EFFECT OF REPLACING TREATED AND UNTREATED CORN IMPURITIES WITH UREA INSTEAD OF WHEAT BRAN ON PRODUCTIVE PERFORMANCE OF AWASSI LAMBS

Thaer A. M. Al-Mamouri[1] **J. A. Tawfeeq Al-Ani[2]**
Researcher **Prof.**
[1]Mesopotamia General Seed Company/ Ministry of Agriculture,
thaer.abd1101a@coagri.uobaghdad.edu.iq
[2]Dep. of Animal Prod. /Coll. Agric. Engin. Sci./ University of Baghdad
jamal.tawfiq@coagri.uobaghdad.edu.iq

ABSTRACT

The study was conducted to study the effect of replacing different levels of treated and untreated corn impurities with urea instead of wheat bran on productive performance of Awassi lambs. Wheat bran were replaced by five levels of treated and untreated corn impurities as: 44:0%, 32:11%, 20:22%, 10:32% and 0:39% bran: impurities in a 2×5 factorial experiment. Concentrated fed at 3% of live body weight as dry matter basis, while alfalfa hay was offered ad libitum. Forty Awassi lambs were used, with an initial weight of 27.45 ± 2.16 kg and 4-5 months old. All lambs were fed individually feeding for 70 days, preceded by 14 days as adaptation period. Results showed a non-significant superiority in dry matter and nutrients intake by increasing corn impurities and a highly significant increased (p<0.01) in ether extract and ash intake (g/day), with superiority of digestibility (P<0.05) of organic matter% (OM) and crude protein% (CP), feed efficiency, daily gain (g/ day) and total weight gain (kg) for feeding 30% of corn impurities treated with urea (T9). In conclusion, it is possible to use corn impurities instead of wheat bran, preferably treated with urea to increase crude protein content, degraded crude fibers and improved nutritional values.

Key words: ruminant, by-product, corn impurities, urea, digestibility, feed efficiency.

تأثير احلال شوائب الذرة المعاملة وغير المعاملة باليوريا بدلاً من نخالة الحنطة في الأداء الإنتاجي للحملان العواسي

ثائر عبد علي منهل المعموري[1] **جمال عبدالرحمن توفيق العاني[2]**
باحث **أستاذ**
[1]شركة مابين النهرين العامة للبذور /وزارة الزراعة
[2]قسم الإنتاج الحيواني/ كلية علوم الهندسة الزراعية/ جامعة بغداد

المستخلص

أجريت هذه الدراسة لمعرفة تأثير احلال مستويات مختلفة من شوائب الذرة المعاملة وغير المعاملة باليوريا بدلاً من نخالة الحنطة في الأداء الإنتاجي للحملان العواسي. تم احلال نخالة الحنطة بخمسة مستويات من شوائب الذرة المعاملة وغير المعاملة بالنسب: 44: 0٪ ، 32: 11٪ ، 20: 22٪ ، 10: 32٪ و 0: 39٪ نخالة: شوائب في تجربة عاملية 2 × 5. قدّم العلف المركز بنسبة 3٪ من وزن الجسم الحي على أساس المادة الجافة، وقدّم دريس الجت بشكل حر. تم استخدام 40 حمل عواسي بوزن أولي 27.45 ± 2.16 كغم وعمر 4–5 شهور. غُذيت الحملان تغذية فردية لمدة 70 يومًا، سبقتها 14 يومًا فترة تمهيدية. أظهرت النتائج تفوقًا غير معنوي في تناول المادة الجافة والعناصر الغذائية بزيادة شوائب الذرة وزيادة عالية المعنوية (p <0.01) في تناول مستخلص الإيثر والمادة غير العضوية (غم/ يوم)، وتفوق معامل الهضم (P <0.05) للمادة العضوية% (OM) والبروتين الخام % (CP)، وكفاءة التحويل الغذائي، والزيادة الوزنية اليومية (غم/ يوم) والزيادة الوزنية الكلية (كغم) عند تغذية نسبة 30٪ من شوائب الذرة المعاملة باليوريا (T9) . نستنتج امكانية استخدام شوائب الذرة بدلا من نخالة الحنطة ويفضل معاملة شوائب الذرة باليوريا لزيادة المحتوى البروتيني الخام والألياف الخام المهضومة وتحسين قيمتها الغذائية.

الكلمات المفتاحية: المجترات، مخلفات عرضية، شوائب الذرة، يوريا، معامل الهضم، كفاءة التحويل الغذائي

Received: 2/1/2022, Accepted:13/3/2022

INTRODUCTION

There are huge numbers of agro-waste or untraditional and bulky feeds that could be used in ruminants feeding. Agro or industrial - waste is defined as agricultural or industrial by-products that don't enter the production process but are associated with the main products like straw, the most widespread agricultural wastes due to direct connection with the production of strategic grains (12). Nutritional value of feeds is a paramount necessity to determine the profit yield from farming ruminants, as feeding costs 75-80% of the capital (23), Therefore, nutritionists interested in using additives to increase the production or improving nutritional value of bulky feeds through physical, chemical or biological treatments. Adding fat-soluble vitamins pre- and post-mating of ewes led to improve the reproductive performance (1), or adding vitamin E to enhance growth (15) while, Khalid and Al-Anbari (16) referred to enhance milk yield by adding 150 ml/ day glycerol to the rations of Holstein cows. Adding ajwain seeds to the rations enhance health and growth performance (8). In addition, the dependency of locally available fodder reduces environmental pollution, recycling and lowering production costs. Many untraditional wastes were used, Seifdavati et al. (21) used pumpkin wastes after harvest with 40% of alfalfa hay to produce good quality silage, Conceição et al. (6) replaced cactus instead of wheat bran and said it could be used with another source roughage due to the low fiber content. Babale et al. (5) mentioned that corn cobs could be replaced with corn bran up to 40% and reduced cost of production. Wheat bran has good protein content with low crude fibers, but it has a high price locally, while corn impurities is cheap with low crude protein and high fiber content, so it is very appropriate to treat with urea and incubation for 30 days at a humidity 60% in order to increase its content of crude protein and reduce the proportion of crude fibers, that’s lead to improve nutritional value (11). Emmanuel et al. (9) stated that treated roughage feeds with 1% urea could positively improve dry matter intake, digestibility, growth performance and feed efficiency of growing camels. Urea hydrolysis to NH_3 by rumen microorganism's enzymes within 2hours after feeding and occurs at a higher rate of NH_3 (14), and could used by soaked grains with urea without side effects in contrast direct feeding of urea (24). So, if we want to increase voluntary feed intake of agro-industrial by--products treated with urea, it's preferable to provide rapid digestible energy like molasse or barley grains to create a synchronization between the release of ammonia and energy fermentation and resulted increased dry matter intake. Recycling of agricultural and industrial by-products is very important to achieve more feed for ruminants and offset the reduction of natural grazing in arid and semi-arid areas and benefit from untraditional feeds like corn impurities. In general, corn cobs formed 8 - 15% as by-products of corn production, while corn impurities formed 1.2 -1.8%. In Iraq, impurities were 9557 tons from 2015 - 2020 and tended to increase every year with expansion of corn production, it's inexpensive and cost 30$ per ton. Al-Ani et al. (2) found that using whey powder had no effect on blood urea comparing with urea nitrogen or expensive soya protein. Nowadays, strategies for using residues in feeds have developed feeding systems to make more profit without affecting the animals, for this reason, this study aimed to evaluate the effect of replacing treated and untreated corn impurities with urea instead of wheat bran on feed intake, digestibility, growth efficiency and feed efficiency in Awassi lambs.

MATERIALS AND METHODS

Chemical treatment and experimental feeds: Chemical treatment of corn impurities with urea (ureated corn impurities UCI) was carried out by adding urea to prepare 3.3% nitrogen (7.17% urea as dry basis) at air temperature (about 30 °C) and a humidity 60% (adding 60L water per 100 kg dry matter corn impurities that is meaning added 50L water for 90% dry matter of impurities which equivalent 60% humidity) for 30 days of incubation period as Hassan and Tawffek (11) as follows: Calculate the amount of urea required to achieve 3.3% nitrogen (7.17 kg urea/ 100 Kg DM of impurities); Calculate the amount of water required to achieve 60% of humidity as DM basis of impurities, then, dissolve urea with water to prepare urea solution, put the impurities on clean nylon and spray prepared urea solution with manual mixing of impurities until homogeneity, then wrapped tightly to ensure the ammonia gas liberated from the decomposed urea does not come out. After 30 days, open the nylon with continuous mixing for drying and volatilization of the remaining ammonia gases. After drying, it was sampled for chemical analysis (Table 1) as AOAC (4) and collected in bags until they were used in experiment. Ingredients of concentrated feeds included barley, wheat bran, soybean meal, mineral and vitamins; wheat bran were replaced by treated and untreated corn impurities with urea as: 44:0%, 32:11%, 20:22%, 10:32% and 0:39%, all mixed to produce ten experimental treatments then sampled for analysis (Table 1) as AOAC (4). Concentrate was fed at 3% of body weight as DM basis, while alfalfa hay was provided ad libitum.

Experimental animals and management

Forty Awassi male lambs aged 4 -5 months with initial weight 27.45 ± 2.16 kg were randomly distributed to ten treatments to replace treated and untreated corn impurities with urea instead of wheat bran at levels: 0, 11, 22, 30 and 39 (%). Individual feeding was conducted for 70 days of experiment preceded by 14 days as adaptation period. All animals were provided clean water, vaccines and kept continuous veterinary supervision all experimental, concentrated feed was given at 3% of live body weight as DM basis, while alfalfa hay offered ad-libitum with remaining. Residual feeds were recorded to calculate daily intake and daily faecal were collected and weighted for five days to determine the digestibility of nutrients, there were weekly weighted for all replicate to monitor live weight changes.

Statistical analysis

All data were statistically analyzed using completely randomized design (CRD), factorial experiment 2 × 5, One-way ANOVA analysis was performed using statistical program (20) while Duncan's multiple range test was used to determine the significant differences ($p<0.05$) and ($p<0.01$) among treatments (7) using following formula:

Yijk = μ + Ai + + Bj + AB(ij) + eijk

Table 1. Formulation and chemical composition of concentrated feeds, alfalfa hay, corn impurities and ureated corn impurities on DM basis (%)

	Untreated corn impurities (%)					Ureated corn impurities (%)							
Ingredients	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**alfalfah ay**	**CI**	**UCI**
Barley	46	46	46	46	46	46	46	46	46	46			
Wheat bran (WB)	44	32	20	10	0	44	32	20	10	0			
Corn impurities (CI)	0	11	22	30	39	0	11	22	30	39			
Soya bean meal (SBM)	8	9	10	12	13	8	9	10	12	13			
Minerals & Vitamins	2	2	2	2	2	2	2	2	2	2			
Dry matter (DM) %	91.29	90.51	91.46	91.69	91.57	91.29	89.62	81.67	78.81	71.42	87.37	93.46	61.85
Organic matter (OM) %	93.53	93.4	92.55	91.36	90.12	93.53	93.37	92.13	91.53	90.71	91.20	87.97	87.75
Crude protein (CP) %	15.96	15.30	14.91	14.05	13.64	15.96	16.17	17.00	17.38	17.52	16.32	7.36	16.77
Ether extract (EE) %	3.92	2.98	3.18	2.80	3.06	3.92	3.73	3.81	3.60	3.50	1.47	3.06	1.54
Crude fiber (CF) %	12.20	12.66	12.89	13.16	14.12	12.20	12.44	12.45	12.68	13.35	24.33	19.95	17.09
Inorganic matter (ash) %	6.47	6.6	7.45	8.64	9.88	6.47	6.63	7.87	8.47	9.29	8.80	12.03	12.25
Nitrogen free extract (NFE)	61.45	62.46	61.57	61.35	59.30	61.45	61.03	58.87	57.87	56.34	49.08	57.60	52.35
***Me (MJ/kg DM)**	12.35	12.13	12.05	11.82	11.60	12.35	12.26	12.08	11.74	11.74	10.51	10.89	8.80
pH value	6.25	6.20	6.00	6.03	6.00	6.25	6.40	6.31	7.80	7.85	6.37	6.11	8.18

*** Me = Metabolic energy (MJ/kg DM) = 0.012 × crude protein + 0.031 × ether extract + 0.005 × crude fiber + 0.014 × nitrogen free extract…(17). CI= Corn impurities; UCI= Ureated corn impurities; T1= WB 44% and CI 0; T2 = WB 32% and CI 11%; T3 = WB 20% and CI 22%; T4 = WB 10% and CI 30%; T5 = WB 0 and CI 39%; T6= WB 44% and UCI 0; T7 = WB 32% and UCI 11%; T8 = WB 20% and UCI 22%; T9 = WB 10% and UCI 30%; T10 = WB 0 and UCI 39%.**

RESULTS AND DISCUSSION

Feed intake and digestibility

Results of table (2) indicated no significant effect of adding corn impurities on dry matter of nutrients and metabolizable energy (MJ/ day) intakes, and linear increase of ash intake (P<0.01) with increasing corn impurities, and ether extract intake (g/ day) (P<0.01) for ureated corn impurities T8 compared with untreated T4, the insignificantly effects of daily feeds intake was a positive indicator to known good palatability of CI as well as wheat bran, while the increasing of ash intake with increasing corn impurities was due to increase ash content in agricultural residues 12.25% compared to 4.04% in wheat bran. Tawfeeq et al (25) referred to higher digestibility with increasing of DM intake, higher rumen flow rate with efficient fermented work when substituted hydroponics barley with barley grains to provide green fodder in tropical and subtropical countries that have few natural pastures due to lack of rain. The benefits of using by-products in feed are reducing environmental pollution and the cost of feed, recycling, integrated agricultural crops with animal husbandry, decreasing the competition between humans and animals for ingredients, which leads to increased productivity of land. Hurley et al. (13) referred to increased animal production when they were given grass-clover compared to grass-only swards because of crude protein content. The increasing of processed feeds will make more industrial by-products and co-products (26), so it's important to recycle by-products as much as possible. The effect of treated and untreated corn impurities instead of wheat bran on digestibility of dry matter and nutrients are shown in table (3). Significant increases in the DM digestibility and nutrients intake (P<0.05) with superiority for corn impurities treated with urea (ureated corn impurities, UCI) treatments comparison to untreated (CI). Ruminal digestibility controlling feed intake especially with low-energy diets (3), Crude fiber or structural carbohydrate is very important for the physiology ruminant's digestive system. So, corn impurities could be great especially with urea treatment, and the digestibility of metabolizable energy (%) increased with increasing impurities, the same way for crude protein digestibility (%), similar results was presented by Babale et al. (5) when replaced corn bran with corn cobs, and found better rumen characteristics, total bacteria count with 50% cobs relatively to better rumen ecosystem.

Table 2. Effect of replacing treated and untreated corn impurities with urea on feed intake (g/day) ± Standard error

Tret.	DM	OM	CP	EE	CF	Ash	NFE	Me*
T1	1116±38.18	1034±35.62	180±6.11	33.32±1.41bac	188±5.15	82.12±2.56c	633±22.99	13.00±0.47
T2	1181±72.69	1094±67.69	185±11.2	28.98±2.03bac	197±10.28	86.94±5.00bc	682±44.18	13.65±0.87
T3	1120±98.56	1031±91.17	173±14.8	28.62±3.00bc	191±13.59	88.99±7.45bac	639±59.73	12.87±1.18
T4	1157±56.94	1057±52.02	172±8.00	26.88±1.60c	199±7.52	100.66±4.92ba	659±34.93	13.14±0.67
T5	1145±49.56	1036±44.74	167±6.93	28.46±1.42bc	204±7.65	108.66±4.83a	637±28.75	12.83±0.57
T6	1116±38.18	1034±35.62	180±6.11	33.32±1.41bac	188±5.15	82.12±2.56 c	633±22.99	13.00±0.47
T7	1176±50.90	1090±47.72	191±8.22	34.89±2.12bc	194±5.46	86.61±3.19 bc	670±32.18	13.72±0.64
T8	1188±38.00	1091±34.98	199±6.44	35.64±1.39a	197±5.09	97.34±3.02 bac	659±22.11	13.71±0.46
T9	1175±82.70	1074±75.67	200±14.29	33.77±2.81bac	196±11.44	100.82±7.03ba	645±47.16	13.45±0.98
T10	1123±43.43	1020±39.43	192±7.54	30.98±1.41bac	195±6.43	102.29±4.01ba	603±24.06	12.68±0.50
Sign.	NS	NS	NS	**	NS	**	NS	NS

Different litters in same column means significant differences; NS= non-significant differences; ** Significant differences at level 0.01. Me*=MJ/ day; T1= WB 44% and CI 0; T2 = WB 32% and CI 11%; T3 = WB 20% and CI 22%; T4 = WB 10% and CI 30%; T5 = WB 0 and CI 39%; T6= WB 44% and UCI 0; T7 = WB 32% and UCI 11%; T8 = WB 20% and UCI 22%; T9 = WB 10% and UCI 30%; T10 = WB 0 and UCI 39%.

Table 3. Effect of replacing treated and untreated corn impurities with urea on digestibility of dry matter, nutrients and metabolizable energy (%) ± Standard error

Growth performance and feed efficiency

Tret.	DM	OM	CP	EE	CF	Ash	NFE	Me
T1	63.24±0.85c	64.47±0.82c	69.64±0.74b	81.84±2.04	46.58±1.59c	47.71±1.24dc	62.34±0.71dc	66.93±0.80b
T2	68.70±2.41ba	70.17±2.24a	74.57±1.34ba	82.00±1.94	47.22±9.42c	50.31±5.05bc	71.00±0.86a	73.16±1.35a
T3	63.73±1.91bc	65.99±1.83bac	70.31±0.76b	85.10±2.50	51.76±2.08bc	37.52±2.82d	63.31±2.42bdc	68.04±1.92b
T4	63.46±1.64c	64.82±1.35bc	73.03±4.01ba	78.99±5.46	64.87±1.88a	49.16±5.74c	61.29±4.45d	67.14±3.14b
T5	68.92±2.13a	69.36±1.90ba	74.65±3.61ba	86.69±1.12	56.85±3.28bac	64.73±4.54a	66.80±2.06bdac	71.00±1.91ba
T6	63.24±0.85c	64.47±0.82c	69.64±0.74b	81.84±2.04	46.58±1.59c	47.71±1.24dc	62.34±0.71dc	66.93±0.80b
T7	66.97±0.71bac	68.46±0.64bac	71.13±0.29b	87.31±0.29	57.29±0.80bac	48.19±1.51dc	69.61±1.11bc	73.31±0.71a
T8	67.34±1.56bac	69.09±1.41bac	75.17±2.05ba	85.73±2.70	49.22±2.22c	47.69±3.44dc	67.92±1.27bac	71.92±1.02ba
T9	68.27±0.54bac	69.06±0.51bac	75.72±1.80ba	88.34±1.53	66.01±3.39a	59.86±0.91ba	64.60±0.67bdc	71.20±0.20ba
T10	68.83±0.46a	69.63±0.42a	77.98±0.22a	86.22±1.37	61.83±8.19ba	60.92±1.09a	68.62±0.54bac	73.68±0.32a
Sign.	*	*	*	NS	*	*	*	*

Different litters in same column means significant differences; NS= non-significant differences; * Significant differences at level 0.05; T1= WB 44% and CI 0; T2 = WB 32% and CI 11%; T3 = WB 20% and CI 22%; T4 = WB 10% and CI 30%; T5 = WB 0 and CI 39%; T6= WB 44% and UCI 0; T7 = WB 32% and UCI 11%; T8 = WB 20% and UCI 22%; T9 = WB 10% and UCI 30%; T10 = WB 0 and UCI 39%.

The results of replacing treated and untreated corn impurities with urea instead of wheat bran showed no significant differences between treatments in initial and final weight (Table 4), while daily gain (g/day) and total gain (Kg) for the treatment 9 (T9) was significantly superior (P<0.05) comparison to other treatments. The non-significance of initial weight was due to the random distribution at the beginning of experiment that led to reduction in variation between treatments, while non-significance of final weight indicated to ability of substitution corn impurities instead of wheat bran without negative effects to growth performance, it is obviously that feeding ureated corn impurities 30% (T9) resulted in linear increases in weekly gain (kg) compared to T1 or control (figure 1), and the same results for final live weights (kg) of animals (figure 2). The results of feed efficiency (Table 5) indicated significant increases (P<0.05) especially when treating corn impurities with urea T9 compared to other treatments and accompanied by improvement energy and protein efficiency, Freitas et al. (10) evaluated the effect of corn, soybean hulls and wheat bran on performance of fattening steers and found that soybean hulls had better feed efficiency compared to wheat bran and referred that soybean hulls could completely replace corn to use as alternative source of carbohydrate in feeds, Ramos-Aviña et al. (19) said that high crude fiber in steam-flaked corn batter for daily gain and feed efficiency for fattening Holstein steers, Suárez et al. (22) said that roughages stimulate rumen development in earlier and could improve performance veal calves later in fattening, and Mollenhorst et al. (18) showed negative effects when increasing solid feeds in veal calves feeding. Therefore, it is important to follow the gradual provision of feed, change ingredients or increase the quantity, whether for small or large animals, to create adaptation within the rumen environment and the animal's body as a whole. In conclusion, it is possible to use corn impurities instead of wheat bran, preferably treated with urea.

Table 4. Effect of replacing treated and untreated corn impurities with urea on daily gain (g/day), final and total weight gain (kg) and ± Standard error

Treat.	Initial weight (kg)	Final weight (kg)	Daily gain (gm/day)	Total gain (kg)
T1	27.38±0.75	37.83±1.59	149.29±12.86b	10.45±0.90b
T2	27.50±0.98	38.67±1.65	159.57±17.74b	11.17±1.24b
T3	27.50±1.32	37.67±2.78	145.29±21.16b	10.17±1.48b
T4	27.50±1.24	40.00±2.16	178.57±14.58ab	12.50±1.02b
T5	27.63±1.46	37.17±2.99	136.29±27.57b	9.54±1.93b
T6	27.38±0.75	37.83±1.59	149.29±12.86b	10.45±0.90b
T7	27.50±1.17	38.83±1.74	161.86±16.24b	11.33±1.14b
T8	27.50±1.19	39.50±1.59	171.43±16.75ab	12.00±1.17b
T9	27.38±1.34	43.17±2.74	225.57±20.85a	15.79±1.77a
T10	27.25±1.25	38.67±1.55	163.14±12.20ab	11.42±0.85b
Sign.	NS	NS	*	*

Different litters in same column means significant differences; NS= non-significant differences; * Significant differences at level 0.05; T1= WB 44% and CI 0; T2 = WB 32% and CI 11%; T3 = WB 20% and CI 22%; T4 = WB 10% and CI 30%; T5 = WB 0 and CI 39%; T6= WB 44% and UCI 0; T7 = WB 32% and UCI 11%; T8 = WB 20% and UCI 22%; T9 = WB 10% and UCI 30%; T10 = WB 0 and UCI 39

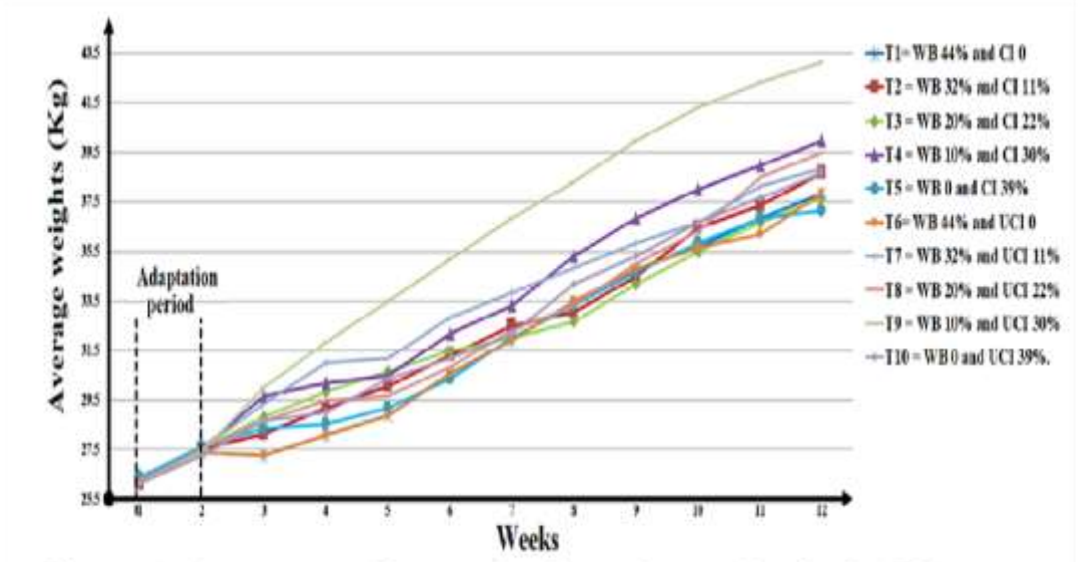

Figure 1. Average weekly growth of experimental animals (Kg)

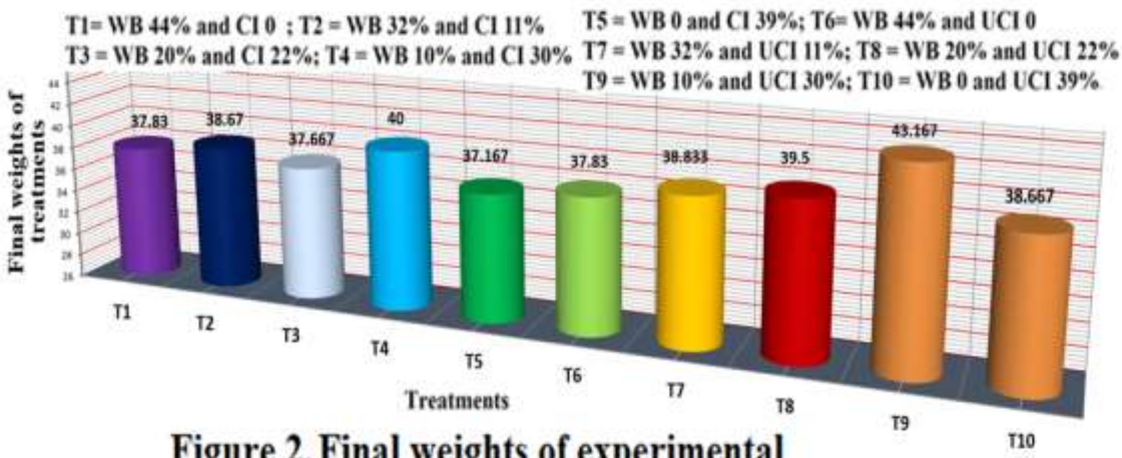

Figure 2. Final weights of experimental treatments (Kg)

Table 5. Effect of replacing treated and untreated corn impurities with urea on feed efficiency ± Standard error

Treat.	Concentrated feed intake/ daily gain	Total feed intake/ daily gain (gm/day)	Metabolic energy intake (KJ/day) / daily gain (gm/day)	Protein intake/ daily gain	Energy intake (KJ/day) / Crude protein (gm/day)
T1	4.62±0.18bac	7.48±0.36bac	0.09±0.004a	1.21±0.06ba	0.0723±0.00c
T2	4.83±0.39bac	7.40±0.57bac	0.9±0.007a	1.16±0.09ba	0.739±0.00b
T3	4.89±0.60ba	7.71±1.05bac	0.09±0.011a	1.19±0.16ba	0.0744±0.00b
T4	4.16±0.34bc	6.48±0.49bc	0.07±0.006ba	0.96±0.07ba	0.0750±0.00a
T5	5.37±0.82a	8.40±1.34a	0.09±0.015a	1.23±0.20a	0.0767±0.00a
T6	4.62±0.18bac	7.48±0.36bac	0.09±0.004a	1.2410.06ba	0.0723±0.00c
T7	4.81±0.47bac	7.27±0.73bac	0.09±0.009a	1.18±0.12ba	0.0719±0.00c
T8	4.53±0.53bac	6.93±0.75bac	0.08±0.009ba	1.16±0.13ba	0.0688±0.00d
T9	3.44±0.29c	5.21±0.40c	0.06±0.004b	0.89±0.07b	0.0673±0.00f
T10	4.47±0.35c	6.88±0.52bac	0.08±0.006ba	1.19±0.09ba	0.0661±0.00e
Sign.	*	*	*	*	**

Different litters in same column means significant differences; * Significant differences at level 0.05; ** Significant differences at level 0.01; T1= WB 44% and CI 0; T2 = WB 32% and CI 11%; T3 = WB 20% and CI 22%; T4 = WB 10% and CI 30%; T5 = WB 0 and CI 39%; T6= WB 44% and UCI 0; T7 = WB 32% and UCI 11%; T8 = WB 20% and UCI 22%; T9 = WB 10% and UCI 30%; T10 = WB 0 and UCI 39%.

ACKNOWLEDGEMENTS

The authors are grateful to the College of Agricultural Engineering Sciences, University of Baghdad, and the workers in the laboratories of higher studies for their valuable material support and assistance during the experimental period.

CONTRIBUTIONS OF AUTHORS

Authors read and commented on draft versions, and agreed to the published version of the manuscript, and there are no conflicts of interest.

REFRENCES

1. Abdulkareem, T.A., S.M. Eidan, F. K. Al-Saidy and N. K. Al-Hassani. 2023. Effect of pre-and post – mating vitamins AD3E treatment on reproductive performance of Awassi ewes. Iraqi Journal of Agricultural Sciences, 54(2):431–437. https://doi.org/10.36103/ijas.v54i2.1717

2. Al Ani, J.A.T., A.A. Al-Wazeer, A.N. Kareem, and R.M. Shaker. 2021. Effects of crude protein degradability on some blood parameters of ruminants. IOP Conf. Ser.; Earth Environ. Sci. 910:1-6. doi:10.1088/1755-1315/910/1/012030

3. Allen, M.S. 2014. Drives and limits to feed intake in ruminants. Animal Production Science 54(10):1513–1524. doi:10.1071/AN14478

4. AOAC. 2012. Official Methods of Analysis, 19th ed.; Association of Official Analytical Chemists: Gaithersburg, MD, USA

5. Babale, D.M., S.M. Yahaya, H.D. Nyako, and T.F. Mbahi. 2018. Effects of Replacing Maize Bran with Maize Cob on Nutrients Utilization, Rumen Metabolites and Microbes of Red Sokoto Bucks. J Vet Ani Res 1: 102

6. Conceição, M.G., M.A. Ferreira, J.M.S. Campos, J.L. Silva, E. Detmann, M.C.B. Siqueira, L.J.A. Barros, and C.T.F. Costa. 2016. Replacement of wheat bran with spineless cactus in sugarcane-based diets for steers. Revista Brasileira de Zootecnia 45:158-164. doi: 10.9755/ejfa.2021.v33.i10.2773

7. Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics. 11: 1-42

8. El-Naggar, S., S. Gad, Z. Mahasneh, M. Tawilla and G Abou-Ward. 2023. Impact of adding Ajwain seeds to the mail lambs rations as growth promoters. Iraqi Journal of Agricultural Sciences. 54(6):1557–1564. https://doi.org/10.36103/ijas.v54i6.1856

9. Emmanuel, N., N.V. Patil, R.S. Bhagwat, A. Lateef, K. Xu, and H. Liu. 2015. Effects of different levels of urea supplementation on nutrient intake and growth performance in growing camels fed roughage based complete pellet diets. Anim. Nutr., 1: 356-361

10. Freitas, L. S., I.L. Brondani, L.R. Segabinazzi, J. Restle, D.C. Alves Filho, L.A.D. Pizzuti, V.S. Silva, and L.S. Rodrigues. 2013. Performance of finishing steers fed different sources of carbohydrates. Revista Brasileira de Zootecnia, Viçosa, 42 (5): p. 354-362

11. Hassan, S.A., and J.A. Tawffek. 2009. Effect of washing and physical form of chemically treated barley straw on nutritive value, phenolic compound and activity of rumen bacteria. 3-Urea treatment. Iraqi Journal of Agricultural Science, 40(1): 118-127

12. Hassan, S.A., and J.A. Tawffek. 2009. Effect of washing and physical form of chemically treated barley straw on nutritive value, phenolic compound and activity of rumen bacteria. 2- Ammonia hydroxide treatment. Iraqi Journal of Agricultural Science 40 (1) :118-127

13. Hurley, M., E. Lewis, M. Beecher, B. Garry, C. Fleming, T. Boland, and D. Hennessy. 2021. Dry Matter Intake and In Vivo Digestibility of Grass-Only and Grass-White Clover in Individually Housed Sheep in Spring, Summer and Autumn. Animals. 11, 306. https://doi. org/10.3390/ani11020306

14. Ibrahim, S.S., J.A.T. Al-ani, A.A.M. Al-Wazeer, and R.M. Shaker. 2021. Impacts of feeding urea on rumen fermentation, total number of bacteria and some blood parameters in Shami goats. Emirates Journal of Food and Agriculture, 33(10): 863-867.

15. Kanyar I. M. and F. Karadaş. 2023. Effect of melatonin and vitamin E as antioxidants on body weight, carcass traits of Awassi lambs fed a high-energy and normal diet. Iraqi Journal of Agricultural Science. 54(5):1339–1350. https://doi.org/10.36103/ijas.v54i5.1835

16. Khalid, W.A. and N.N. Al-Anbari. 2023. Effect of glycerol on milk yield, its quality and blood parameters of Holstein cows. Iraqi Journal of Agricultural Sciences. 54(6):1520–1528. https://doi.org/10.36103/ijas.v54i6.1851

17. MAFF. 1975. Ministry of Agriculture Fisheries and Food Dept., of Agric. and Fisheries for Scotland Energy allowances and Feed systems for ruminants, Technical Bulletin, 33. First Published

18. Mollenhorst, H., P.B.M. Berentsen, H. Berends, W.J.J. Gerrits, and I.J.M. de Boer. 2016. Economic and environmental effects of providing increased amounts of solid feed to veal calves. J Dairy Sci. 99:2180–2189.

19. Ramos-Aviña D, A. Plascencia, and R. Zinn. 2018. Influence of dietary nonstructural carbohydrate concentration on growth performance and carcass characteristics of Holstein steers. Asian-Australas J Anim Sci., 31(6):859-863. doi:10.5713/ajas.17.0425.

20. SAS. 2012. User's Guide. Statistical, Version 9. 11th ed. Statistical Analysis System, Cary, NC, USA

21. Seifdavati, J., S. Seifzadeh, M. Ramezani, R.B. Mashak, R. Seyedsharifi, M.M.Y. Elghandour, A.B. Pliego, and A.Z.M. Salem. 2021. Wastes valorization of wheat straw and wheat bran treated with urea, probiotic or organic acids to enhance ruminal gas production and digestibility of pumpkin by-product. Waste Biomass Valor 12, 5979–5989. https://doi.org/10.1007/s12649-021-01432-y

22. Suárez, B. J., C. G. Van Reenen, N. Stockhofe, J. Dijkstra, and W. J. J. Gerrits. 2007. Effect of roughage source and roughage to concentrate ratio on animal performance and rumen development in veal calves. J. Dairy Sci. 90:2390–2403. http://dx.doi.org/10.3168/jds.2006-524

23. Tawfeeq, J.A., and S.A. Hassan. 2014. Handbook of Nutrition Science. First Edition, University of Baghdad. Academic Press

24. Tawfeeq, J.A., L.S. Ibrahim, R.M. Shaker, and Z.R. Hamza. 2017. In-vitro digestibility of barley grains treated with urea: in-vitro study. Iraqi Journal of Agricultural Science. 48(4). pp. 1075-1080. doi: 10.36103/ijas.v48i4.364

25. Tawfeeq, J.A., S.A. Hassan, S.H. Kadori, R.M. Shaker and Z.R. Hamza. 2018. Evaluation of feeding hydroponics barley on digestibility and rumen fermentations in Awassi lambs. Iraqi Journal of Agricultural Sciences, 49(4):p636- 645.

26. Yang, K., Y. Qing, Q. Yu, X. Tang, G. Chen, R. Fang, and H. Liu. 2021. By-Product Feeds: Current Understanding and Future Perspectives. Agriculture, 11, 207. https://doi.org/10.3390/ agriculture11030207.