

## **NUTRITIONAL EVALUATION OF SOME UNCONVENTIONAL DIETARY ENERGY SOURCES IN RUMINANTS RATIONS.**

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### **SUMMARY**

**T**hirty five Ossimi male lambs with an average LBW 35 Kg were divided randomly into five nutritional groups for 195 days fattening trial. Five iso-caloric and iso-nitrogenous rations based mainly on yellow corn, grease and biscuit residuals were tested. The control ration (R1) based mainly on 45% corn grains (C); (R2) 30% corn and 6.5% grease (G); (R3) 15% corn, 15% bakery by-product (DBP) and 6.5% grease; (R4) 15% corn and 30% (DBP), while R5 was 45% (DBP). Results indicated that; lambs fed rations based mainly on (DBP) and (G) showed higher ( $P<0.05$ ) DM and OM digestibility. Highest (CP) digestibility ( $P<0.05$ ) was shown by lambs fed diet contained 30% DBP, however the lowest ( $P<0.05$ ) CP digestibility was obtained by R5. Results of CF digestibility pointed out to insignificant differences among different experimental rations. Grease and (DBP) supplemented groups recorded higher ( $P<0.05$ ) EE digestibility. Insignificant differences among different groups, neither in daily nitrogen intake nor in nitrogen retention (g/h/d). Four hrs. post feeding; higher ( $P<0.05$ ) ruminal pH values were shown by lambs fed ration contained grease, while the control recorded the lowest one, but the highest ( $P<0.05$ )  $\text{NH}_3\text{-N}$  value. Although, different experimental rations indicated insignificant  $\text{NH}_3\text{-N}$  concentration. Grease rations showed lower ( $P<0.05$ ) TVFA's, however the control indicated higher ( $P<0.05$ ) value. Different experimental groups indicated insignificant LBW gain, while animals fed ration contained 45% (DBP) recorded the best ( $P<0.05$ ) feed conversion ratio.

**Keywords:** *bakery by products, yellow grease, corn, Ossimi sheep.*

### **INTRODUCTION**

Shortage in concentrate feeds for ruminants in Egypt has emphasized the need for maximizing the use of industrial agriculture by-products. Strategies in developing countries must be based on concepts different from those in developed countries. Most of the available industrial or agriculture waste materials should be properly used as animal feeds, to ensure maximum livestock production from minimum land and available resources.

Lack of energy concentrates had emphasized the need for new sources of energy to minimize this lack on one hand, and partially spare imported yellow corn grains on the other hand. This could be achieved by using some energy by-products, such as poultry fat (grease) or bakery by-products, which are potential sources of valuable nutrients of energy (Salama *et al.*, 1996). Fat supplementation can effectively increase the energy density of rations while providing adequate fiber and forage (Abou Ward *et al.*, 1997). França *et al.* (2012) reported that bakery waste can be included in sheep diets without adverse effect on feed intake, digestion coefficients, ruminal pH and volatile fatty acids concentration, as well as increasing ammonia nitrogen utilization by rumen microflora. Adding non-protein nitrogen (urea) might probably reduce to some extent, the adverse effect of dietary fat supplementation (Salama *et al.*, 1999). Using bakery by-products (often biscuit, had relatively high fat content) is a cheaper source of energy compared with corn grains.

Knowledge of the composition of dried bakery by products (DBP) fed to livestock is becoming more important and necessary to be used more efficiently in ruminant feeding. The variability in chemical composition of (DBP) was recently shown to be significant (Arosemena *et al.*, 1995), however, nutritional efforts were exerted to overcome such variability during ration formulation (St. Pierre and Harvey, 1986a ; Johnson *et al.*, 1994).

The main objective of the present study was to evaluate the effect of using untraditional energy sources in ruminant rations to substitute imported yellow corn, which its cost is unstable, besides its necessity in poultry and human feeding.

## MATERIALS AND METHODS

This study was undertaken in the Experimental Farm station belongs to Animal Production Department, Faculty of Agriculture, Al- Azhar University, Nasr city, Egypt.

Thirty-five Ossimi male lambs with an average live body weight (35 Kg and 9 months age) were divided randomly into five feeding groups for 195 days fattening trial (7 lambs each) according to their live body weights. Each group was kept in separated brick made pens. Animals were weighed biweekly during the fattening trial before the morning meal.

Animals were offered their diets *adlib*, according to (NRC, 2007) twice daily and orts, if any were daily weighed. The amount of rations offered was adjusted every 2 weeks to ensure that rations were in excess of the voluntary intakes of the animals, while water and salt blocks were freely available to animals all the day time.

Five experimental rations based mainly on yellow corn, grease and biscuit residuals were tested in the study as different energy sources.

The ingredients and experimental rations formula are presented in Table (1). Feed intake was daily recorded, meanwhile, daily body weight gain was biweekly measured and feed conversion (g feed intake/g gain) was calculated. Metabolic trials were carried out according to El-Shazly *et al.*, (1963) to determine nutrients digestibility and N-balance for the five experimental rations.

**Table (1): Composition of experimental rations %.**

Item	R1	R2	R3	R4	R5
Corn grains	45	30	15	15	-
Bakery by product	-	-	15	30	45
Grease	-	6.5	6.5	-	-
Soybean meal	15	15	15	15	15
Sugar can bagasse	15.5	19.5	19.5	15.5	15.5
Corn cobs	14.5	18.5	18.5	14.5	14.5
Urea	1.0	1.5	1.5	1.0	1.0
Molasses	5.5	5.5	5.5	5.5	5.5
Limestone	2.0	2.0	2.0	2.0	2.0
Salt	1.0	1.0	1.0	1.0	1.0
Mineral mix and Vit. premix*	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100

\* Premix contained per 1 kg., 185g di calcium phosphate, 54g potassium sulfate, 24.8g manganese sulfate, 10g zinc oxide, 21g sulphur, 43.5g magnesium sulfate, 50.2g ferrous sulfate, 11.9g copper sulfate, 50g molasses, 88mg pantothenic acid, 7mg vitamin B<sub>1</sub>, 3mg vitamin B<sub>6</sub>, 287mg cobalt sulfate, 527mg iodine potassium, 145mg sodium selenate, 600mg coline chloride, 53mg vitamin B<sub>2</sub>, 6400 IU vitamin A, 64 IU vitamin E, 60000 IU vitamin D<sub>3</sub> and sodium chloride up to 1 Kg.

During the collection period, samples from experimental rations and residues were taken and dried, finely ground and kept in tight plastic containers for later chemicals analysis.

### **Chemical analysis:**

Samples of feedstuffs ingredients, complete mixed rations, residues and feces were analyzed for moisture, crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE), ash and urinary nitrogen according to A.O.A.C (2012).

**Rumen liquor analysis:**

Rumen fluid samples were taken individually from three animals per each treatment at the end of the metabolic trials, before feeding, and 4 hrs. after feeding using a stomach tube technique. Samples were filtered through four layers of surgical gauze, before being subjected to ruminal fluid parameters assessment.

**Ruminal measurements:**

The ruminal pH was measured immediately using the Orion 680 digital pH meter. Ammonia N concentration was determined according to the method of Conway (1963). The total VFA's concentration was determined by steam distillation method as mentioned by Waner, (1964).

**Statistical analysis:**

Data were analyzed using the general linear model's procedure adopted by SAS (2002). Difference between means were tested for significantly using the L.S.D test according to Duncan (1956). One-way analysis of variance was adopted using the following equation:

$$Y_{ij} = \mu + T_i + R_j + E_{ij}$$

Where:

- $Y_{ij}$  : The observation of the parameter measured.
- $\mu$  : Overall means.
- $T_i$  : The effect of dietary treatment.
- $R_j$  : The effect of replication.
- $E_{ij}$  : The random error terms.

**RESULTS AND DISCUSSION**

Table (2) showed the effect of chemical composition of the experimental rations on dry matter basis. As shown, similar DM content was observed with R2, R3 and R5 which ranged between 92.56% for R5 to 93.12% for R2. On the contrary, both of R4 and R1 (the control) indicated lower DM content, *i.e.* 89.60 and 90.27%, respectively. And although, different experimental rations indicated almost similar OM contents, ranged between 92.89% for R4 and 94.25% for R5. However, results presented in Table (2) indicated that the five experimental rations had almost the similar chemical composition, except for ether extract (EE).

The higher EE% in rations 2, 3, 4 and 5 resulted from (6.5%) grease and/or bakery by product (biscuit) replacements. As shown in Table (2) both of yellow grease (6.5%) and bakery by product which is relatively had higher fat contents led to increase EE percentage in different experimental rations in comparison with the control group (1.65%EE). The chemical composition of the experimental rations indicated lower CF contents for both R1 and R5, but higher NFE contents for both rations, respectively. Such result may be attributed to the higher percentage of nonstructural carbohydrate incorporated in both the two rations, *i.e.* 45% corn grain and/or bakery by-product, respectively. However, different experimental rations showed on the average an iso-caloric and iso-nitrogenous values.

**Table (2): Chemical analysis of experimental rations (on DM basis %).**

Prox. Anyls.rations	DM	OM	CP	CF	EE	Ash	NFE
R1	90.27	93.01	13.86	12.40	1.65	6.99	65.10
R2	93.12	93.76	14.26	17.10	5.73	6.24	56.67
R3	92.63	94.23	14.41	18.5	7.24	5.77	54.08
R4	89.60	92.89	14.16	15.80	5.23	7.11	57.70
R5	92.56	94.25	14.31	12.10	7.55	5.75	60.29

As for OM digestibility coefficient values, (Table 3), it was of interest to note that both of the control ration and R4 which had lower DM and OM contents (Table 2) indicated higher digestibility values. This result may point out to a negative relationship between chemical composition and its digestibility

coefficient values. Also, no significant differences were observed among R2, R3 and R5 which indicated intermediated DM and OM digestibility values.

On the other hand, highest (CP) digestibility ( $P<0.05$ ) was shown by lambs fed diet contained 30% bakery by product (R4) and without significant difference with R2 *i.e.* 85.7% and 84.8%, respectively. The lowest ( $P<0.05$ ) CP digestibility value (70.8%) was obtained by lambs fed diet contained 45% bakery R5.

Results of CF digestibility pointed out to insignificant ( $P<0.05$ ) differences among different experimental groups, except R4 (30% DBP) which had the higher value (62.1%). As for (EE) digestibility, the grease and DBP supplemented groups recorded the higher ( $P<0.05$ ) digestibility, without significant differences among them. On the other hand, the control group (nil fat sources) recorded the lowest EE digestibility (81.3%). Such result may be related to source of energy incorporated in rations formula *i.e.* biscuits and poultry grease which are rich, in their fat contents.

**Table (3): Nutrients digestibility and nutritive value of the experimental rations.**

Item	Experimental ration					
	R1	R2	R3	R4	R5	±SE
Digestion Coefficient %						
DM	75.6 <sup>a</sup>	69.0 <sup>b</sup>	66.3 <sup>b</sup>	76.3 <sup>a</sup>	68.7 <sup>b</sup>	1.46
OM	78.4 <sup>a</sup>	72.3 <sup>b</sup>	69.0 <sup>b</sup>	78.6 <sup>a</sup>	72.2 <sup>b</sup>	1.34
CP	76.2 <sup>b</sup>	84.8 <sup>a</sup>	76.6 <sup>b</sup>	85.7 <sup>a</sup>	70.8 <sup>b</sup>	2.11
EE	81.3 <sup>b</sup>	88.1 <sup>a</sup>	87.6 <sup>a</sup>	93.3 <sup>a</sup>	89.0 <sup>a</sup>	1.57
CF	51.2 <sup>b</sup>	53.0 <sup>b</sup>	56.6 <sup>a</sup>	62.1 <sup>a</sup>	47.8 <sup>b</sup>	1.92
NFE	82.7 <sup>a</sup>	74.4 <sup>b</sup>	70.6 <sup>b</sup>	79.2 <sup>a</sup>	74.3 <sup>b</sup>	1.67
Nutritive Values, ( % DM basis)						
TDN	73.8	74.7	74.0	78.6	75.8	—
DCP	10.6	12.1	11.0	12.1	10.1	—

*a, b Means in the same row with different superscript are significantly different ( $P<0.05$ ).*

Highest ( $P<0.05$ ) digestibility coefficient value of (NFE) was shown by lambs fed the control diet and without significant difference with R4, such higher NFE digestibility values may be attributed to source of energy used, being nonstructural carbohydrates *i.e.* yellow corn and biscuits, respectively at higher levels (45%). Insignificant difference ( $P<0.05$ ) were shown for digestibility coefficient of NFE for R2, R3 and R5.

Similar results were obtained by (Bayourthe, *et al.*, 1993) who reported that the digestibilities of DM, EE, OM and CP increased ( $P<0.05$ ) with supplemented fat. While, many other investigators reported that DM, OM, CP and EE digestibilities were not affected by added fat, since added fat tended to reduce the CF digestibility (Bock *et al.*, 1991; White *et al.*, 1992 and Mahmoud 2017). However, results obtained in Table (3) supported the suggest of Jenkins and Palmquist (1984), and Soliman *et al.*, (1985) who pointed out that all of DM, protein and much of fiber that escaped ruminal digestion were digested in the hindgut. On the contrary, Jerred *et al.*, (1990) found no change in digestibilities of DM, OM and CP when Holstein cows were fed on diets containing 5.0% prilled fat on DM basis. Also, El - Bedawy *et al.* (1996) found no effect due to the addition of yellow grease on digestion of growing buffaloes. On contrast, Bendary *et al.* (1994) reported a depression in CF digestibility by feeding buffalo bulls' rations containing more fat (8.2% EE).

As known fat in ruminant's diets could cause some adverse effects on nutrients digestibility, especially CP and CF. However, Salama *et al.*, (1996) reported that there were no significant differences in nutrients digestibility due to supplementation of experimental rations of lambs with both of 3% and/or 6% grease level.

It well known that addition of fat reduced  $\text{NH}_3$  in the rumen, particularly with higher levels, which need more N supplement. For this reason, 2% urea in combination with 9% fat might have an improvement in  $\text{NH}_3$  production in the rumen which enhanced micro-organisms activity, (Salama and Abou Ward, 1999).

Ørskov *et al.*, (1978) noted that the metabolizable energy (ME) was reduced by 28.8% when 130 gm tallow was added per kg diet, however, urea addition led to diminish the reduction in ME from 28.8% to 12.7%. This could explain the highest nutrients digestibility for both of R2 and R4 which contained urea and fat (about 5.5% EE), while R3 and R5 recorded lower nutrients digestibility, because their higher EE content (about 7%), the matter which might suggest, the necessity to increase urea level to more than 1%.

Feeding values of the experimental rations expressed in terms of TDN and DCP are presented in Table (3). Highest TDN value was observed with diet contained 30% and 45% bakery by product, *i.e* R4 and R5. TDN values were 78.6% and 75.8%, respectively. While the lowest TND values were recorded by the diet contained 15% bakery by-product with 6.5 grease and the control groups (73.6% and 73.7%, respectively).

As for DCP value, R2 and R4 groups recorded highest values in comparison with the other experimental groups, (12.1% both). The lowest DCP value was observed with 45% bakery by-product (R5) and the control R1 (10.1 and 10.6%, respectively). Ration 3 contained 15% bakery by-product with 6.5% grease had an intermediate DCP value (11%).

Table (4) showed nitrogen utilization by lambs fed the different experimental rations. Data obtained pointed out to insignificant differences among groups, neither in daily nitrogen intake nor nitrogen retention. However, animals in different dietary treatments showed positive nitrogen balance and without significant difference with each other.

**Table (4): Nitrogen balance for lambs fed the experimental rations.**

Item	Experimental ration					±SE
	R1	R2	R3	R4	R5	
Nitrogen Intake (g/h/d)	32.5	30.1	30.8	31.8	28.2	2.15
Fecal Nitrogen	7.7 <sup>a</sup>	4.6 <sup>b</sup>	7.2 <sup>a</sup>	4.6 <sup>b</sup>	8.2 <sup>a</sup>	1.36
Digestible Nitrogen	24.8	25.4	23.6	27.2	20.0	2.12
Urinary Nitrogen	20.2 <sup>a</sup>	21.0 <sup>a</sup>	19.1 <sup>ab</sup>	22.8 <sup>a</sup>	15.7 <sup>b</sup>	1.52
Nitrogen balance:(g/h/d)	4.6	4.4	4.5	4.4	4.3	0.85

*a, b; Means with different superscripts in the same row are significantly different from each other (p≤0.05).*

**Ruminal parameters:**

**Ruminal pH:**

Ruminal pH values at 0 time and 4 hours post feeding for lambs fed the experimental rations are presented in Table (5). At 0 time and 4 hours post feeding, higher ( $P<0.05$ ) ruminal pH values had been shown by lambs fed ration contained grease (R2 and R3), while those contained (DBP) showed lower ( $P<0.05$ ) ruminal pH (R4 and R5). The control group recorded the lowest ruminal pH value without significant difference ( $P<0.05$ ) with both of R4 and R5.

The same results were reported by Smet *et al.*, (1990) who found that addition of tallow or soya oil resulted in severe increase in rumen pH. Moreover, White *et al.*, (1992) found that the pH values tended to increase with increasing fat level. These results were in contrast with data reported by Ikwuegbu and Sutton (1982), and Mahmoud, (2017) who found that ruminal pH was not affected by fat supplementation. Similarly, Weakley *et al.*, (1990) noticed that feeding diets supplemented with 2.5, 4.6, 7.6 and 12% soya oil or tallow had no significant influence on pH. Also, Zervas *et al.*, (1998), reported that the addition of 5% soya oil to soya hulls concentrate and Abdullah *et al.*, (2000) with diets contained different levels of forage and supplemental fat did not find any significant differences in ruminal pH. The lowest values of ruminal pH of the control, R4 and R5 (45% DBP) might be due to the highly fermentable carbohydrate in such rations (starch and sugars) which might lead to decrease ruminal pH. Four hrs. Post-feeding, similar significant differences were detected among different experimental groups, indicating the same trend as that at 0.0 times. However, ruminal pH values, 4 hrs Post feeding tended to show lower values in compare with the corresponding ones at 0.0 times.

**Table (5): Rumen Liquor parameters for lambs fed experimental rations at 0 and 4 hrs. post feeding.**

Item	Experimental ration					±SE
	R1	R2	R3	R4	R5	
PH						
0	6.3 <sup>b</sup>	7.0 <sup>a</sup>	6.9 <sup>a</sup>	6.5 <sup>b</sup>	6.4 <sup>b</sup>	± 0.30
4	5.9 <sup>b</sup>	6.5 <sup>a</sup>	6.4 <sup>a</sup>	6.0 <sup>b</sup>	6.0 <sup>b</sup>	±0.30
NH <sub>3</sub> – N (mg/100 ml)						
0	28.8 <sup>b</sup>	38.7 <sup>a</sup>	35.3 <sup>a</sup>	32.2 <sup>b</sup>	30.1 <sup>b</sup>	±3.50
4	60.1 <sup>a</sup>	46.9 <sup>b</sup>	43.8 <sup>b</sup>	50.0 <sup>b</sup>	48.1 <sup>b</sup>	±5.70
TVFA's ml. equ/ 100ml						
0	7.20 <sup>a</sup>	5.60 <sup>c</sup>	5.30 <sup>c</sup>	6.90 <sup>ab</sup>	6.30 <sup>b</sup>	±0.40
4	14.30 <sup>a</sup>	11.10 <sup>c</sup>	11.30 <sup>c</sup>	13.70 <sup>ab</sup>	12.90 <sup>b</sup>	±1.30

*a, b and c; Means with different superscripts in the same row are significantly different from each other (p ≤ 0.05).*

#### **Ruminal ammonia nitrogen concentration:**

Ruminal ammonia nitrogen (NH<sub>3</sub>N) concentration at 4 hours post feeding illustrated higher values compared with the corresponding ones at 0 time. Animals fed rations contained grease (R2 and R3) at 0 time recorded the highest ( $P < 0.05$ ) values in compare with the other treatments which showed insignificant difference. Four hrs. Post feeding, the control group indicated the higher ( $P < 0.05$ ) NH<sub>3</sub>-N value in compare with the different experimental groups. However, both of T4 and T5 containing higher (DBP) showed relatively higher NH<sub>3</sub>-N values in compare with the two grease supplemented rations. Such results pointed out that both of the control (45%corn) and both the two (DBP) *i.e* rations contained higher soluble carbohydrates showed, in general the higher NH<sub>3</sub>-N values. In other words, T2 and T3 which supplemented with 6.5% grease showed the lower NH<sub>3</sub>-N indicating negative effects of fat supplementation on ruminal ammonia production. Similar results were reported by Weakley *et al*, (1990) and Nangia and Sharma (1994) who found that ammonia-N concentration was lowered when buffaloes fed on cotton seed oil. Contradictory results were reported by others, Bunting *et al*, (1992) who noticed that the addition of fat increased the concentration of NH<sub>3</sub>-N, while, Krysl *et al*, (1991) and Tjardes *et al*, (1998) reported that ruminal NH<sub>3</sub>-N concentration was not affected by adding soybean oil to the diets.

#### **Ruminal total volatile fatty acids concentration:**

The TVFA's concentration 4 hrs. post feeding were about two folds the corresponding ones at 0-time for different experimental rations. Results of TVFA's indicated significant differences among different experimental groups at both the two measuring times. However, the control group indicated the higher ( $P < 0.05$ ) TVFA's value, but without significant differences with T4 (15% corn + 30% bakery). Both the two groups indicated higher TVFA's concentration at zero and 4 hrs. post feeding. On the contrary, both the two grease supplemented rations (T2 and T3) showed the lower values indicating negative effects of grease supplement on TVFA's production. Similar results were reported by Jenkins and Fotouhi, (1990), Broudiscov *et al*, (1990), El-Bedawy (1995) feeding 5% unprotected oil in supplemented ration and Jenkins (1995) on soya oil supplement who showed that, dietary feed supplement led to decrease the concentration of ruminal TVFA's before and after feeding. These results were in contrast with those reported by Weakley *et al*, (1990) who noticed that the addition of 2.5, 4.6, 7.6 and 12% soya oil or tallow had no significant influence on TVFA's. Similarly, Elliott *et al*, (1994) pointed out to insignificant influences of fat supplementation or dietary periled fat on total VFA's production; Tjardes *et al*, (1998) and Abdullah *et al*, (2000) who reported that addition of 4% fat to lactating beef cow rations did not influence ( $P < 0.05$ ) the concentration of TVFA's. Matching data of pH values with the corresponding ones of NH<sub>3</sub>-N and TVFA's at 4 hrs. post feeding, pointed out that lambs fed rations rich in higher soluble carbohydrates *i.e* the control (45% corn and T4 and T5 corn and bakery by-products), showed higher TVFA's concentration which in turn led to an appropriate ruminal media which resulted consequently in higher ammonia production. On the contrary, rations contained grease T2 and T3 showed lower TVFA's production, and lower ammonia production, due to the negative influences of fat supplemented diets on the biochemical activity of rumen microorganisms which in turn led to reduce ruminal ammonia production.

**Animal performance:**

Data presented in Table (6) pointed out to higher insignificant daily dry matter intake (DMI) values by lambs fed R1 and R4 rations (1465 and 1403 g/h/d, respectively). The lowest DMI was recorded by lambs fed ration containing 45% bakery by product. Similar result concerning the negative effects of fat supplementation on animals DMI were reported by Son *et al.*, (2000). On the contrary, White *et al.*, (1992) observed that DMI was increased with calves fed diets based on ground corn (65%) and supplemented with stabilized animal-vegetable blended at 0, 2.5, or 5%. Also, El-Bedawy *et al.*, (1996) who pointed to significant increase in DMI for fat supplemented diets. In contrast, Hindiyeh *et al.* (2011) found that different levels of bakery by product (100, 200, and 300 g/kg DM) decreased DM, OM, CP, NDF, and metabolizable energy (ME) intake in a fattening diet for Awassi lamb compared to a control diet.

**Table (6): Effect of dietary energy sources on fattening lamb's performance.**

Item	R1	R2	R3	R4	R5	±S.E
Feed intake g/h/d						
DMI g/h/d	1465	1317	1334	1403	1233	
TDN intake g/h/d	1081	984	987	1103	935	
DCP intake g/h/d	155.3	159.4	146.7	169.7	124.5	
Initial live body weight, (Kg)	35.6	35.6	35.6	35.6	34.2	2.25
Final live body weight, (Kg)	65.7	66.7	66.1	66.0	64.6	3.30
Total live body weight gain, kg	30.1	31.1	30.5	30.4	30.4	1.65
Daily body weight gain, (g/h/d)	155.2	160.3	157.2	156.7	156.7	2.69
Feed conversion (Kg intake/Kg gain)						
Kg DMI/Kg gain	9.4 <sup>a</sup>	5.2 <sup>ab</sup>	8.5 <sup>ab</sup>	9.0 <sup>a</sup>	7.9 <sup>b</sup>	
Kg TDNI/Kg gain	7.0 <sup>a</sup>	6.1 <sup>ab</sup>	6.3 <sup>ab</sup>	7.0 <sup>a</sup>	6.0 <sup>b</sup>	

*a, b; Means with different superscripts in the same row are significantly different from each other (p ≤ 0.05).*

**Live body weight gain:**

Changes in live body weight gain, Table (6), indicated insignificant differences among different experimental groups in favor of fat supplemented ones in compare with the control group (nil fat or bakery by product sources). The corresponding values were 155, 160, 157, 157 and 157 g/h/day for the control (nil fat), 6.5 fats (R2), 6.5 fats with 15% bakery by-product (R3), 30% bakery by-product (R4) and 45% bakery by-product (R5), respectively.

Adding fat as grease or as bakery by-product did not affect average daily gain. Similar results were reported by El-Bedawy (1989), who pointed out, that the inclusion of 5% hydrogenated vegetable fat into diets of goats and sheep did not influence average daily gain. Also, White *et al.*, (1992) who found that supplemental fat did not affect average daily gain. The same results were also obtained by El-Bedawy, *et al.*, (1996), Sutter, *et al.*, (2000) and Wistuba *et al.*, (2006). On the contrary, Obeidat, *et al.*, (2012) and Hutchison *et al.*, (2006) found that fat supplementation increased average daily gain with steers fed diet containing 4% poultry fat and gained more efficiently (  $p < 0.05$ ) than the control steers, while 4% tallow-fed steers showed an intermediate DG values.

**Feed Conversion:**

Results of feed conversion efficiency in terms of kg DMI/kg gain, Table (6) showed significant ( $P < 0.05$ ) differences among different experimental groups.

The best feed conversion value ( $P < 0.05$ ) was recorded with animals fed ration contained 45% (DBP) followed by those fed rations contained 6.5% grease or 6.5% grease with 15% (DBP), but without significant difference among them. Lowest ( $P < 0.05$ ) feed conversion value was recorded by the control group (9.5 kg DMI/kg gain) and without significant difference with lambs given ration contained 30% (DBP). These results were confirmed by the findings of Bock *et al.*, (1991) on sheep fed 3.5% tallow or soybean oil soap stock; Brandt *et al.*, (1992) with steers supplemented with yellow grease and Moustafa *et al.*, (1995) on palm oil. The later referred the improved feed conversion efficiency to the significant intensification of energy of fat diets. The same results were obtained by Wistuba *et al.*, (2006) and Hutchison *et al.*, (2006).

The improvement attained in feed conversion by lambs fed rations contained grease or 45% bakery by-product (T2, T3 and T5) may be referred to restricting lambs intake, but with higher energy density

provided through the supplemented grease and oil involved in bakery by products. Such higher energy density provided more energetic resources which might in turn enable ruminal microorganisms to satisfy their energetic requirements and consequently led to enhance microbial protein synthesis. On the other hand, fat supplementation prevented microorganisms to attack true proteins in the basal ration and this protein had an opportunity to be by passed to the lower tract. Moreover, adding fat to animal rations led to reduce heat increment. Ensuring adequate NH<sub>3</sub>-N in the rumen to supply the majority of N for microbial growth is the first priority in optimizing fermentative digestion of the diet (Abou Ward, 1992). Also, Abou Ward, (2001) showed that addition of fat, reduced NH<sub>3</sub> in the rumen, particularly with higher levels which need more N supplement. For this reason, urea in combination with fat might have increased NH<sub>3</sub> production in the rumen which enhanced micro-organisms activity and this was consequently reflected on lamb's performance.

Results of the present study are supported by the findings of El-Bedawy *et al*, (1996); Richards *et al*, (1998) and Plascencia *et al*, (1999). The authors stated that, fat supplementation increased (P<0.05) feed efficiency. On the other hand, white *et al*, (1992) stated that supplemental fat did not affect feed efficiency of converting feed to gain.

## CONCLUSION

Bakery by products and yellow grease could be successfully used as an energy sources and in formulating finishing ration of sheep without any hazard effects or negative disorders on either animal health or performance; through different combination it can lead to an appropriate and economic energy resources.

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### التقييم الغذائي لبعض مصادر الطاقة الغير تقليدية في علائق المجترات

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استخدم في الدراسة 35 ذكر أوسيمي بمتوسط 35 كجم، قسمت عشوائياً إلى 5 مجاميع غذائية متماثلة في محتواها من الطاقة والبروتين في تجربة تسمين استمرت لمدة 195 يوم. اعتمدت مصادر الطاقة بالعلائق التجريبية على الذرة الصفراء (45%) في المجموعة الأولى كمصدر تقليدي للطاقة، تم استبدال 15% منها في المعاملة الثانية بـ 6,5% دهن دواجن أما المعاملة الثالثة فقد احتوت على 15% ذرة + 6,5% دهن دواجن + 15% مخلفات مخابز، وفي المعاملة الرابعة فقد تم استبدال 30% من الذرة بمخلفات مخابز وفي المعاملة الخامسة فقد تم استبدال الذرة بـ 45% مخلفات مخابز، تم تقييم العلائق هضماً و غذائياً بالإضافة لقياس التخمرات بالكروش وتقدير النيتروجين المحتجز. أظهرت النتائج زيادة معنوية في معاملات الهضم للمادة الجافة والعضوية في المجاميع المغذاه على دهن الدواجن ومخلفات المخابز، كما سجلت الحيوانات المغذاه على 30% مخلفات مخابز أعلى معامل هضم للبروتين وكانت أقلها معنوية (المعاملة الخامسة)، ولم تظهر أي فروق معنوية بين المجاميع المعاملة في النيتروجين المأكول أو المحتجز. ارتفع الـ PH في سائل الكرش لمجاميع المعاملتين 2&3 مقارنة بالكنترول والتي سجلت أعلى تركيز للأمونيا والأحماض الطيارة. أظهرت المجاميع المغذاه على الدهن أقل تركيز للأحماض الطيارة. لم تظهر فروق معنوية بين الحيوانات في معدلات الزيادة اليومية وإن أظهرت المعاملة الخامسة أفضل كفاءة تحويل غذائي، وكانت أقلها تحويلاً (الكنترول). وعلى ضوء هذه النتائج، فإنه يمكن وبنجاح استبدال الذرة جزئياً كمصدر طاقة تقليدي في علائق المجترات بدهن الدواجن ومخلفات المخابز وبالنسب التي تم إختبارها وبدون أية مخاطر على صحة الحيوانات أو إنتاجيتها.