areas, organic farmers, researchers and policy makers can work together to develop evidence-based strategies for improving the welfare and productive performance of sheep and goats in organic farming systems. This interdisciplinary approach is crucial to promoting the sustainability, resilience and success of organic livestock production.

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