

**EFFECT OF FEEDING RATIONS CONTAINING DIFFERENT LEVELS OF DRIED STRAWBERRY BY-PRODUCT ON GROWTH PERFORMANCE OF LAMBS**

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**ABSTRACT**

This study was conducted to evaluate the partial replacement of berseem hay (BH) with agro-industrial strawberry by-product (SBP) on growth performance, digestion coefficients, feeding values, rumen parameters, some blood constituents and economic efficiency of Awassi lambs.. Eighteen lambs 17kg average weight and four months old were divided into three similar groups (six animals each) considering their body weight and assigned randomly to receive the experimental rations R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub> contained 0, 25 or 75% SBP, replacing BH, respectively. Randomized complete block design was used in this trial that lasted 120 days. Three digestibility trials were conducted to determine the digestibility and feeding values of the experimental rations.

Results indicated that DM digestibility of tested rations (R<sub>2</sub> and R<sub>3</sub>) was higher significantly (P<0.05) than control ration (R<sub>1</sub>). While, CF digestibility of R<sub>3</sub> was significantly higher than R<sub>1</sub> and R<sub>2</sub>. The CP digestibility was significantly higher with R<sub>3</sub> than control ration (R<sub>1</sub>), while R<sub>2</sub> was slightly higher. No significant differences between tested rations and control in respect of OM, EE and NFE. Also, the values of TDN did not significantly affected by dietary treatments, but DCP values were significantly decreased with tested treatment compared with control one. Slight differences among dietary treatments were observed regarding final LBW, total gain and daily gain (growth performance). Feed conversion efficiency had nearly similar values, while the best result recorded with ration contained 25% SBP (R<sub>2</sub>) followed by 75% SBP (R<sub>3</sub>) and lastly control (R<sub>1</sub>). There were no significant differences in ruminal pH among rations, while the concentrations of ruminal NH<sub>3</sub>-N were significantly reduced with R<sub>3</sub> but insignificantly reduced with R<sub>2</sub>. Inverse trend was occurred with TVFA's among treatments. Most blood parameter values appeared in favor of the dietary treatments vs. control one. Economic efficiency was improved in tested rations compared with control.

It could conclude that dried strawberry by-product could replace berseem hay, up to 70 %, in growing lambs rations without any adverse effect on productive performance and lambs health.

**INTRODUCTION**

There are many ways to overcome the chronic and acute shortage of feed for livestock population in Egypt, one of these approaches is the utilization of agro-industrial by-products. The steady increases in prices of traditional feed ingredients in Egypt and other countries of the world have forced the nutritionists to increase their interest for utilization of agro-industrial by-products particularly in ruminants' diet. In Egypt, industrial by-products of fruit and vegetables for ruminant feeding could considered as a significant source to alleviate the acute shortage of feedstuffs that represents up to 30% of production (Industrial Union of Egypt, 2015).

Strawberry (*Fragaria xanahassa*) by-product can be considered as one of the most important untraditional feed ingredient (Rus et al., 2011) that include green cup and part of fruit. Fresh strawberry has high contents of polyphenolics, flavonoids, anthocyanins as 488.12, 296.11 and 19.48 mg/100 g, respectively, while leaves contain Tannins, Flavonoids, small amounts of ascorbic acid and have an anti-oxidant activity (Vulic et al., 2011). Strawberry fruit reported to contain phenolic substances (Aaby et al., 2007) and leaves (Hukkanen et al., 2007) known to have rich secondary metabolite particularly the phenolic compounds which include phenolic acids, anthocyanins, flavonoids and condensed tannins.

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Donohoe et al. (2011) noticed that feeding strawberry produce a large amount of butyrate which provides sufficient energy for bacterial fermentation that stimulate the growth of tissue by hyperplasia and hypertrophy. Amany et al. (2015) noticed that agro-industrial strawberry by-product had higher NFE and lower Cp, CF, DE than berseem hay.

The present study aimed to investigate the effect of replacing dried agro-industrial strawberry by-product with berseem hay on lambs growth performance, digestibility, feeding values, rumen parameters, some blood contents and economic evaluation.

### MATERIALS AND METHODS

The present study was carried out at Borg Arab Experimental Research Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt. The experiment lasted for 120 days and conducted to investigate the possibility of utilization of agro-industrial strawberry by-product (SBP) in lambs feeding.

#### Preparation of strawberry by-product

Strawberry by-product include green cup and part of the fruit that sun dried to reach the most suitable dryness that ranges from 10 to 16%. It stored under ideal storage condition until used.

#### Experimental rations

The experimental rations formulated of concentrate feed mixture (CFM), berseem hay (BH) and SBP as follows:

R<sub>1</sub> : 60 % CFM + 40 % BH.

R<sub>2</sub> : 60 % CFM + 30 % BH+ 10 % SBP

R<sub>3</sub> : 60 % CFM + 10 % BH+ 30 % SBP

#### Feeding trial

This study conducted to evaluate the nutritive value of strawberry by-product as replacement to BH in sheep rations. Eighteen growing Awassi male lambs aged four months and weighed 17.00 kg (as average) were blocked on three equal groups (six animals each) considering their live body weight in an experiment lasted for 120 days. The Feeding trial was carried out using randomized complete block design. Lambs of 1<sup>st</sup> group fed ration consisted of 60% CMF plus 40% BH and served as control (R<sub>1</sub>). Lambs of the two tested

rations (R<sub>2</sub> and R<sub>3</sub>) fed the control ration while replacing 10% and 30% of BH by SBP, respectively. The experimental rations were offered to lambs at rate 3% of live body weight (LBW) on DM basis. Animals fed in groups two equal portions at 8:00 am and 4:00 pm while refused feed (if any) were daily collected. Daily amounts of feeds biweekly adjusted according to body weight changes. Feed intake by lambs recorded daily, while live body weight recorded biweekly and drinking water always available.

#### Digestibility trial

At end of feeding trial, all animals used to determine the digestibility and feeding values of the experimental rations. Acid Insoluble Ash (AIA) used as internal marker according to the method of Van Keulen and Yoahg (1977) for determination of nutrients digestibility according to the following equation:

$$\text{Digestion coefficient of nutrient} = 100 - \frac{\% \text{ AIA in feed}}{\% \text{ AIA in feces}} \times \frac{\% \text{ nutrient in feces}}{\% \text{ nutrient in feed}} \times 100$$

Samples of feces were taken from rectum for five consequent days of each animal and dried at 60°C for 24 hrs.

#### Rumen fluid samples

At end of feeding trails, rumen liquor samples were collected, first before feeding then at 3 and 6 hrs. post feeding, from 3 animals of each group, by using stomach tube attached to vacuum pump. Samples of rumen content of each animal was filtered through four layers of cheesecloth, then ruminal pH immediately measured. The rest of strained samples were kept in a clean glass bottle top-dressed with few drops of toluene and paraffin oil, covered with a rubber stopper and stored at -18°C until further analysis for some ruminal parameters.

#### Some blood constituents' analysis

Blood samples were taken at the end of feeding experiment from the jugular vein and allowed to flow into heparinized tubes and immediately centrifuged at 4000 rpm for 20 minutes to separate the serum which stored at -20 °C until analysis.

#### Analytical procedures

The proximate analysis of feeds and feces determined according to A.O.A.C. (1996). Rumenal ammonia nitrogen (NH<sub>3</sub>-N)

concentration was determined according to Conway (1964), ruminal total volatile fatty acids (TVFA's) determined according to Warner (1967). Plasma samples used to determine total protein (Henry and Todd, 1974), albumin (Doumas and Biggs, 1971), while globulin obtained by subtracting albumin values from the total proteins. Creatinine (Henry, 1965), Urea (Potton and Cruouch, 1977), AST (asparatate amino transaminase) and ALT (alanine aminotransferase) enzymes (Schmidt and Schmidt, 1963) were determined.

**Statistical analysis**

Data from six replicates analyzed according to SAS, (2001). Differences among means were evaluated using Duncan's multiple range test

(Duncan, 1955). Tested rations (R) assigned as the main factor. The statistical model performed was as follow:  $Y_{ik} = \mu + R_i + E_{ik}$   
 $Y_{ik}$  = an observation                       $\mu$  = Overall mean  
 $R_i$  = effect of rations                       $E_{ik}$  = random error

**RESULTS AND DISCUSSION**

**Chemical composition**

Chemical composition of feedstuffs and experimental rations are shown in Table (1). Data demonstrate that nitrogen free extract (NFE) and ash contents in the dried agro-industrial strawberry by-product (SBP) were higher than BH. While, crude protein (CP), crude fiber (CF) and ether extract (EE) were markedly higher in BH than SBP.

**Table (1): Chemical composition concentrate feed mixture, berseem hay, strawberry by-product and calculated composition of experimental ratios (DM%)**

Items	DM	OM	CP	CF	EE	NFE	Ash
<b>CFM</b>	89.78	92.24	15.76	7.53	2.49	66.46	7.76
<b>BH</b>	95.12	89.59	10.64	38.54	1.03	39.38	10.41
<b>SBP</b>	93.18	80.68	7.38	11.65	0.89	60.76	19.32
<b>Experimental rations</b>							
<b>R<sub>1</sub></b>	91.92	91.18	13.72	19.94	1.90	55.62	8.82
<b>R<sub>2</sub></b>	91.73	90.30	13.39	17.25	1.89	57.77	9.71
<b>R<sub>3</sub></b>	91.33	88.51	13.72	11.87	1.86	62.05	11.50

The CFM consisted of 33% yellow corn grains, 36% wheat bran, 15% soybean meal, 8% undecorticated cotton seed meal, 5.2% molasses, 1.5% limestone, 1% sodium chloride and 0.3% minerals and vitamins.

These results are in agreement with those obtained by Omar et al. (2011) that strawberry by-product had higher NFE% and lower CP and CF% than berseem hay. The same trend were observed by Galal et al. (2015), who used strawberry by-product as replacement to berseem hay in the diets of lambs and goats. In addition, SBP contained higher amount of flavonoid (20.42 mg/100 mg) compared with BH (Amany et al. 2015). Flavonoid plays an essential role as antioxidant (Vulic et al., 2011). All experimental rations contained the same amounts of CP while CF was high in R<sub>1</sub> than R<sub>2</sub> and R<sub>3</sub> and also R<sub>2</sub> was higher than R<sub>3</sub>.

**Digestibility and feeding values:**

Digestion coefficients and feeding values of the experimental rations are presented in Table (2). Results indicate that DM digestibility of the two tested rations (R<sub>2</sub> and R<sub>3</sub>) were significantly (P<0.05) higher than control one (R<sub>1</sub>), while digestibility of CP and CF of R<sub>3</sub> were significantly higher than R<sub>1</sub>, but the corresponding values were similar between R<sub>1</sub> and R<sub>2</sub> rations. Otherwise, the digestibility of OM, EE and NFE did not affected significantly by dietary treatments.

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**Table (2) Digestibility and feeding values of the experimental rations fed to lambs**

Item	Treatments			SE
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	
<b>Digestibility</b>				
DM	65.01 <sup>b</sup>	67.49 <sup>a</sup>	68.49 <sup>a</sup>	2.24
OM	70.40	70.60	69.50	2.04
CP	69.48 <sup>b</sup>	70.06 <sup>ab</sup>	70.81 <sup>a</sup>	0.82
CF	53.08 <sup>b</sup>	54.36 <sup>b</sup>	56.08 <sup>a</sup>	1.38
EE	70.23	70.70	70.49	0.05
NFE	71.56	72.67	72.46	3.12
<b>Feeding value (%DM)</b>				
TDN	62.78	63.75	63.58	1.16
DCP	9.53 <sup>a</sup>	9.38 <sup>b</sup>	9.01 <sup>c</sup>	0.01

<sup>a, b, ...</sup> Means within each row have no similar letter(s) are significantly different ( $P \leq 0.05$ )

No significant difference found between rations had the low and high levels of SBP, in respect of most nutrient digestibilities. Improvement of CP digestibility with rations contained SBP may be due to its content of polyphenolic compounds, which decrease the proteolytic activity which compromise protein digestion (Oliveria et al., 2010).

The feeding value as TDN % did not significantly affected by the dietary treatments, being 62.78, 63.75 and 63.58 for R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub>, respectively. The DCP values of tested rations (R<sub>2</sub> and R<sub>3</sub>) were significantly lower than the control one (R<sub>1</sub>). In addition, the high SBP-ration had significantly lower value than the low SBP-ration.

### Growth performance

Growth performance of lambs are shown in Table (3). Final body weight and daily gain (DG) were similar among the experimental rations with slight higher values with R<sub>2</sub> (32 kg and 125g, respectively), compared with other groups. Similar trend among groups was observed in respect of total gain. These results may be due to antioxidant activity or phenolic compounds which has an ability to produce large amount of butyrate that ensuing bacterial fermentation stimulated the growth of tissue by hyperplasia and hypertrophy (Pusztai et al., 1995). Also, SBP contained sulfur volatiles which are the main biochemical compound in

structure of amino acids such as cysteine (McGrath and Rainses, 2011) Total dry matter intake (TDMI) of lambs fed the two tested rations was significantly lower ( $P < 0.05$ ) than control one, with non significant differences in-between (R<sub>2</sub> and R<sub>3</sub>). These results may due to the unpleasant smell of butyric acid, which configured as a result of starch resistant (Omer et al., 2011).

Data in Table (3) show that feed conversion efficiency as kg DM intake/kg gain, was the best for 25%- SBP ration (R<sub>2</sub>) followed by 75% SBP ration (R<sub>3</sub>), while, the least one was control ration without SBP. These results are in agreement with those recorded by Omer et al (2011) and Amany et al (2015) who found that feed conversion significantly improved by using SBP in feeding.

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**Table (3): Growth performance of lambs fed the experimental rations containing the two levels of SBP**

Items	Experimental rations			SE
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	
Experimental period (d)	120	120	120	
Initial LBW (kg)	17.00	16.83	17.17	2.24
Final LBW (kg)	31.33	32.00	31.17	2.01
Total gain (kg)	14.33	15.17	14.00	2.01
Daily gain (g)	118.33	125.00	118.33	0.001
<b>Dry matter intake per head</b>				
CFM	576.02 <sup>a</sup>	552.61 <sup>b</sup>	242.65 <sup>b</sup>	71.79
BSM	384.02 <sup>a</sup>	276.30 <sup>b</sup>	90.44 <sup>c</sup>	18.21
ASBP	0.00	92.10 <sup>b</sup>	271.00 <sup>a</sup>	5.74
Total dry matter intake (g)	960.00 <sup>a</sup>	921.01 <sup>b</sup>	904.41 <sup>b</sup>	199.42
Feed conversion DM/Gain	6.74	6.12	6.51	0.35

<sup>a, b, ...</sup> Means within each row have no similar letter(s) are significantly different ( $P \leq 0.05$ )

that feed conversion significantly improved by using SBP in feeding.

**Rumen fermentation parameters**

The pH values, ammonia nitrogen (NH<sub>3</sub>-N) and total volatile fatty acids (TVFA's) concentrations in rumen liquor of the experimental animals are presented in Table 4. Results indicate that dietary treatments had no significant effect on rumen liquor pH values. The overall mean of pH values were 6.32, 6.41 and 6.36 for R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub>, respectively. Attained rumen pH values in the present study

are within the normal range (4.96-7.92) reported for sheep, which is suitable for maximal cellulolytic activity (Salem, 2006).

The rumen NH<sub>3</sub>-N concentration ranged from 22.00 – 37.38 mg/100 ml. for all treatments and sampling times. Almost, the values of the two tested rations were significantly less than the control one. The average of all sampling times show that concentration of NH<sub>3</sub>-N was significantly higher

**Table (4). Rumen parameters of growing lambs fed diets containing different levels of SBP.**

Item	Treatments			SE
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	
pH				
0 hrs	6.83	6.69	6.65	0.019
3 hrs	6.53	6.52	6.29	0.032
6 hrs	5.85	5.99	5.92	0.01
Overall means	6.32	6.41	6.36	0.01
NH <sub>3</sub> -N (mg/dl)				
0 hrs	25.35 <sup>a</sup>	23.18 <sup>b</sup>	22.00 <sup>b</sup>	0.77
3 hrs	37.38 <sup>a</sup>	34.90 <sup>b</sup>	32.61 <sup>c</sup>	0.75
6 hrs	27.24 <sup>a</sup>	25.91 <sup>a</sup>	21.33 <sup>b</sup>	0.56
Overall means	29.00 <sup>a</sup>	28.00 <sup>a</sup>	25.32 <sup>b</sup>	1.24
TVFA's				
0 hrs	7.57 <sup>b</sup>	7.74 <sup>b</sup>	9.12 <sup>a</sup>	0.19
3 hrs	10.52	10.36	10.91	0.15
6 hrs	7.50 <sup>b</sup>	8.05 <sup>b</sup>	8.84 <sup>a</sup>	0.12
Overall means	8.53 <sup>b</sup>	8.72 <sup>b</sup>	9.51 <sup>a</sup>	0.07

<sup>a, b, ...</sup> Means within each row have no similar letter(s) are significantly different ( $P \leq 0.05$ )

The same trend mostly kept at different collection times with more clear reduction by increasing SPB levels. The lower NH<sub>3</sub>-N concentration with tested rations might be due to decrease of nitrogen degradation in the rumen than control ration (Khattab, 2007) and in support to this point most berries such as strawberry contain both hydrolysable and condensed tannins (Vatten *et al.*, 2005), which decrease ruminal ammonia production, likely due to their inhibition effect on microbial activities in rumen which illustrated by depress of crude protein degradation in rumen (Ishida *et al.*, 2015).

**Blood parameters**

Data presented in Table (5) show the effect of replacement with SBP on some blood

parameters. Increasing level of SBP in rations of lambs increased plasma total protein and globulin concentrations. Based on control ration (R<sub>1</sub>) such increases were insignificant with R<sub>2</sub> and significant with R<sub>3</sub> ration. While albumin concentration showed the same level in all rations. These results may due to increasing digestibility coefficient of crude protein, which therefore increase the plasma total protein. The present results are in agreement with those found by Zanouny (2011). The increase of globulin concentration might be due to that strawberry leaf contains polyphenolic compounds such as flavonoids, which are working as antioxidant and used as immune factor.

**Table (5) Blood parameters of growing lambs fed diets containing different levels of SBP.**

Item	Treatments			SE
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	
Total protein, (g/dl)	6.31 <sup>b</sup>	6.70 <sup>ab</sup>	7.30 <sup>a</sup>	0.096
Albumin, (g/dl)	3.21	3.09	3.37	0.019
Globulin (g/dl)	3.10 <sup>b</sup>	3.61 <sup>ab</sup>	3.92 <sup>a</sup>	0.131
Total cholesterol (mg/dl)	73.62 <sup>a</sup>	70.85 <sup>b</sup>	68.52 <sup>c</sup>	0.05
Urea (mg/dl)	38.33 <sup>a</sup>	36.52 <sup>b</sup>	35.43 <sup>b</sup>	0.477
Creatinine (mg/dl)	1.84 <sup>a</sup>	1.55 <sup>b</sup>	1.42 <sup>b</sup>	0.477
ALT (u/l)	40.34	40.10	39.68	0.132
AST (u/l)	51.70	50.84	50.00	0.805

<sup>a, b, ...</sup> Means within each row have no similar letter(s) are significantly different (P ≤ 0.05)

Plasma cholesterol and kidney functions (urea and creatinine concentrations) were significantly decreased in lambs fed strawberry by-product compared with those fed control ration. These results indicate a favorite healthy effect of lambs fed SBP. This result agree with Amany *et al.* (2015) who found that cholesterol, urea and creatinine were significantly decreased by including levels of SBP in the diets. There were no significant effect on ALT and AST due to experimental rations. Concentration of plasma activities of ALT and AST were within the normal ranges. Abd-El-Kareem (1990) found that values ranged from 24 to 65 Iu/L for

ALT and 14 to 37 Iu/L for AST in goat and sheep.

**Economic evaluation:**

The economic evaluation of growth of lambs fed rations containing SBP are shown in Table (6). Lambs fed 75% SBP recorded the best economic efficiency compared to those fed 25% SBP and control. The worst value recorded with the control group. These results are in agreement with those obtained by Galal, et al., (2015) and Amany *et al.* (2015) who found that strawberry waste improved feed conversion efficiency. This due to the relatively low price of SBP compared to berseem hay besides its role in improving growth performance of lambs.

**Table (6): Economic analysis of growing lambs fed rations containing different levels of SBP.**

Item	Treatments		
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>
Total feed intake (g/h/d)	960.09	921.01	904.09
CFM	576.02	552.61	542.65
BH	384.04	276.30	90.44
SBP	0.00	92.10	271.00
Price of total feed intake (LE. h/d)			
CFM	1.73	1.66	1.63
BH	0.58	0.41	0.14
SBP	0.00	0.05	0.14
Total feeding cost, LE.	2.26	2.12	1.91
Average daily gain g/d	118.33	125.00	118.33
Price of daily gain, LE.	5.92	6.25	5.92
Net profile (LE./h/d)	3.66	4.13	4.01
Economic efficiency %	161.95	194.81	209.95
Relative improvement	100	120.29	129.64

Total price for feeds was calculated according to the price of different ingredients available in Egypt.

- 1- The local market prices were; 3000 LE for one ton CFM, 1500 LE one ton of BH, 500 LE one ton SBP and 50 LE price of one Kg lambs live weight.
- 2- Net profile= price of daily gain, LE.- total feeding cost, LE.
- 3- Economic efficiency (EE) = net profile / total feeding cost, LE.
- 4- Relative improvement of the control, assuming that the EE of the control (R<sub>1</sub>)=100

### CONCLUSION

From the present study, it could conclude that dried strawberry by-product can be used as a favorable feed ingredient in growing lambs' ration without any adverse effect on productive performance or health condition. Also, the economic efficiency improved in lambs in particular for those fed 75% SBP-ration.

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### الملخص العربي

تأثير التغذية علي علائق تحتوي نسب مختلفة من مخلف الفراولة الجاف علي نمو الحملان

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تهدف الدراسة إلي تقييم استخدام مخلف تصنيع الفراولة بمستويات صفر و25 و75% بدلا من دريس البرسيم في العلائق علي الأداء الإنتاجي ومعاملات الهضم والقيمة الغذائية وقياسات الكرش وبعض قياسات الدم والكفاءة الاقتصادية للحملان العويسى النامية. تم استخدام 18 حمل متوسط وزن 17كجم ومتوسط عمر 4شهور، قسمت الي ثلاث مجاميع (6 حيوانات في كل مجموعة) حسب وزن الجسم وأستمرت التجربة لمدة 120يوم.

أوضحت النتائج أن العلائق المختبرة (الثانية والثالثة) سجلت أعلى قيم هضمية للمادة الجافة ومعظم العناصر الغذائية خاصة البروتين الخام والألياف الخام مقارنة بعليقة الكنترول وكانت الفروق مؤكدة معنويًا خاصة من المجموعة الثالثة والكنترول للمادة الجافة والبروتين الخام وكذلك من الألياف الخام. من ناحية أخرى لم تظهر فروق معنوية في قيم العناصر المهضومة الكلية بين جميع العلائق ووجود فروق معنوية في قيم البروتين الخام المهضوم حيث كانت اعلى قيمة في مجموعة الكنترول يليها المجموعة الثانية ثم المجموعة الثالثة على التوالي.

لم تلاحظ اي فروق معنوية في وزن الجسم النهائي ومعدل الزيادة اليومية بين المجموعات المختبرة ومجموعة الكنترول وكانت القيم 31.33 ، 32 ، 31.17 كجم ، 118.33 ، 125 ، 118.33 جم / يوم لعليقة المقارنة والعليقة الثانية والثالثة على الترتيب. لوحظ فروق معنوية في الماكول الكلي من المادة الجافة للحملان بين العلائق المختبرة والكنترول وكانت اقلهم في العلائق المحتويه علي مخلف تصنيع الفراولة مقارنة بالكنترول. لوحظ عدم وجود فروق معنوية في معدل التحويل الغذائي وسجلت أفضل النتائج للعلائق المختبرة المحتويه علي 25% من مخلف تصنيع الفراولة تليها العليقة المحتوية علي 75% من مخلف تصنيع الفراولة ثم عليقة المقارنة. لم تظهر فروق معنوية في متوسط درجات حموضة الكرش بين المعاملات، في حين أن تركيز الامونيا قل بصورة معنوية مع المعاملة الثالثة مقارنة بالمعاملات الأولى والثانية وعكسياً كان الوضع مع الاحماض الدهنية الطيارة. زاد كل من البروتين الكلي والجلوبيولين بصورة معنوية، علي العكس الكوليسترول الكلي والكرياتينين واليوربا تناقصوا في المعاملة الثانية والثالثة مقارنة بالمجموعة المقارنة. لا يوجد أي تأثير لاستخدام مخلف الفراولة في علائق الحملان النامية علي قياسات وظائف الكبد وتحسنت الكفاءة الاقتصادية في العلائق المختبرة مقارنة بالعليقة المقارنة.

ويمكن أن نستخلص أنه يمكن استخدام مخلف تصنيع الفراولة في علائق الحملان العويسى النامية بنسبة 75% علي حساب دريس البرسيم دون حدوث أي تأثير عكسي علي الأداء الإنتاجي وصحة الحملان.

**EFFECT OF FEEDING RATIONS CONTAINING DIFFERENT LEVELS OF DRIED STRAWBERRY BY-PRODUCT ON GROWTH PERFORMANCE OF LAMBS**