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RESEARCH PAPER

The effect of adding protected amino acids (methionine and lysine) on the performance and carcass characteristics of male Arabi lambs

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ABSTRACT This study was conducted at the Agricultural Research Station of the College of Agriculture / Basra University / Karma Ali site for the period from July 2019 to May 2020, to assess the effect of adding protected amino acids (methionine and lysine and their mixture) on the performance of Arab lambs and some characteristics of carcasses. So (16) male lambs were selected with an average weight of 27.95 kg and at the age of 5-6 months, and were randomly distributed to four transactions by four animals per treatment and were housed in separate cages for each group which; first the control treatment (without additives); the second treatment (5g) of protected methionine; the third treatment (5g) of protected lysine; the fourth treatment (5g + 5g) of protected methionine and lysine per kg of feed mixture for (90) days. The results indicated a significant increase ($p< 0.05$) in favor of the fourth and second treatments in the final live body weight rates and the daily and total weight gain compared with the first treatment and there was an improvement in the amount of feed consumed and the efficiency of food conversion. Also, there was a significant increase ($p< 0.05$) in carcass weights, clearance ratios, and weights of the shoulder and leg joints of the fourth and second treatments compared to the first treatment. There were no differences in the weights of cuts neck, loin, and ribs.

KEYWORDS: *food additives; lamb carcass performance; protected amino acid.*

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Efeito da adição de aminoácidos protegidos (metionina e lisina) no desempenho e nas características da carcaça de cordeiros árabes machos

RESUMO Este estudo foi realizado na Agricultural Research Station of the College of Agriculture / Basra University / Karma Ali, no período de julho de 2019 a maio de 2020, para avaliar o efeito da adição de aminoácidos protegidos (metionina e lisina e a mistura destes) no desempenho de cordeiros Arabi e algumas características das carcaças. 16 cordeiros machos foram selecionados com um peso médio de 27,95 kg, com 5 a 6 meses de idade e foram distribuídos aleatoriamente em quatro tratamentos, sendo quatro animais por tratamento, e foram alojados em gaiolas separadas para cada grupo; primeiro o tratamento controle (sem aditivos); o segundo tratamento (5 g) de metionina protegida; o terceiro tratamento (5g) de lisina protegida; o quarto tratamento (5g + 5g) de metionina e lisina protegida por kg de mistura alimentar, por (90) dias. Os resultados indicaram um aumento significativo ($p< 0,05$) a favor do quarto e do segundo tratamento nas taxas finais de peso vivo e no ganho diário e total de peso em comparação com o primeiro tratamento e houve uma melhora na quantidade de alimento consumido e a eficiência da conversão alimentar. Além disso, houve um aumento significativo ($p< 0,05$) nos pesos de carcaça, taxas de depuração e pesos das articulações dos ombros e pernas do quarto e do segundo tratamentos em comparação com o primeiro tratamento. Não houve diferenças nos pesos dos cortes no pescoço, lombo e costelas.

PALAVRAS-CHAVE: aditivos alimentares; desempenho de carcaça de cordeiro; aminoácido protegido.

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Introduction

The protein is one of the food items that limited to ruminants, especially when feeding on poor quality food, additionally, the animals different between them in their requirements of it, according to the physiological stages of growth, pregnancy and milk production stage, so, for this reason, must find ways to provide amino acids, to meet the body's requirement and protection it from degradation by rumen and thus led to the best efficiency of the digestive and absorption (Archibeque et al 2002).

The addition of the protected amino acids is a major cause to get good production efficiency (Ali et al 2009). Food representation of a protein is a complex process in ruminant animals, protein diet`s analysis by micro-organisms in the rumen and transform to peptides, amino acids, and ammonia to benefit of these components in the production of microbial protein (Giallongo et al 2016). Therefore, many researchers and headed cattlemen ruminant animals in the past years turned to us modern methods to improve the food value of the native food which consider a poor-quality diet, through the use of non-traditional additions to the diets, to obtain the maximum production of animal (Al-Badri 2010). One of these methods using methionine to improve some of the production and carcass traits (Al-Aidi 2017), or add yeast bread to fatting lamb diets to improve the daily gain and the and increase the digestion efficiency of food (Al-Baidani 2018).

As confirmed by recent studies that the addition of nutrients such as selenium and amino acids (arginine, lysine, and vitamin E) plays an important role in the organization of the growth, production, and reproduction (Al-Saadoon 2020; Gavade et al 2019; Al-Badri 2010). Many strategies can protect the protein and amino acids from analyzing them by micro-organisms in the rumen and transform it to microbial protein with ensuring digested in the stomach and small intestine by treatment of amino acids with formaldehyde and fatty packaged (Al-Badri 2010; Schwab et al 2003). Use methionine and lysine, such as supplements in ruminant diets improving the performance of animals, the rates of growth of animals, the efficiency of food conversion, quantitative and qualitative carcass (Li et al 2019; Gami et al 2017; Abdelrahman and Hunaiti 2008; Sun et al 2007).

Methionine and lysine are specific factors in animal production and as a result of variance, their content in ruminant diets has become necessary to add these amino acids to the diets of the animal to improve the productivity of the animal further due to the short period between birth and slaughter. So, this study aimed to find the effect of adding protected amino acids methionine and lysine to ruminant diets and examine their impact on the performance and carcass characteristics of male Arabi lambs.

Materials and Methods

Protection of amino acids

The protection of the amino acids methionine and lysine was happening before adding to the diet in a nutrition laboratory of the College of Agriculture, University of Basra, Basra Iraq according to the method of Preston and Leng (1985). According to the following steps: weighed the amount of 1000 grams of amino acid and placed in a special container for mixing and homogenization with formalin. It takes 11.5 ml of formalin (concentration of 4%) in addition to the 88.5 ml of distilled water by using graded test tubes, are placed in a glass bowl and then moved and transported to the small hand spray pump. Sprinkled the mixture of Formalin and distilled water by using a spray pump on the amino acid with the continuing mix-up, to ensure complete protection, then placed in a plastic sack and kept for three days starting from the day of treatment before being used and its addendum to diet lambs. All the sacks were open to exposing treated amino acid to air for removing excess formaldehyde.

Experiment design and system dietary

This study was carried out in the animal field of the College of Agriculture, University of Basrah from July 2019 to May 2020 was preceded by a preparatory period. A total of 16 lambs male aged between 5-6 months old and 27.95 kg of body weight were brought from the local market after checking by veterinarians in the field to ensure that the animals were not sick. The Lambs were put in cages equal dimensions 3x2 meters (four animals for each group). The yards were half shaded with the sandy ground and each cage was equipped with a water bowl and a cylinder food bowl.

All the lambs were fed on the basic concentrated diet as shown in Table 1 and the chemical composition in Table 2, in two weeks without the addition of methionine and lysine for adaptation to the diet. Later, lambs fed on meals as follows: The 1st group Without any addition, 2nd treatment added with 5g/ kg feed methionine, 3rd treatment added with 5g/ kg feed lysine, and 4th treatment added with 5g methionine + 5g lysine/kg feed.

Table 1 The ingredients compositions of the diet (%).

Groups / Ingredient	First	Second	Third	Fourth
Barley	61	61	61	61
Bran	35	35	35	35
Uria	1	1	1	1
Vitamins and mineral premix	2	2	2	2
Salt	1	1	1	1
5g methionine	–	5	–	5
5g lysine	–	–	5	5

Table 2 The Chemical compositions of the diet.

Chemical compositions	(%)
Dry matter	88.27
Crude protein	14.96
Ether Extract	2.27
Crude Fibre	7.68
Nitrogen free extract	62.14
Organic matter	84.20
Ash	4.07
Metabolic energy MJ/kg Dry matter	11.56

The concentration diet was given twice daily at 7:00 a.m. and 4 p.m. by (3%) of the body weight, and the remaining feed brings together on the following day before the new meal for calculating the amount of daily feed intake during all the experiment periods. The weight of the lambs was taken every two weeks throughout the experiment using a digital balance for small animals (sheep and goats) to adapt the amount of feed according to new weights with the follow-up the daily feed consumption. After the end of the experiment, the lambs were fasted for 12 hours and then slaughtered. The body weight of the live animal before slaughtering, the weight of the hot carcass, dressing percentage, and the major cuts (neck, shoulder, ribs, loin, and the leg) were recorded. The data statistically analyzed using random design (C R D) using the statistical program version copy 23 SPSS, (2015) and tested the differences between means at the $P<0.05$ level of significance.

Results and Discussion

Table 3 obtained the effect of the addition of the protected amino acids on body weight during the experiment period. The final body weight of 1st, 2nd, 3rd, and 4th groups were 39.00, 42.20, 40.37, and 43.37 respectively. There was a significant increase ($P<0.05$) in body weight in the 4th (methionine + lysine) and 2nd (methionine) groups in comparison with other groups. Whereas, the 3rd treatment (lysine) was a significant increase ($P<0.05$) in comparison with control, which may due to that supply the diets with amino acid will provide the tissue requirements (Hussein et al 1991) and achieving the best and maximum growth. (Jefferson and Kimball 2004; Averous et al 2003).

Table 3 The effect of adding protected amino acids on live body weight (kg) (Mean ± S. E.).

Period / Treatment	Initial body weight	Bodyweight at 30 days	Bodyweight at 60 days	Bodyweight at 90 days
Control (1st)	0.37 ± 27.88	0.73 ± 32.38	0.60^{c} ± 35.67	0.86^{c} ± 39.00
5g methionine/kg diet (2nd)	0.39 ± 27.73	0.80 ± 33.38	0.95^{a} ± 38.08	0.62^{a} ± 42.20
5g lysine/kg diet (3rd)	0.24 ± 27.95	0.98 ± 33.02	0.73^{b} ± 36.75	0.94^{b} ± 40.37
5g methionine +5g lysine/kg diet (4th)	0.50 ± 27.98	0.82 ± 33.42	0.91^{a} ± 38.33	0.80^{a} ± 43.37
Significant level	N. S	N. S	0.05	0.05

Different small letter within column means a significant difference ($P<0.05$) between experimental treatment

Also, the amino acids have a role in increasing metabolic hormones, which have a direct impact on improving the nutritional representation and the growth of animals (Kassim et al 2019). These results agree with the results of

Muhammad and Abubakar (2012), when used protected methionine at different levels of (0.2% and 0.4%/kg dry matter) in the lamb diet, where he noted a significant improvement in the rate of live body weight. Also, Amrutkar et al (2015) in his study on the calves (Karan-Friza breed) when use diets include 5g of protected methionine and 20g of protected lysine, found a significant increase in live body weight. Kassim et al (2019) reported that using a mix of amino acids at 10g/head/day dosage caused elevation in the bodyweight of lambs as compared with a control.

Whereas, the results did not agree with the results of the Wiese et al (2003) when giving protected methionine at (0, 1, 2, 3, and 5) g/day/head in the diet of Merino lambs on body weight. Similary, Obeidat et al (2008) did not find differences between Awassi lambs in body weight when using protected methionine at levels 0.7%, and 1.4% day/head in the diets, may due to the difference in the results of this study with other studies because of differences in age, breed, the type of animals, food additives and the amount of amino acids in diets (Rodriguez-Guerrer et al 2018).

Table 4 shows the daily and the final average weight during the study period. There was a significant increase ($P<0.05$) in 4th and 2nd treatments (171.18, 160.77g), respectively, compared with the control group, which recorded 123.55 g. As well as, the same table observed significant differences ($p<0.05$) in the total gain in 4th and 2nd treatments (15.40, 14.46) kg, respectively compared with the control group 11.11kg. This may be caused by the improvement the weighting daily gain is the result of adding the protected amino acids, which stimulate growth hormone secretion. (Sun et al 2007). These results are consistent with the results of the Hassan et al (2011) when using protected Arginine in feeding the Awasi lambs in the average daily gain and total gain in comparison with the control group.

Table 4 The effect of adding protected amino acids on the daily gain (g) and the total gain (kg) (Mean ± S. E.).

Period / Treatment	0-30 days	30-60 days	60-90 days	Overall mean 0-90 days	Total gain
Control (1st)	150.00^{b} ± 20.70	109.66^{b} ± 10.60	111.00^{b} ± 10.70	123.55^{b} ± 12.99	11.11^{b} ± 0.62
5g methionine/kg diet (2nd)	188.33^{a} ± 10.60	156.66a ± 14.40	137.33^{ab} ± 17.00	160.77^{ab} ± 14.90	14.46^{a} ± 1.57
5g lysine/kg diet (3rd)	169.00^{b} ± 15.20	24.33^{b} ± 11.40	120.66^{b} ± 14.50	137.77^{b} ± 16.80	12.40^{b} ± 1.95
5g methionine +5g lysine/kg diet (4th)	181.33^{a} ± 12.99	163.66^{a} ± 17.70	168.56^{a} ± 12.20	171.18^{a} ± 19.90	15.40^{a} ± 1.26
Significant level	0.05	0.05	0.05	0.05	0.05

Different small letter within column means a significant difference ($P<0.05$) between experimental treatment

As for the results of the study of Yahya and Abubakar (2012), when added protected methionine at different levels (0.2%, 0.4%/kg of dry matter) to the diets of fattening lambs where they noticed a significant increase in the average daily gain compared with the control group. Elwakeel et al (2018) did not record significant differences in the average daily gain when fed Barki lambs on diets contain 3g of protected lysine. Also, Abdelrahm (2010) did not find significant differences in the average total gain when fed Baladi goat breed on protected methionine (0, 2.5, 5) g/head/day. As it happened with Gami et al (2017) when they added lysine and methionine protected at levels 2 and 17 g/ kg feed, respectively, to the diets of buffalo calves aged between 7 to 12 months.

Table 5 shows a statistically increase in the food consumption rates throughout the experiment of the 4th and 2nd treatment (1.080, 0.320) g/head/day, respectively, compared with the 3rd and 1st groups (0.973, 1.004) g/head/day, respectively. This is consistent with the result of Muhammad and Abubakar (2012) on lambs and Li et al (2019) on Ningxia Tan lambs (China breed) at 5 months old. While, did not agree with Acosta et al (2012) on Creole lambs at small ages, and, with Abdelrahman (2013), who did not find differences between groups in food consumption when used 2.5 g/head/day of protected lysine on Shami goats.

Table 5 The effect of adding protected amino acids on the feed consumption and feed conversion efficiency.

Parameters / Treatment	Feed consumption kg/head/day	Food conversion efficiency kg feed/ kg gain
Control (1st)	1.004	8.139
5g methionine/kg diet (2nd)	1.033	6.432
5g lysine/kg diet (3rd)	0.973	7.063
5g methionine +5g lysine/kg diet (4th)	1.080	6.316

Table 5 indicated as well as to the overall mean of food conversion efficiency. The 4th and 2nd groups were the best in feed conversion (6.316, 6.432) kg feed/ kg gain as compared with the 1st and 2nd groups (8.139, 7.063) kg feed/ kg gain. The reason for the improvement of the food conversion efficiency to protect the protein and amino acids from

in the rumen by micro-organism into microbial protein with ensuring digested and absorbed in the stomach and small intestine by treatment of amino acids with formalin (Al-Badri 2012; Kandil et al 2017). These findings are similar to the reports of Muhammad and Abubakar, (2012), when fed lambs fatting diets contained 0.2 and 0.4 %/ kg dry matter, and, with Li, et al (2019) when used protected methionine at different levels (0, 1.5, 3, 4.5, 6) g/head/day in the diets of Ningxia Tan male lambs at 5 months old. As it happened with Gami et al (2017) when they added lysine and methionine protected at levels 2 and 17 g/ kg feed, respectively, to the diets of buffalo calves aged between 7 to 12 months.

The data are shown in Table 6 indicated that was a significant (P<0.05) increase in the hot carcass weight and dressing percentage in 4th group (21.69 kg, 50.01 %) respectively, in comparison with 3rd and control (1st) groups (19.51 kg, 48.32%), (18.20 kg, 46.66%). The reason for the excess weight of the carcass in 4th treatment may due to increase the final body for this group as compared with other groups because of there is a strong relationship between weight carcass and the live weight of the animal, or may due to use methionine and lysine protected as supplements in ruminant diets, which improves the performance trails of animals such as the rates of growth of animals, the efficiency of food conversion and the quantity and quality of the carcass (Gami et al 2017; Abdelrahman and Hunaiti 2008).

Table 6 The effect of adding protected amino acids on the hot carcass weight (kg) and dressing percentage (%) (Mean ± S. E.).

Parameters / Treatment	Hot carcass weight	Dressing percentage
Control (1st)	18.20^{c} ± 1.35	46.66^{c} ± 2.50
5g methionine/kg diet (2nd)	20.68^{ab} ± 1.27	49.00^{ab} ± 1.41
5g lysine/kg diet (3rd)	19.51^{b} ± 1.80	48.32^{b} ± 2.75
5g methionine +5g lysine/kg diet (4th)	21.69^{a} ± 1.32	50.01^{a} ± 2.20
Significant level	0.05	0.05

Furthermore, added protected amino acids may due to improve the representation of food and reduce the damage of muscle protein and increase the amount of protein that arrives in the intestines and thus meet the requirements of the tissues, which effect on the increase of the final body weight. The results were similar with the results of the Abdelrahman and Hunaiti (2008), when added methionine (0, 2, 4) g/day/head to the diets of Awasi lambs led to a significant increase in hot carcass weight and dressing percentage in comparison with the control group Also, agree with Hassan et al (2011) when added arginine protected to lambs Awasi diets find a significant increase in weight of the carcass compared with the control group.

Furthermore, Kassim et al (2019) when using a mix of amino acids at dosage 10 g/head/day, the percentage of methionine and lysine in the mix of amino acids was 18%, recording a significant increase in the carcass weight of the lambs compared with the control group. There were no significant differences shown between groups in the carcass weight and dressing percentage through added methionine and lysine to the diets lamb (Ao et al 2019). As well as, Kudrnáčová et al (2019) recorded no significant differences between groups when they use methionine protected (5g/head/day) in the diet of deer on carcass weight and dressing percentage in comparison with the control group.

There was a significant increase (P < 0.05) in the weight of shoulder and leg in 4th and 2nd treatments (5.97, 5.02) kg and (5.91, 4.97) respectively, compared with the control (5.06, 4.35) kg (Table 7). No significant differences were observed in weights of the neck, ribs, and loin cuts, which may due to the direct correlation between carcass weight and dressing percentage and the weight of cuts that improved when adding protected amino acids.

Table 7 The effect of adding amino acids protected on the weights of carcass cuts (kg) (Mean ± S. E.).

Parameters / Treatment	Neck	Shoulder	Ribs	Loin	leg
Control (1st)	1.33 ± 0.08	5.06^{b} ± 0.32	2.31 ± 0.21	2.2 ± 0.26	4.35^{c} ± 0.49
5g methionine/kg diet (2nd)	1.40 ± 0.06	5.91^{a} ± 0.26	2.73 ± 0.23	2.43 ± 0.30	4.97^{a} ± 0.38
5g lysine/kg diet (3rd)	1.38 ± 0.07	5.70^{ab} ± 0.30	2.46 ± 0.24	2.41 ± 0.24	4.70^{b} ± 0.40
5g methionine +5g lysine/kg diet (4th)	1.43 ± 0.09	5.97^{a} ± 0.41	2.75 ± 0.28	2.45 ± 0.29	5.02^{a} ± 0.41
Significant level	N. S	0.05	N. S	N. S	0.05

Different small letter within column means a significant difference (P<0.05) between experimental treatment

The results of this study agreed with the of Obeidat et al (2008) and with Kassim et al (2019) when using a mix of amino acids at dosage 10 g/head/day, the percentage of methionine and lysine in the mix of amino acids was 18%, since they found a significant increase in the weight of the shoulder and leg and no significant differences in the weight of the rib in comparison with control group lambs.

Conclusion

To use protected amino acid in dosage 5g methionine/Kg or 5g methionine + 5g lysine/kg in the diet of Arabi lambs will increase daily gain and body weight significantly and improve food conversion efficiency and hot carcass weight and dressing percentage of fed lambs.

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