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Effect of Feeding Non-Conventional Energy on Productive Performance of Rahmani Lambs.

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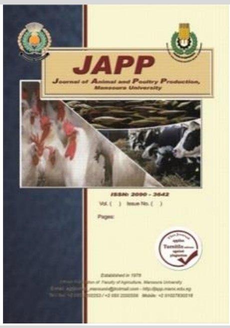

ABSTRACT

This study was conducted to assay the using of non- conventional energy sources on chemical composition, digestibility coefficients, cell wall constituents, nutritive value and productive performance of growing Rahmani lambs. Twelve Rahmani lambs with average body weight 22.60±0.20 kg and 4 months old were used in this study for 120 days. Lambs were distributed into two similar groups (6 lambs each) and randomly assigned to two experimental rations. The two respective rations composed of R_1 (control) contained 60% concentrate feed mixture (CFM)+40% rice straws(RS). While, R_2 consisted of 55% CFM + 40% RS + 5% corn steep liquor (CSL).The digestibility and nutritive values of experimental rations were determined using six adult Rahmani rams. Rumen liquor and blood samples were collected at the end of collection period. The results showed that nutrient digestibility and feeding values were higher ($P<0.05$) for rations R_2. The highest values of TDN and DCP were observed R_2. Digestibility of cell wall constituents (NDF, ADF, cellulose and hemicellulose) were improved by treatment. Blood constituents were generally normal in all experimental groups. Growth performance e.g. total body weight gain and average daily gain was improved in R_2. The same trend was observed for feed conversion and economic efficiency and the best values were recoded with R_2. It could be concluded that addition of CSL to ration of growing Rahmani lambs could improve their productive performance and economic feed efficiency.

Keywords: *Rahmani lambs, growth rate of lambs, blood parameters, non-conventional energy.*

INTRODUCTION

In ruminants, non-classical energy sources such as corn steep liquor (CSL) was reported to be a good source of protein, energy and minerals for the animals (Filipovic *et al*., 2002 and Pittroff *et al.*, 2006). Moreover, Notter *et al.*, (2012) concluded that diet with higher concentration of energy is recommended for finishing lambs, producing greater body weight gain, better corporal condition and a shorter time spent in feedlot. Feed flushing has been known as a tool to enhance ovulation rate and overall reproductive efficiency. Flushing is widely accepted practice in sheep husbandry to provide ewes with extra energy supply (flushing) prior to and during breeding season, for the purpose of increasing the number of lambs produced (Shad *et al.*, 2011).Corn steep liquor (CSL) is a major by-product of corn starch processing. It is an inexpensive source of nitrogen, vitamins, amino acids, peptides and soluble nutrients (Nisa *et al*., 2004).

High cost of conventional protein sources as well as competitiveness of dairy and feedlot cattle in feeding high quality protein sources made obligations on farmers to invest in different cheap by-products for lamb production. Previous works cleared that some industrial by-products those are rich in protein content had potential to use as ruminant nutrition feedstuff (Kazemi-Bonchenari *et al.*,2017).

It is viscous slurry with light to dark brown color, having ensiled odour and acidic pH (3.5) due to considerable amount of lactic acid (Sarwar *et al*., 2004. It contains about 40% crude protein on dry matter basis, out of which more than 90% is in the form of amino acids and peptides. Biological trials on beef animals by using CSL as a liquid source of protein supplement have been reported to enhance animal performance (Trenkle, 2002). Other studies suggest that it supports better weight gains and feed efficiency in steers kept on high roughage rations (Nisa *et al*., 2004). Use of CSL as growth medium in microbiological studies for growth and maintenance of microbes also gives indirect information about absence of any macro / micro undesirable / harmful element for animals. The present study was planned to examine the influence of feeding CSL as source of energy in growing lambs rations on chemical composition, digestibility coefficients, feeding value, some blood parameters , performance productive and their economic feed efficiency of Rahmani lambs.

MATERIALS AND METHODS

The experimental work of this study was carried out at El-Serw Experimental Research Station belongs to Animal Production Research Institute (APRI), Agriculture Research Center, Ministry of Agriculture, Giza, Egypt. Twelve Rahmani ram lambs at four months of age with an average live body weight 22.6±0.20 kg were assigned to two groups,(6 lambs for each) in growth feeding trial(120 days). The animals were fed according to NRC(1985)**,** two respective rations in two meals /day(8a.m and 3p.m). R_1(control) contained 60% concentrate feed mixture (CFM) + 40% rice straws (RS). While, R_2 consisted of 55% CFM + 40% RS + 5% corn steep liquor (CSL).

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Corn steep liquor (CSL) was obtained from Maize Industries. The chemical composition of CSL is shown in Table 1. Briefly, in corn wet-milling process, after cleaning corn is transported to large tanks called steeps. Warm water (125–140°F) having dissolved in sulphur dioxide is circulated in it for approximately 40 hr. Soaking softens the corn kernels, while diluted sulphurous acid (formed by interaction of water and sulphur dioxide) controls the fermentation and helps in separating starches and protein. The water is drained and concentrated via evaporated resulting behind the concentrated steep water called CSL. The steps of CSL manufacturing are Shelled corn; corn cleaners; steeps tanks; steeps water; steep water evaporator and corn steep liquor in the end. The experimental diets were prepared and adjusted daily by mixing basal diet with non-conventional energy materials. Fresh water and salt templates are presented free all experimental period to all groups. The chemical compositions of CSL, rice straw and concentrate feed mixture are chemically analyzed according to AOAC (2006) and results were shown in (Table1 and Table 2).

Table 1. Chemical Composition (% on DM basis) of Corn Steep Liquor(CSL),Rice Straw (RS) and Concentrate Feed Mixture (CFM).

Item	CSL	RS	CFM*
DM	63.89	89.22	88.7
OM	87.08	83.75	92.82
CP	14.46	3.86	14.16
CF	15.59	36.70	11.05
EE	2.85	1.75	2.30
NFE	54.18	41.44	65.31
Ash	12.92	16.25	7.18
NDF	35.62	74.20	27.75
ADF	26.14	40.31	8.86
ADL	4.93	8.50	2.98
Cellulose	21.21	31.81	5.88
Hemicelluloses	9.48	33.89	18.89
Gross energy (kcal /kg/DM)**	4021	3638	4188

*** Concentrate feed mixture (CFM) consisted of: 38% ground yellow corn, 22% undecorticated cotton seed meal, 7% soybean meal, 12% wheat bran, 13% rice bran, 5% cane molasses, 2% lime stone and 1% common salt.**

****Gross energy calculated according to MAFF (1975).**

Two digestibility trials were conducted using six adult Rahmani rams and divided into two similar groups (3 animals for each) averaged (54 ± 3.00kg, a live body weight) and 3 years old. .Animals were housed in individual metabolic cages for 21 days (14 days as a preliminary period followed by 7 days as collection period) to determine the digestibility coefficients and nutritive values of the two respective tested rations. Feces were collected quantitatively every day and 10% daily sample was taken and sprayed with 10% sulfuric acid and dried during the collection period. At the end of the collection period, feces samples for each ram were ground mixed well and kept in the refrigerator for chemical analysis. Chemical analyses of feedstuffs and feces were carried out according to the AOAC (2006). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by the methods of Van Soest *et al.* (1991).

Blood samples were taken at the end of the experimental period. Blood samples were taken from the Jugular vein of three animals in each group at 8.00 am into vacationer tubes, and then allow the coagulated blood samples were centrifuged at 3000 rpm for 20 min to obtain blood serum. The supernatant was frozen and stored at -20°C for subsequent analysis. Blood serum was analyzed for total protein (Armstrong and Carr 1964), albumin (Doumas *et al*., 1971), globulin calculated by subtracting concentration of serum albumin from the corresponding concentration of total protein, creatinine (Folin, 1994), urea (Siest *et al*., 1981), cholesterol (Fassati and Prenciple, 1982) and as well as activity of asprtate (AST) and alanine (ALT) aminotransaminases (Reitman and Frankel, 1957) and total antioxidant capacity (Sies, 1997) was estimated using commercial kits by calorimetric determination.

Collected data of nutrients digestibilities, rumen fermentation and blood biochemical parameters were subjected to statistical analysis using one-way-analysis of variance according to Snedecor and Cochran (1980) was using the following mathematical model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where: **Y_{ij} is the parameter under analysis, μ is the overall mean, T_i is the effect due to treatment and e_{ij} is the experimental error.**

The general linear model of SAS (2004) program was used in processing measured parameters. The difference between means was statistically measured for significance at (P<0.05) according to Duncan's test (1955)

Table 2. Calculated chemical composition of the experimental rations.

Item	Experimental rations	
	R_1	R_2
DM	88.91	87.67
OM	89.19	88.91
CP	10.04	10.06
CF	21.31	21.54
EE	2.08	2.11
NFE	55.76	55.20
Ash	10.81	11.09
NDF	46.27	46.68
ADF	21.38	22.26
ADL	5.13	5.24
Cellulose*	16.25	17.02
Hemicelluloses*	24.89	24.42
Gross energy (kcal /kg/DM)	3968.00	3959.65

*** Calculated by differences.**

RESULTS AND DUSCUSSION

Digestibility coefficients and nutritive values:

Data of Table (3) clearly indicated that animals fed R_2 recorded the higher digestibility values of DM, OM, CP, CF, EE and NFE. The same higher fiber constituents (NDF, ADF, ADL, cellulose and hemicellulose) in R_2 compare with $R_1$and nutritive values as (TDN and DCP) compared with control ration (R_1). Results indicated that addition of CSL in ration R_2 had significant (P<0.05) effect on all nutrient digestibility coefficients compared with control ration (R_1). Azizi-Shotorkhoft *et al.,*(2016) reported that the highest intakes were observed in R_2 (CSL).The better nutrient digestibility of CSL-based diets in comparison with the control diet might be attributed to provision of soluble protein in the form of CSL and increasing protein solubility improved its digestibility(Ferrer *et al.*, 1997). Azizi-Shotorkhoft *et al.,* (2016) indicated that the enhancing effects of CSL on diet digestibility were controversial and might be mainly affected by the total amount of CSL in the dietand by the composition of the diet (interactions of the diet). The higher DM and CP digestibility of CSL group in feeding might be due to low feed intake might result in decreased digest a flow rate, enhanced digest a transit rate thus in turn better feed digestibility (Scott, 2015).

Table 3. Nutrients digestibility and nutritive values of experimental rations by Rahmani lambs.

Item	Experimental ration		±SE
	R_1	R_2	
Digestibility coefficients%:			
DM	63.82[b]	65.98[a]	0.50
OM	60.73[b]	64.77[a]	0.02
CP	66.43[b]	69.04[a]	0.78
CF	62.82[b]	65.96[a]	0.54
EE	73.40[b]	76.40[a]	0.60
NFE	65.08[b]	67.70[a]	0.34
Cell wall constituents %:			
NDF	60.98[b]	63.70[a]	0.44
ADF	52.33[b]	54.60[a]	0.87
ADL	40.62[b]	44.75[a]	0.67
Cellulose	20.48[b]	22.62[a]	0.54
Hemicellulose	50.93[b]	55.72[a]	0.80
Nutritive value %:			
TDN	60.06[b]	62.52[a]	0.43
DCP	6.67[b]	6.95[a]	0.04

[a,] and[b] Means in the same row with different superscript are significantly (P<0.05).

Blood serum parameters:

Table (4) showed no significant (P<0.05) differences between the two experimental rations for blood serum total protein, albumin and globulin. Merek (1991) recorded that the normal value of total protein ranged from 6-7.5 g/dl in sheep. Also, the values of albumin concentration in the present study were within the normal range (2.7-3.8g/dl).Recently, studies by Nagy *et al.* (2014) came with our study indicative no significant effects of dietary energy variations in serum total proteins. The results for Rahmani lambs were similar with those recorded also by Ghattas and Nasra (2010). It could be resulted from higher urea levels due to dietary energy confined and blood urea nitrogen has as a useful indicator for nitrogen (protein) utilization in ruminants as has been suggested by Ramin *et al.,* (2010). Lambs fed R_2 have higher (P<0.05) concentration of serum cholesterol than R_1 lambs. These results were agreement with those obtained by Bhatt *et al.* (2011) who proposed that an increase in dietary fat stimulated intestinal cholesterol synthesis to meet the increased demand and for absorption and transport of fat in ruminants. Generally, Singh *et al.* (2013) concluded that the reduced metabolizable energy density significantly affects the growth performance, blood metabolic profile and immune response of lambs.

Table 4. Effect of feeding tested rations on blood serum parameters for lambs.

Item	Experimental rations		±SE
	R_1	R_2	
Total protein (g/dl)	6.67	6.86	0.35
Albumin (g/dl)	3.49	3.07	0.19
Globuline	3.18	3.79	0.20
Creatinine (mg/dl)	1.30	1.28	0.11
Urea (mg/dl)	44.22	41.05	3.48
ALT (U/ml)	19.50	20.44	2.61
AST (U/ml)	39	41	3.67
Cholesterol (mg/dl)	150.20	152.10	4.40

Growth performance and feed conversion:

The average values of feed intake, daily gain and feed conversion are shown in Table (5). Data revealed that total body gain and daily gain were higher for lambs fed ration contained CSL (R_2). Final body weight significantly higher (P<0.05) with R_2 than those fed R_1. Lambs fed CSL energy (R_2) had reached to better marketing LBW than lambs received the no CSL energy (R_1). The non-conventional energy could improve rumen fermentation in terms of the fermentation end-products from the rumen of sheep that has been shown to improve growth rates. Finding of, Manso *et al.*, (2006) revealed that addition of energy source at of 5-7% / DM provides increased lamb weight by 15 to 20%. In the research of Ghattas and Nasra (2010) reported that feeding fat increases bacterial population and the microbial protein flow from the rumen are increased. Moreover, Carvalho and Medeiros(2010) observed that energy enhances efficiency of feed utilization and causes stimulation of weight gain that can be attributed to improve emulsification of fat. The beneficial effect of non-conventional supplementation in current study can be explained by the finding of Shivambu *et al.*, (2012) noted that it is possible to improve digestibility that caused increased microbial activities.

Economic efficiency:

The average values of economic efficiency are shown in Table (6). Data revealed that total body gain and daily gain, were significantly (P<0.05) high for lambs fed ration containing either CSL compared with control. The result confirms with Carvalho *et al.* (2010) who observed that energy enhances the DM intake, efficiency of feed utilization and causes stimulation of weight gain that could be attributed to an improved emulsification of fat. When CSL added to the diet lambs emphasized improvement of weight gain and feed efficiency, because of CSL has a high protein, energy, B vitamins and minerals (Mirzaand and Mushtaq, 2006).

Table 5. Effect of experimental rations on growth performance of lambs and feed efficiency.

Item	Experimental rations		±SE
	R_1	R_2	
Experimental periods (day)	120	120	0.40
Initial live body weight (I.B.W), Kg	22.67	22.78	
Final live body weight (F.B.W), Kg	42.73[b]	46.57[a]	0.20
Total body gain, Kg	20.13[b]	23.79[a]	0.30
Daily gain, g	167.17[b]	198.25[a]	0.33
Feed intake/day (DMI), g:			
CFM	776	732	
RS	671	622	
Total DM, g	1447	1354	
Feed conversion (DMI Kg/Kg gain)	8.65	6.82	
Av. Feed unit intake(DMI), g:			
Concentrate feed mixture (CFM),gm	776	732	
Rice straw (RS), gm	671	622	
Av. Total DM intake (gm)	1447	1354	
Av. TDN intake (gm)	869	847	
Av. DCP intake (gm	96.51	94.10	
Feed utilization efficiency :			
Kg DM/kg gain	8.66	6.83	
Kg TDN/ kg gain	3.59	3.13	
Kg DCP/kg gain	0.35	0.31	

[a,] and [b] Means in the same row with different superscript are significantly (P<0.05).

Table 6. Economical efficiency of lambs fed different experimental rations.

Item	Experimental rations	
	R_1	R_2
Av. Daily feed intake as fed (kg):		
Concentrate feed mixture	776	732
Rice straw	671	622
Av. daily gain	167.16	198.25
Av. Daily feed cost (LE):		
CFM	3.49	3.29
RS	0.53	0.49
SCL	-	0.02
Total daily feed cost, LE	4.02	3.80
Price LBW gain (LE)	10.02	11.90
Feed cost /kg weight gain (LE)	40.11	31.93
* Economical feed efficiency,%	249.25	313.15

Price of kg LBW is 60 LE; Price of 1 ton CFM= 4500 LE; Price of 1 ton RS = 800LE Price; Price of 1 ton CSL (non- conventional energy) = 400 LE Price.

*** Economic feed efficiency% = Price LBW gain / total daily feed cost X 100.**

CONCLUSION

It could be concluded that incorporation of additives non-conventional energy (CSL) improved digestibility, nutritive value, performance and economic feed efficiency of growing lambs and. From another point of view, non-conventional energy had successfully supposed of lambs feedlot and caused beneficial effects on blood metabolites and meanwhile, solving the problem of environmental pollution

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تأثير التغذية بمصدر طاقة غير تقليدي على الأداء الإنتاجي للحملان الرحماني

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أجريت هذه الدراسة لتقييم اثر اضافة مخلفات التصنيع (الطاقة الغير تقليدية) مثل مياه منقوع الذرة على الأداء الإنتاجي لحملان الأغنام حيث تم اجراء تجارب هضم على كباش تامة النمو لتقدير معاملات الهضم والقيم الغذائية للعلائق واستخدام بها 6 كباش رحمانى وزن(54 ± 3 كجم) وكذلك اجراء تجربة نمو على الاغنام النامية باستخدام 12 من الحملان الرحمانى تزن في بداية التجربة 22.6±0.2 كجم كمتوسط وزن حيث قسمت الحيوانات إلى مجموعتين (كل مجموعة ستة حيوانات) وغذيت على العلائق التجريبية وتم إجراء التحليلات الكيميائية للعلائق المختبرة. وتم تقدير أداء الأغنام كل أسبوعين من خلال تقدير معدل الزيادة اليومية والمأكول من المادة الجافة والكفاءة الغذائية. غذيت الأغنام على النحو التالي: المجموعة الأولى: 60% مخلوط علف مركز + 40% قش ارز (مجموعة المقارنة). المجموعة الثانية: 55% مخلوط علف مركز +40% قش ارز +5% من منقوع الذرة. أشارت النتائج ان المجموعة الثانية التى غذيت على (منقوع الذرة كمصدر طاقة غير تقليدية)أدى إلى تحسين معاملات الهضم خاصة البروتين والألياف والكربوهيدرات والسيلولوز والهيمسيلولوز وكان هناك تحسين في القيمة الغذائية كمركبات غذائية مهضومة وبروتين خام مهضوم. وكذلك إضافة منقوع الذرة كمصدر طاقة غير تقليدية قد أدى إلى ارتفاع معدل النمو اليومي بالمقارنة بمجموعة المقارنة وكذلك ارتفاع الكفاءة الغذائية وأيضا زيادة فى معدلات التحويل الغذائي . يستنتج من هذه الدراسة انة يمكن إضافة منقوع الذرة كمصدر طاقة غير تقليدى في علائق الأغنام الرحمانى مما يودى إلى تحسن معاملات الهضم وكذلك معدل النمو اليومي وكفاءة تحويل الغذاء والكفاءة الاقتصادية.