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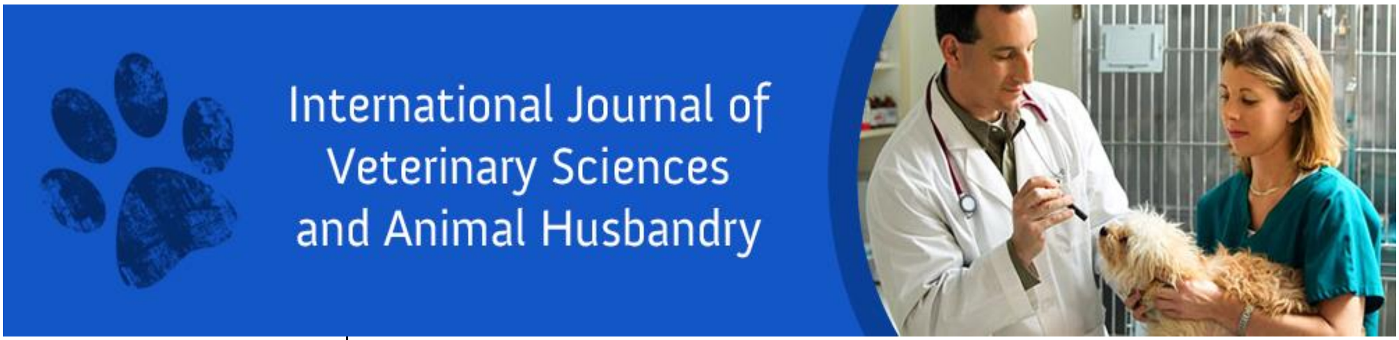

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Impact of different feeding strategies on welfare, milk yield and productive performance in Egyptian dairy sheep and goat

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Abstract
The purpose of this study was to see if feed intake, chewing activity, and milk yield in fattening and dairy small ruminants were affected by two types of the feeding system depending on maize silage and rice straw were part of the study design. The supplement's effect on the behavior of small ruminants. Total chewing behavior, sleeping frequency and duration (min), grooming and walking, and production performance were greater ($p<0.01$) in small ruminants fed on maize silage than in rice straw, while on other hand total effective time per minute of chewing behavior, jaw movement and laying frequency higher significantly increased in small ruminant fed on rice straw than fed on maize silage ($p<0.05$, $p<0.01$). Productions characteristics on lambs and kids were significantly higher in kids and lambs from mothers fed on maize silage than mothers fed on rice straw, while age at weaning per day with longer age in kids and lambs fed on rice straw than maize silage. No significant difference in milk yield per kg per day, milk fat, and protein per 100 gm of milk in goat and sheep fed on maize silage and rice straw.

Keywords: Maize, silage, behaviour, performance, milk yield, small ruminants

1. Introduction
Small ruminant farming is an essential aspect of livestock farming all around the world, but especially in developing countries (Ketema, 2007; Thornton *et al*., 2009) [1, 2]. Goats can not only survive in a range of surroundings, but they can also adapt to them. The diet would be more consistent for daily feeding. Because of its good yielding capabilities, relatively high-calorie content, palatability, and ease of incorporation into total mixed rations, corn silage is increasingly frequently employed as a green feed for ruminants (Hafez, 2012) [3]. (Kononoff *et al*., 2003) [4] Domestic animals can benefit from corn silage as a cost-effective source of nutrition. In Egypt, animal production is considerably due to the high cost of feeding throughout the year as there is a kind of completion between humans and livestock for the conventional feedstuffs like corn grains as a main source of energy, therefore it is necessary to look for another source of feed that are inexpensive and available and does not directly required as a component of human diet and can economically considering as a vital ingredient in the rations of farm animals without adverse effects on the animals' performance and rumen microbial fermentation (Qelurem *et al*., 2007) [5]. Animal rations formulations depend on corn grain as a main source of energy. The improvement of animal productivity, and in particular, stability of milk yield with the maintenance of its high quality, is a fundamental goal in dairy farming. The maize silage is considered a common alternative food source for dairy goats owing to several benefits such as the possibility of being stored for longer periods than fresh maize; particularly in times of scarcity, its balanced composition, and at the same time, being more economic. However, Small producers have been unable to use it due to its high cost (Luís *et al*., 2000) [6]. Rumination time appears to be proportional to roughage cell-wall composition and is controlled by the nature of the diet. (Van Soest, 1994) [7]. In addition, the lignification of fodder affects ruminant digestibility and eating behaviour (Moon *et al*., 1995, Hummel *et al*., 2006) [8, 9]. As a result, the physical form of diet influences the amount of time spent chewing and ruminating.

Chewing high-quality fodder with lower cell-wall composition, according to Mertens (1997) [10], is easier than chewing low-quality forage. When concentrates and finely ground or pelleted hay are provided, rumination time is reduced; yet, when roughages with high cell-wall content are fed, rumination time is enhanced. (Dado and Allen, 1994) [11]. Goats alternate eating time with one or more periods of rumination or inactivity, with rumination taking up more time at night. Individual differences in the duration and distribution of feeding and rumination activities appear to be linked to hunger, anatomical differences, and energy needs supply, or rumen fill, which is controlled by roughage: Ratio of dietary concentrate (Fischer *et al*., 1998) [12]. Because plant material is mechanically disrupted by initial chewing during eating and subsequent chewing while rumination, (Ulyatt *et al*., 1986) [13], Eating time is prolonged because exceptionally large particles increase the amount of chewing necessary to swallow a bolus of feed (Grant and Ferraretto 2018) [14]. Feeding behaviour, feed intake, and total dairy metabolic and lactational responses to forage are all influenced by forage quality. Dairy that is lactating can be fed at various times. The interaction between eating and resting behaviour is widely studied, emphasizing dairy's inflexible resting requirement. (Jensen *et al*., 2005; Munksgaard *et al*., 2005) [15,16]. The increase in time spent eating with greater forage content and NDF digestibility was almost exactly offset by a reduction in lying time, similar to Jiang *et al*. (2017) [17], They changed their diet to include more forage. The slow process of rumination and fermentation may be delayed if the digestible components aren't tiny enough to be eliminated in the rumen. If these processes were delayed, the throughput and hence daily intake would be lowered, as the forage would be kept longer in the rumen. This is linked to the productivity and performance of the animal. (McDonald *et al*., 2002) [18]. Corn is a good crop for ensiling because of its excellent producing qualities, high energy value, and high fiber content. The nutritional value of corn silage is determined by the hybrid, maturity, and moisture level at feeding time (Johnson *et al*., 2002) [19]. Precision harvest chopping improves packing density and fermentation, as well as perhaps maintaining nutritional value, in addition to these advantages. Because the effect of corn silage particle size on breastfeeding ruminants is less clear (Haigh and Parker, 1985.) [20], the purpose of this study was to see how forage quality influenced animal behaviour, performance, and lactation in small ruminants.

2. Materials and Methods

2.1 Experimental design and animals

All trials were carried out in two caprine private farms in Menia Alkamah city, Elsharkia governorate, Egypt. A total number of 192 animals were incorporated in the trials including two groups, 48 fattening and dairy Egyptian Baladi sheep (2-4 years old with a body weight 75±6 kg), as well as 48 fattening and dairy Egyptian Baladi goats (2-4 years old with a body weight 45±5 kg), 48 kids and lambs from mother feed on corn silage and 48kids and lambs from mother feed on rice straw. The trials were including two feeding systems, the first one used maize silage, and the second one used rice straw for two stages of mature and lactating goat and sheep. The institutional animal care and use committee at Zagazig University accepted the research protocol for this study (APPROVAL NO.ZU – IACUC/2/F/2/2021). Sheep and goats were housed in a closed shed and they were released to an open yard during daylight hours, adult goats and sheep feed with 1-2 kg maize silage and rice straw, milkers animal needed 3.5 kg of rice straw and maize silage daily, concentrate 500- 1000gram per day and divided the total ration into two or three feeds in case of rice straw. They were identified by painting a number with different colour spray on the body of the animal.

Table 1: Animals incorporated in trials with different feeding systems

Group	Number of animals	Feeing system
1. Group (1) Fattening goat	12	Maize silage
2. Group (2) Dairy goat	12	Maize silage
3. Kids	24	Maize silage
4. Group (3) fattening sheep	12	Maize silage
5. Group (4) Dairy sheep	12	Maize silage
6. Lambs	24	Maize silage
7. Group (5) Fattening goat	12	Rice straw
8. Group (6) Dairy goat	12	Rice straw
9. Kids	24	Rice straw
10. Group (7) fattening sheep	12	Rice straw
11. Group (8) Dairy sheep	12	Rice straw
12. lambs	24	Rice straw
Total	192	

2.2 Formulation of Ration and chemical composition of first feeding system

Table 2: Formulation of Ration and chemical composition of first feeding system (rice straw)

A. Concentrates		
Wheat Bran	9.00 kg	
Corn	35.5 kg	
Soybean Meal (48%)	13.5 kg	
Vitamins & Minerals Premix	0.3 kg	Phosphorus 5.00%, Calcium 18%, Sodium 5%, Magnesium 5%, Manganese 500 mg/kg, Cobalt 100 mg/kg, Zinc 2000 mg/kg, Iodine 125 mg/kg, Selenium 10 mg/kg, Vitamin A 400000 IU/kg, Vitamin E (Alpha-Tocopherol) 400 IU/kg
Limestone	0.2 kg	
Calcium dibasic Phosphate	1.00 kg	
Salt	0.5 kg	
Total	60.00 kg	
B. rice straw (kg)	40.00	
Total	100 kg	
Chemical composition		
Digestible energy	2554.1, Kcal/Kg	
Crude protein	14.05%	
Crude fiber	10.44,%	
Calcium	0.69%	
Available phosphorus	0.51%	

Table 3: Formulation of ration and chemical composition of second feeding system (Maiz silage)

Item	Corn silage
pH	3.91
Buffering capacity (meq/100Gdm)	59.12 kg
Chemical composition	(% of DM)
Dry matter	25.7
Crude protein	9.3
Ether Extract	3.5
NDF	46.00
ADF	26.6
NFC	31.4
Total Phenolics	00.0
Total Tannins	00.0
CP fractions	10.44,%
Ca,	(% of CP (CNCPS)
A	46.1
B1	13. 7
B2	15. 9
B3	9. 5
C	14. 8

Non-fiber carbohydrate (NFC) is a type of carbohydrate that does not contain fiber.
Cornell Net Carbohydrate and Protein System (CNCPS) is the abbreviation for Cornell Net Carbohydrate and Protein System.
At time zero, A is the amount of cp that is instantly dissolved.
The amount of cp that dissolves in borate phosphate buffer and precipitates with trichloroacetic acid is designated as B1.
Total cp minus A1, B1, B3, and C = B2.

2.3 Behavioral observation

The behavioural observations were carried out utilising the focal sample technique, as advised earlier by Kilgour and Dalton, 1984, Darwish, 1999, Dawkins *et al*., 2007, Jalalia *et al*., 2012. [21-24] a stopwatch, field notice (observation sheet), and digital camera were used. Behavioral observations were recorded at every 15 min interval for each group from 8 a.m.: 4p.m /week; by 2 h daily represented the daylight hours. The following behavioral patterns were observed:

- Eating: total time (min) and frequency/8 hour observation
- Ruminating: total time (min) and frequency/8 hour observation
- Chewing activity: total time (min) and frequency/8 hour observation.
- Frequency and time (min.) of drinking per 8h observation
- Laying time: this means the total time (min.) and frequency in which the animal rest during 8 h observation.
- Sleep: Total time (min.) and frequency in which the animal lies down on the ground with head turned back towards the flank with closed eyes during 8 h observation.
- Grooming: total frequency of licking or grooming by an animal to its own body, during 8 h observation
- Walking: Frequency and total time (min.) during 8 h observation

2.4 Productive Performance: Each goat and sheep, as well as their progeny, were individually weighed at the outset of the experiment to ascertain the average beginning body weight. Following that, the body weight was monitored weekly, and the life body weight gain and growth rate were determined using the equation (Widdowson, 1980) [25]

$$\text{Growth rate} = \frac{W2-W1}{W1} \times 100$$

Where,
W1 = First calculated weight (kg)
W2 = Next calculated weight (kg)

2.5 Milk Performance

2.5.1 Milk sampling

Eighty quarter milk samples were collected from lactating sheep and goats.

2.5.2 Preparation of the udder before milk sampling (Oliver *et al*., 2004) [26]

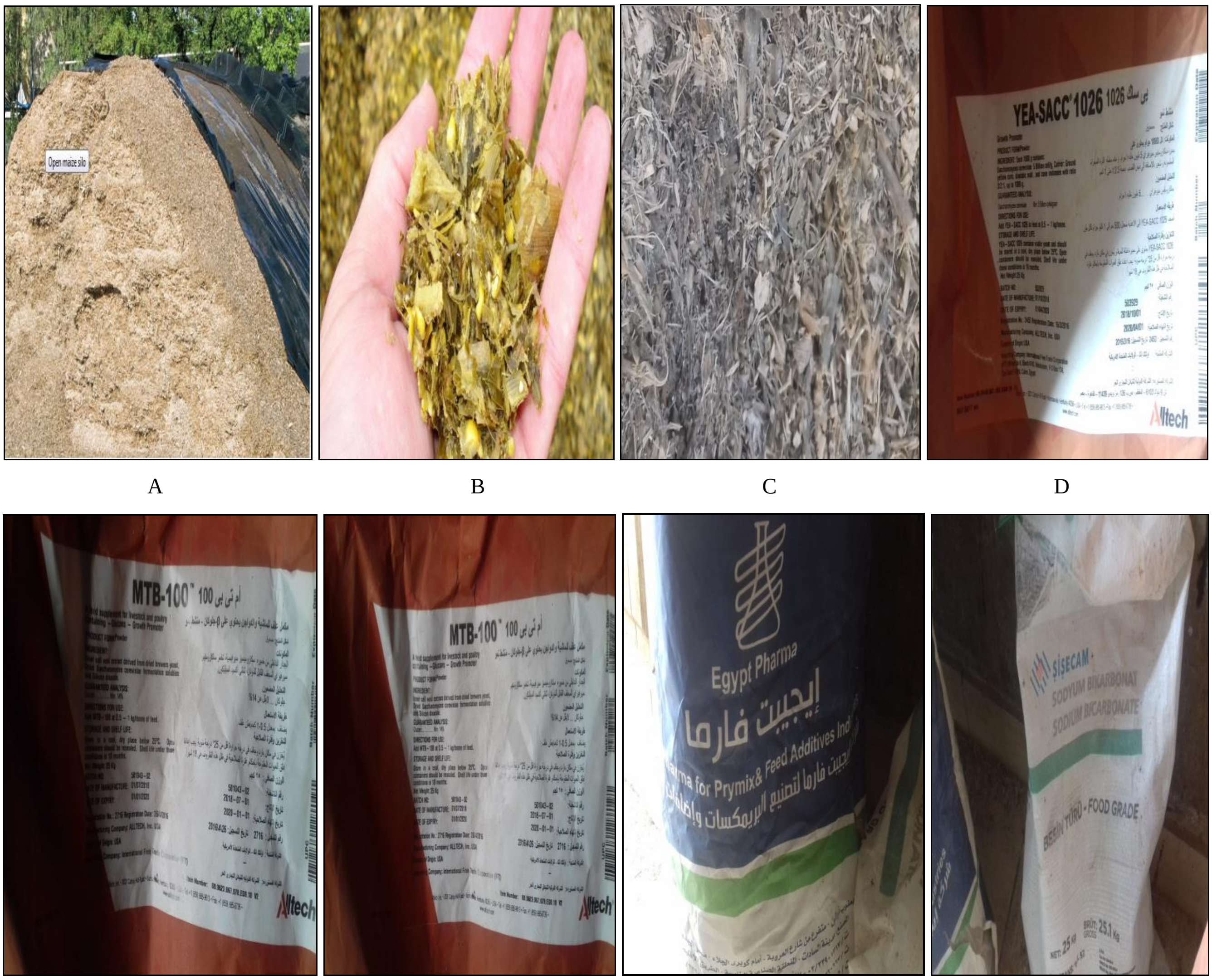
Each animal was first clinically checked, with special care paid to the udder's condition. All of the animals used in this study were clinically healthy and showed no signs of mammary disease. Before sampling, each animal's udder was palpated for any anomalies such as edoema, asymmetry, or other physical alterations.
According to National Mastitis Council guidelines (Larry 2001) [27] the teat ends were firstly cleaned externally with a commercial pre-milking disinfectant solution with paying attention to the teat orifice then dried with an individual clean towel, and then the udder and teats were wiped with 70% ethyl alcohol solution. The first few streams of fore milk from each quarter were discarded.

2.5.3 Determination fat and protein in milk

Milk yeild (kg/day) was measured by an electronic milk meter. Milk yield was analyzed analyzed for fat /100 gm of milk and protien /100 gm of milk using milk scan.

2.6 Statistical analysis

SPSS software, version 16.1, was used to conduct all statistical analyses (SPSS Inc., Chicago, IL, USA). The data was examined using a two-way ANOVA, with two factors influencing sheep and goat behaviour: the first is the type of forage, and the second is fattening and dairy goat and sheep. According to Duncan (1955) [28]. The standard error of mean (SEM) was used to express data variability, and the alpha threshold for significance was established at p0.05 and p 0.01. T test software with SPSS (Tamhane and Dunlop, 2000) [29] for examining the differences between milk production and composition in dairy goats and sheep.



A B C D

E F G H

Fig 1: (A, Band c) in figure 1 illustrates that shape of maize silage under black plastic sheet used for feeding fattening and dairy small ruminants (D, E, F, G and H) additives added to maize silage

3. Results

Table 4: The effect of feeding system on total frequency and time (min) of chewing behavior in goat and sheep per 8 hours observation

Behavior pattern	Maize silage				Rice straw				p-value
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	
Eating behaviour frequency of chewing during eating	14.12±0.12	8.11±0.18	11.13±0.13	6.11±0.06	6.13±0.11	4.11±0.09	8.12±0.05	3.08±0.03	**
Chewing during eating duration (min)	41.17±0.13	22.10±0.17	10.09±0.10	17.13±0.08	37.13±0.11	15.11±0.09	14.13±0.06	12.07±0.08	*
Number of chewing movement during eating	20.03±0.11	10.07±0.10	15.05±0.09	5.04±0.13	32.06±0.11	18.01±0.14	25.05±0.13	11.06±0.11	**
Rumination frequency of chewing during rumination	19.11±0.10	12.13±0.09	10.00±0.13	8.13±0.06	13.14±0.13	6.11±0.06	8.12±0.09	4.13±0.07	*
Chewing during rumination duration (min)	36.13±0.17	21.09±0.13	11.05±0.09	18.06±0.13	55.13±0.14	32.06±0.15	20.08±0.13	18.01±0.14	**
Number of chewing movement during rumination	21.11±0.18	11.01±0.11	15.03±0.13	8.11±0.06	45.13±0.13	32.13±0.17	27.14±0.07	20.13±0.03	**
Chewing activity Total chewing behaviour	33.08±0.10	20.11±0.12	21.06±0.08	14.04±0.07	19.15±0.13	10.13±0.07	16.12±0.12	7.11±0.11	**
Total effective time / min of chewing behaviour	77.13±0.15	43.08±0.13	21.11±0.11	35.06±0.12	92.12±0.12	47.14±0.19	34.08±0.08	30.13±0.6	*
Total number of jaw movement during chewing behavior	41.06±0.06	21.12±0.07	30.05±0.10	13.03±0.1	77.14±0.09	50.12±0.01	52.10±0.04	31.03±0.12	**

NS: Non-significant changes; *Significant at 0.05 probability; ** highly significant at 0.01 probability

Group 1 = (n=12) fattening goat feed on maize silage, group 2 = (n=12) dairy goat feed on maize silage, group 3 = (n=12) fattening sheep feed on maize silage, group 4= (n=12) dairy sheep feed on maize silage, group 5 = (n=12) fattening goat feed on rice straw, group 6 = (n=12) dairy goat feed on rice straw, group 7 = (n=12) fattening sheep feed on rice straw, group 8= (n=12) dairy sheep feed on rice straw.

Table 5: effect of feeding system on frequency and time (min) of goat and sheep behaviour per 8 hours observation

Behavior pattern	Maize silage				Rice straw				p- value
	Group1	Group2	Group3	Group4	Group5	Group6	Group7	Group8	
frequency of laying	48.03±0.10	26.11±0.13	77.08±0.12	42.10±0.12	68.04±0.09	45.4±0.12	79.07±0.12	53.03±0.07	*
Laying time /min	121.08±0.13	55.11±0.11	162.13±0.07	93.11±0.12	175.07±0.08	94.10±0.13	181.08±0.14	123.11±0.10	*
Frequency of sleeping	60.03±0.12	43.09±0.10	72.04±0.07	50.08±0.13	43.11±0.12	23.08±0.05	70.11±0.12	41.09±0.08	**
Sleeping duration /min	169.08±0.10	90.07±0.15	173.01±0.07	118.08±0.12	113.12±0.12	46.08±0.13	151.05±0.11	160.05±0.12	**
Grooming frequency	40.03±0.10	27.11±0.12	56.12±0.09	37.08±0.10	25.12±0.02	17.14±0.07	45.08±0.14	32.10±0.11	*
Walking frequency	43.11±0.09	25.10±0.05	59.09±0.11	34.05±0.15	22.08±0.12	11.05±0.13	40.08±0.14	28.13±0.05	**
Drinking frequency	13.14+0.13	6.11+0.06	8.12+0.09	4.13+0.07	17.11+0.10	11.13+0.09	10.00+0.13	7.13+0.06	*

NS: Non-significant changes; *Significant at 0.05 probability; ** highly significant at 0.01 probability

Group 1 = (n=12) fattening goat feed on maize silage, group 2 = (n=12) dairy goat feed on maize silage, group 3 = (n=12) fattening sheep feed on maize silage, group 4= (n=12) dairy sheep feed on maize silage, group 5 = (n=12) fattening goat feed on rice straw, group 6 = (n=12) dairy goat feed on rice straw, group 7 = (n=12) fattening sheep feed on rice straw, group 8= (n=12) dairy sheep feed on rice straw.

Table 6: The effect of the feeding system on Body weight, daily intake and growth rate on goat and sheep

Performance parameter	Maize silage				Rice straw				p-value
	Group1	Group2	Group3	Group4	Group5	Group6	Group7	Group8	
Bodyweight / Kg	45.11±0.07	53.13±0.11	69.01±0.13	78.07±0.14	38.12±0.09	49.11±0.12	59.12±0.08	68.13±0.09	**
Daily intake /Kg	1.51±0.16	1.00±0.13	1.83±0.11	1.35±0.10	0.75±0.10	0.50±0.09	0.95±0.11	1.00±0.08	**
Growth rate	0.67±0.07	0.77±0.11	1.43±0.12	1.95±0.08	0.32±0.12	0.52±0.11	0.81±0.07	0.75±0.05	**

NS: Non-significant changes; *Significant at 0.05 probability; ** highly significant at 0.01 probability

Group 1 = (n=12) fattening goat feed on maize silage, group 2 = (n=12) dairy goat feed on maize silage, group 3 = (n=12) fattening sheep feed on maize silage, group 4= (n=12) dairy sheep feed on maize silage, group 5 = (n=12) fattening goat feed on rice straw, group 6 = (n=12) dairy goat feed on rice straw, group 7 = (n=12) fattening sheep feed on rice straw, group 8= (n=12) dairy sheep feed on rice straw.

Table 7: Influence of feeding system on productions characteristics of lambs and kids

Production characteristics	Mother feed on maize silage		Mother feed rice straw		p- value
	Kids	Lambs	Kids	Lambs	
Birth weight/kg	2.34±0.07	3.12±0.9	1.82±0.11	2.10±0.16	**
Body weight at weaning/kg	35.1±0.09	82.01±0.11	63.02±0.07	14.00±0.04	**
Age at weaning / days	5.16±0.11	6.45±0.08	3.45±0.13	4.75±0.09	*
Daily gain / gram	150.22±0.08	203.23±0.12	85.13±0.14	133.12±0.09	**

NS: Non-significant changes; *Significant at 0.05 probability; ** highly significant at 0.01 probability

Table 8: Influence of feeding system on milk production and composition of goat and sheep.

Item	Maize silage		Rice straw		p- value
	Goat	Sheep	Goat	Sheep	
Milk yeild (kg/day)	0.75±0.03	1.11±0.16	0.73±0.07	1.12±0.09	NS
Milk fat /100 gm of milk	1.11±0.07	2.12±0.13	1.12±0.13	2.14±0.11	NS
Milk protein / 100 gm of milk	2.19±0.12	3.11±0.10	2.17±0.09	3.13±0.12	NS

NS: Non-significant changes; *Significant at 0.05 probability; ** highly significant at 0.01 probability

Eating behaviour was affected by type of forage as presented in table (4), frequency of chewing during eating and number of chewing movement during eating per 8 hour observation significant increase in fattening goat, dairy goat, fattening sheep and dairy sheep fed on maize silage than on rice straw. Chewing during eating duration by minutes increased by maize silage feeding. Rumination frequency and time was significantly, different among small ruminant fed on maize silage and rice straw (p<0.05, p<0.01). Total chewing behaviour was greater (p<0.01) in small ruminant fed on maize silage than rice straw, while on other hand total effective time per minutes of chewing behaviour and jaw movement higher significantly in small ruminant fed on rice straw than fed on maize silage (p< 0.05, p< 0.01).

Some behavioural pattern were affected by type of forage as presented in table (5), sleeping frequency and duration (min), grooming and walking significant increase in fattening goat, dairy goat, fattening sheep and dairy sheep fedon maize silage than rice straw, while laying frequency and duration by minutes was lower in small ruminant fed on maize silage than rice straw feeding.

Result in table (6) showed that some productive performance was affected by type of forage fed for small ruminant, So body weight per kilogram, daily intake per kilogram and growth rate were significantly Lower (p<0.01) in small ruminant fed in the rice straw than maize silage.

The result in table (7) the effect of forage type on lamb and kid production characteristics was demonstrated., birth weight per kg, body weight at weaning and daily per gram were significantly higher in kids and lambs from mother's fed on maize silage than mother's fed on rice straw, while age at weaning per days with longer age in kids and lambs fed on rice straw than maize silage.

The data in table (8) represent the influence of forage type on milk production and milk composition of goats and sheep. There were no significantly in milk yield per kilogram per day in goat and sheep fed on maize silage and fed on rice straw, while milk fat and protein per 100 gm of milk were no significantly effect on goat and sheep fed on rice straw and fed on maize silage.

4. Discussion

When the causal elements for the two activities conflict, feeding takes precedence over ruminating, indicating that feeding is ruminants' principal behaviour. The amount of food ingested is the most essential factor influencing milk production and body condition changes throughout lactating feeding. Grant and Albright 2001 [30] the type of feed influences sheep and goat behaviour; ruminants typically spend more time ruminating than eating. (Dulphy *et al*., 1980 [31] Our findings for sheep and goats fed maize silage showed a substantial increase in feeding behaviour, rumination, and chewing activity when compared to sheep and goats fed rice straw. In accordance with which our research was conducted (De Boever *et al*., 1990) [32] It has been claimed that small ruminants fed low-quality fodder such as rice straw have a shorter rumination cycle and a reduced rate of mastication due to lengthy forage fibre particles rather than microscopic particles, which takes longer to digest. (Mc donald, 2002 sjaastad *et al*., 2003 [18, 33] indicated that forage with low quality and high fibrous content had more extended chewing activity, and that chewing frequency and time are dependent on both the type and content of plant fibrous components. (Forbes, 2007) [34] It was discovered that there was a link between body weight and total chewing activity and duration, and that larger animals chewed more efficiently, resulting in an increase in daily intake and feed utilization, improving animal welfare and productivity. (Phillips, 2002) [35] Long fibre particles in the diet have been proven to enhance chewing duration, saliva production, and rumination. (Cozzi *et al*., 2009) [36] Ruminants preferred short plant particles over long fibers plants, according to research. looked at how feed size particles and fibres affected chewing behaviour The physical appearance of forage in the diet as particle size (Saras, 2011) [37] concluded that chewing behaviour duration, enhanced biting efficiency, and rumination efficiency, as well as fibre content and particle size, affect chewing time, intake, and rumination. (Grant and Ferraretto, 2018) [14] It was shown that feeding goats and sheep a diet high in roughage and high in long fibre requires longer time in eating and chewing activity, and goats and sheep prefer to stand at feed bunks rather than rest, resulting in a decrease in sleeping frequency and time. (Van *et al*., 2013) [38] Because fodder with long fibre increases the time spent eating and chewing, which leads to an increase in laying behaviour, animals fed rice straw spent more time laying than those fed maize silage. Silage can be successfully incorporated into the diets of sheep and goats and appropriate inclusion levels within high-specification feed lot diets should be monitored. (Mohammad *et al*., 2020) [39] The size of forage particles was discovered to affect chewing activity, increase eating and rumination activity, increase dry mater intake, and improve animal body weight growth rate and welfare in small ruminants.

Feeding behaviour is crucial in the development of models that support livestock husbandry research and enable for improved animal performance through feeding and management strategies. (Correia *et al*., 2015) [40]. According to Carvalho *et al*. (2011) [41] the composition of the fibre, in addition to the NDF concentration, may influence behavioural activities, particularly rumination (Italo *et al*., 2020) [42]. Silage in diets increased the amount of time spent consuming compared to other forage diets. (Mohammed *et al*., 2020) [39] It was discovered that range development alternatives should be implemented for a more nutritious supply of herbaceous vegetation and, as a result, increased livestock productivity. Juniper *et al.* (2005) [43] According to reports, switching from corn to grass silage can shorten the time it takes to fatten an animal. Because the native vegetation is insufficient to provide the nutritional needs of the animals, farmers experience poor performance and low profitability (Santos *et al*., 2011) [44]. One of the most expensive parts of animal agriculture is animal feed (Khan *et al*., 2015) [45]. Because forages are less expensive to manufacture than concentrate ingredients (corn and soybean meal), they are always used in large proportions in ruminant diets, typically exceeding 40%. (Nicory *et al*., 2015) [46]. The utilization of forage plants that have been adapted to the practise increases fodder allowance, especially during the dry season, and may make sheep farming a sustainable business. Cowan (2000) [47] claims that forage silage with a low dry matter content frequently results in poor-quality silage due to concerns such as spoilage and the development of Clostridium bacteria, both of which cause dry matter and nutritional value losses. Mondina *et al*., 2021 [48] Ewes and goats in mid-lactation appear to respond differently to different forms of carbohydrates (i.e., starch vs. digestible fibre) and have varied nutrient partitioning toward milk or body reserves due to metabolic and hormonal variations. For milk production in the middle of the lactation, dairy goats benefit from high-starch diets, whereas ewes benefit from low-starch, highly digestible fibre diets.

In our investigation, the form of fodder had an impact on the body weight of small ruminants.

Sheep and goats preferred chopped maize silage with small particles over rice straw, preferring leafy material and leaving low-digestible stem material, resulting in higher maize silage intake and digestibility of the eaten diet than rice straw, resulting in higher daily intake per kilogram, increased body weight, and increased growth rate. (Anaam *et al*., 2019) [49] The feeding of maize silage to small ruminants increased concentrate intake and had a positive impact on goat and ewe reproductive performance, body weight, daily gain, and neonatal behaviour of lambs and kids till wearing. (Khaing *et al*., 2015) [50] Compared to grass silage, whole corn plant silage exhibited a greater DMI, digestible nutrition, and calorie content. Browne *et al.* (2004) [51] on the other hand, claimed that replacing the grass silage basal diet with a high proportion of corn silage had a negative impact on voluntary intake and growth performance due to the accumulation of high levels of fermentation acid, which may have slowed the activity of cellulolytic bacteria in the rumen. A benefit of high-energy meals in enhancing the amount of microbial protein synthesis is the synchronization of available energy and ammonia nitrogen in the rumen, which contributes to an increase in nutrient digestibility and body weight gained. Furthermore, it's possible that rumen bacteria converted a large amount of lactic acid in silage to propionic acid. (Abedol and colleagues, 2013) [52]. Propionic acid enters the bloodstream via the rumen wall, where it is converted to glucose in the liver. The glucose produced will be used as an energy source by the animal for both maintenance and production. (Hariadi and Santoso 2010) [53] Animals fed 100 percent whole corn plant silage would most likely have the best growth performance and nutritional digestibility when compared to other forage diets., Silage can be used as a component in diets for completing Merino lambs up to a 50% inclusion level without affecting the animals' meat production, according to research. Silage added at a rate of 20% or 50% to the carcasses increased the dressing percentage, on the other hand, can be improved by creating diets with higher nutritional requirements in order to sustain high growth rates. (Khaing *et al*., 2015) [51] The composition of mother milk given to kids and lambs fed maize silage had a significant impact on the average daily increase and body weight of kids and lambs at weaning.

(Nay *et al*., 2015) [54] Found that feeding suckling goat kids maize silage increased dry matter intake and produced superior weight gain and growth performance than feeding rice straw to kids and lambs. (de Garvalho *et al*., 2017) [55] It was discovered that children and lambs fed maize silage had superior nutritional and production outcomes than those given rice straw, demonstrating the potential of ensiling these silages for use in sheep and goat farming systems.

The type of fodder provided to small ruminants has an impact on milk output and composition, according to our findings. (Bal *et al*., 2000) [56] It was discovered that goats and sheep fed on corne silage had higher fat and protein per 100 mg of milk than goats and sheep fed on rice straw due to higher milk production and improved nutritional absorption. (Krause *et al*., 2002) [57] Shortening and longest rations alter the period of chewing activity in dairy animals, which affects energy requirements, which impacts milk yield, fat and protein percentage in milk. (Ken on off *et al*., 2003) [58] Feeding corn silage with smaller fibre particles enhanced fed intake while lowering chewing activity and time, increased milk output in nursing dairy cattle, and raised milk fat percentage yield, according to the findings. (Vanhatalo *et al*., 2008) [59] Reduced maize silage particle size was linked to greater milk output and composition, as well as increased consumption. Corn silage, which animals consume in large quantities and has adequate levels of crud protein, increases performance by raising dry mater intakes, body weight, and development rate, according to (Moorby *et al*., 2009) [60].

5. Conclusions

It could be concluded that the inclusion of corne silage whereas a daily ration for goats and sheep ration than rice straw, gave the best behaviour, productive performance and economic efficiency. In small ruminant with fed on maize silage lead to high dry mater intake, lowering chewing activity and duration during eating and rumination, increase body weight, daily gain intake, growth rate, and increased animal welfare and production economy.

6. Recommendations

In sheep and goat in door farms recommended using maize silage with better production performance compared to rice straw, maize silage with short particles lowers the time of chewing and stimulates rumination cycle, increases daily intake of dry matter, increases body weight, growth rate, kids and lambs with higher growth rate and body weight with improve farm welfare productivity.

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8. Conflict of interest

There are no conflicts of interest stated by the authors.

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