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The effect of adding probiotics or prebiotic to the diet on the characteristics of local Iraqi goat carcasses and fat deposition

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Abstract

The present study aimed to find out the effect of adding both the probiotics (3 g / kg feed) or the prebiotic (2 g / kg feed) to the local Iraqi kids diets on some characteristics of carcasses quantitative and qualitative traits. The study used 16 male kids who were evenly distributed over four treatments. The first treatment was fed 60% concentrated diet (included 20% wheat flour, 25% wheat bran, 20% corn, 7% soybeans, 3% salts and vitamins) with 40% alfalfa hay (control), while the remaining three groups were fed the same control diet in addition to 3 g probiotic/kg feed, 2 g prebiotic/kg feed or 1.5 probiotic + 1 gm prebiotic/ kg feed, respectively. The average weight of the kids was 18.90 kg at the start of the study and their average age was 4-5 months. The duration of the study was 105 days, including 15 days for adaptation. Diets were provided based on 3% of body weight. Kids were slaughtered and the carcasses cooled to 2 ° C for 24 hours. A range of measurements were made that included carcass characteristics, physical composition, muscle and bone distribution, and fat distribution pattern in the carcass. The results showed that the groups that were added to the probiotic diets significantly outperformed the control group in all measurements of carcass cuts. Both probiotic and prebiotic groups exceeded the control group in cold carcass weight, dressing percentage, fat layer thickness and eye muscle area. The three treatments also recorded the highest dressing compared to the control treatment.

***Keywords**: Probiotics, Prebiotics, Diet supplementation, Carcass characteristics, Fat deposition*

I. Introduction

Iraqi goats suffer from severe neglect compared to other animal species. Iraqi goats include a variety of breeds, the most important and widespread of which is the breed of local Iraqi black goats, which are widespread in most areas in Iraq. Maraz is also widespread in northern Iraq.

The most important obstacles that limit the expansion of the production of meat from ruminants are the scarcity of concentrated feed, its high prices and the low quality of roughage feed used in feeding these animals. These problems have contributed to the deterioration of animal meat productivity. Attention has been focused on improving the quality of poor-quality roughage feed through its biological treatment (Al-Galbi, 2010).

Goat meat is characterized by its unique flavor, low in cholesterol and contains a high percentage of conjugated linoleic acids reflecting its benefits to consumer health adding its action as an anticancer (Badawy et al., 2023).

Osman *et al* (2023) stated that adding 100 g of probiotics / 100 kg of concentrated diet fed to goats improved dressing percent and protein content in meat with a decrease in fat and saturated fatty acid concentration with an improvement in the percentages of unsaturated fatty acids.

Lima et al (2018) determined that the best level of fat in carcasses ranges from 47% to 54%, which is lower than the percentage of fat in lamb and beef cattle meat.

Probiotic indirectly improves the level of conjugated linoleic acids in meat by affecting the abundance of substances produced by bacteria (e.g. *Lactobacillus acidophilus*), making it an important strategy in increasing the conjugated linoleic acids content in meat (Ozer and Kilic, 2021). On the other hand, Cai et al (2021) found that adding 0.6% of baking yeast to cross male goat improved fermentation in the rumen and their productive performance. Probiotic was also act on the parameters of muscle quality, improve digestion and growth in lambs (Singh et al., 2016).

Although probiotics are used to improve local feed, most studies have focused on sheep and calves while not applied to goats. That's why this study was conducted to evaluate the addition of prebiotics and probiotics to goat diets to improve the quality and quantity of meat produced.

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II. Materials and methods

The experiment used 16 grandfathers of the local Iraqi goat breed aged 4-5 months and an average weight of 18.9 kg. kids are placed in a barn divided into 4 boxes. Each box was equipped with fodder and drinking water. Kids were distributed randomly at a rate of nearly similar weights to four treatments, each treatment contains 4 kids.

The first treatment was considered a control treatment and is free of pro- or pre- biotic, fed concentrated diet (60%) and alfalfa hay (40%). The second treatment, 3 kg of probiotic/ ton was added to the concentrated diet. The third treatment, 2 kg of prebiotic/ ton was added to the concentrated diet. The fourth treatment, 1.5 kg of probiotic and 1 kg of prebiotic/ ton was added to the concentrated diet. Concentrate included 20% wheat flour, 25% wheat bran, 20% corn, 7% soybeans, 3% salts and vitamins.

The composition of the probiotic microorganisms and the number of colonies used from these microorganisms were *Lactobacilli* (10^{10} CFU/kg), *Lactobacillus acidophilus* (10^{10} CFU/kg), *Bacillus subtilis* (10^{10} CFU/kg) and *Saccharomyces cerevisiae* (10^{10} CFU/kg). The concentrated feed was given in the morning at the rate of 3% of the animal's weight throughout the experiment, which was adjusted this quantity weekly according to the new weight of the kid.

Feed was given in two meals in the morning and the other in the evening, with clean water provided throughout the experiment.

The kids were weighed at the beginning of each week after it was forbidden to eat for a period of not less than (12) hours for the purpose of weight.

The animals were slaughtered at the end of the experiment period of 105 days after cutting off food for 04 hours with the availability of water, and then they were skinned, hollowed and cleaned, then the carcasses were weighed by a Salter suspension balance of (50) kg and the carcasses were placed in a cooling refrigerator at a temperature of (2 m) for a period of (24) hours, and then a set of quantitative and qualitative measurements were made on the carcasses.

The cold carcass weight and empty body weight were calculated and the percentage of netting was calculated in two ways, the first by calculating the weight of the cold carcass to the weight of the live animal at slaughter and the second was calculated the weight of the cold carcass to the weight of the empty body, and the cold carcass was weighed and the thickness of the fat layer was measured using the Vernier device and the area of the eye muscle in the area between the twelfth and thirteenth rib on the left half of the carcass by printing the image of the muscle on transparent wax paper and then measuring the area of the muscle using a planometer takes three readings for each measurement.

The carcass was cut by first separating it into two equal halves from the middle of the spine as much as possible using a rotating electric saw type M.K.6 (380acw (super). The left half of the carcass was cut into eight pieces, four of which were main pieces (shoulder, ribs, cotton and thigh) and the other four were secondary pieces (neck, shoulder, chest and flank) and the cutting process is carried out as homogeneously as possible.

After that, these eight pieces were weighed by means of a Mettler scale (capacity of 8 kg), then the pieces were placed in polyethylene bags. With the amount of meat due to the difficulty of separating this fat from the meat, due to the method described by Jones et al. (1983) in the process of physical separation and each of the three components was weighed with the electronic balance Mettler (capacity of 8 kg).

Statistical analysis

Data were analyzed statistically based on the Completely Randomized Design to study the effect of coefficients on the quantitative and qualitative qualities of carcasses using the ready-made statistical program SPSS (2019) for statistical analysis and the Duncan test (1955) was used to compare significant differences between means.

III. Results and Discussion

Table (1) shows the body weight at slaughter, cold carcass weight, empty body weight and refinement ratio. All these characteristics were affected by the type of addition and the superiority ($P<0.05$) of the groups that fed the diets to which the probiotic or the prebiotic, or both to the control group. Also, the cold carcass weight of the probiotic group outperformed ($P<0.05$) over the two prebiotic group or both additions together**.**

These results are agreed with Osman *et al* (2023) and Han *et al.* (2020). Cai *et al* (2021) found that adding 0.6% of baking yeast to cross male goat improved fermentation in the rumen and their productive performance. Probiotic was also act on the parameters of muscle quality, improve digestion and growth in lambs (Singh *et al*., 2016). Many studies have stated that probiotic improve the utilization of feed, enhancing rumen ecosystem, nutrient digestibility and growth (Abd- El-Tawab *et al*., 2016). While Tripathi and Karim (2011) and Soren *et al* (2013) found little variation (not significant) of adding probiotics to growing lamb diets in slaughter weight, carcass weight and cut weights.

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Table (1) The effect of both probiotic or prebiotic on body weight at slaughter, empty weight, carcass and dressing percentt

Item	Treatments			
	Control	Probiotic	Prebiotic	Pre- and pro-biotic
Slaughter body weight (kg)	30.60^{b}±1.36	37.60^{a}±1.10	35.25^{a}±1.05	36.05^{a}±1.31
Empty body weight (kg)	25.40^{b}±1.66	31.08^{a}±1.73	29.96^{a}±1.68	29.56^{a}±1.74
Carcass weight (cold, kg)	12.51^{d}±0.09	17.81^{a}±0.10	15.86^{c}±0.08	16.58^{b}±0.11
Dressing percent	40.88^{b}±2.53	46.99^{a}±2.84	44.99^{a}±2.93	45.99^{a}±2.78

- **Means with different superscripts horizontally differ significantly at P ≤ 0.05.**

Effect of probiotic or prebiotic on dressing percent, eye muscle area and fat thickness are described in table (2). All these traits were significantly (P<0.05) influenced by the addition of probiotic or prebiotic. Groups received probiotic or prebiotic or both were exceeded the control group, except for fat thickness. The highest value of the eye area recorded by the kids' group that fed the probiotic (15.28 cm2). The area of the eye muscle is an important characteristic in predicting the amount of meat produced by the animal due to the presence of a high positive correlation coefficient between these two characteristics (Stewart *et al*., 2021). The increase in the surface area of the eye muscle comes from the health status of the animal, which is represented in increasing its consumption of feed, increasing the efficiency of the metabolism of the feed material, and to increasing the readiness of nutrients through the production of microorganisms for digestive enzymes and decomposing of feed materials, especially cellulosic and complex carbohydrates (Kruk *et al*., 2024)), which is reflected in its impact on the meat produced and the growth of the animal (Wood *et al*., 2024), which increases the efficiency of the nutritional conversion of nutrients to the feed material. As well as the effect of the symbiotic action of microorganisms in the probiotic in improving the microbial balance of the rumen flora (Arowolo *et a*l., 2018).

Table (2). The effect of both probiotic or prebiotic on dressing percent, eye muscle area and fat thickness of local goat kids

Item	Treatments			
	Control	Probiotic	Prebiotic	Pre- and pro-biotic
Dressing % (carcass weight/ empty body weight)	49.25^{c}±1.27	57.30^{a}±1.14	52.93^{b}±1.28	59.09^{a}±1.31
Eye muscle area (cm^2)	13.40^{b}±0.66	15.28^{a}±0.77	15.16^{a}±0.68	15.19^{a}±0.78
Fat thickness (mm)	4.59^{a}±0.29	3.41^{b}±0.27	3.56^{b}±0.28	3.46^{b}±0.11

- **Means with different superscripts horizontally differ significantly at P ≤ 0.05.**

dding probiotic or prebiotic significantly (P<0.05) impacted the main cuts weight except the weight of shank (Table, 3). Group supplemented with probiotic or prebiotic and combination significantly (P<0.05) exceeded that of control group, which recorded the lowest value. Carcass length and leg circumference were non significantly influenced by different feeding treatments.

These results are consentient with those of Osman et al (2023), who reported a linear relationship between level of probiotic and the improvement of carcass weight and major cuts. The enhancement of feed utilization and nutrients digestion by goats due to probiotic supplementation (Singh *et al*., 2016) reflected positively on body weight carcass weight and other carcass parameters.

Carcass length and leg circumference were non significantly influenced by different feeding treatments. The improvements in the weight of carcass was not associated with an upsurge in its length, but rather with an advance in the distribution of meat.

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Table (3). Effect of probiotic or prebiotic on carcass cut weight and carcass measurements

Item	Treatments			
	Control	Probiotic	Prebiotic	Pre- and pro-biotic
Shoulder (kg)	2.25^{b}±0.17	2.99^{a}±0.14	2.93^{a}±0.18	2.90^{a}±0.15
Loin (kg)	1.10^{b}±0.16	1.48^{a}±0.17	1.46^{a}±0.16	1.45^{a}±0.18
Leg (kg)	2.79^{b}±0.20	3.21^{a}±0.21	3.16^{a}±0.18	3.17^{a}±0.16
Rack (kg)	1.90^{b}±0.09	2.23^{a}±0.10	2.20^{a}±0.07	2.21^{a}±0.08
Shank (kg)	1.19±0.06	1.21±0.08	1.19±0.07	1.20±0.09
Neck (kg)	0.45^{b}±0.02	0.53^{a}±0.04	0.51^{a}±0.03	0.52^{a}±0.03
Carcass length (cm)	87.00±3.40	89.23±3.60	88.21±3.10	87.11±3.22
Leg circumference (cm)	61.45±2.37	63.15±3.10	61.89±2.81	62.03±2.27

- **Means with different superscripts horizontally differ significantly at P ≤ 0.05.**

IV. Conclusion

Both probiotic and prebiotic groups exceeded the control group in cold carcass weight, dressing percentage, fat layer thickness and eye muscle area. The three treatments also recorded the highest dressing compared to the control treatment. The main cuts weight except the weight of shank of treated groups exceeded that of control group, which recorded the lowest value. These results suggest that supplementation of probiotic or prebiotic and their combination to the local goat diet enhance carcass traits and most parameters.

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