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NUTRITIONAL AND ECONOMICAL IMPACT OF USING DRIED ORANGE PULP AS ENERGY SOURCE IN GROWING LAMBS RATIONS.

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SUMMARY

Thirty growing Rahmany male lambs (5-6 months old and weighed in average 28.9 ± 0.9 Kg) were used in growth trial for 120 days and eighteen adult male sheep (weighed in average 60 ± 3 Kg) were used in digestion trials, to evaluate using of dried orange pulp (DOP) as alternative energy source in growing lambs rations contained different protein sources with and without yeast. Lambs in growth trial, depending on its live body weight, were divided into six feeding groups (5 head each). Three animals from the eighteen adult sheep in digestibility trial were randomly assigned to fed one of six experimental rations. The first three rations contained soybean meal (SBM) as protein source and either corn grains, (R1), 50% corn grains plus 50% DOP (R2) or 50% corn grains plus 50% DOP plus yeast, 3 g/h/d., (R3), while the other three rations contained corn gluten meal (CGM) as protein source with the same previous energy sources and yeast supplementation in the same sequence R4, R5 and R6. The results showed that all of the experimental rations were almost similar in their chemical composition. Data of nutrients digestibility, nutritive value and average daily gain showed that there were insignificant ($P<0.05$) differences between lambs fed R2 and R3 compared with those fed R1, while lambs fed R5 and R6 recorded best values for the previous parameters compared with those fed R4. On the other hand, all rations contained DOP, regardless protein source, recorded the best values of microbial protein synthesis and the lowest values of pathogenic bacteria and the best feed conversion, but it recorded insignificant differences in blood parameters compared with 100 % corn rations. In the same time, R2 ration recorded the lowest cost (Feed cost / Kg gain, L.E.) compared with the other rations. It could be concluded that corn grains could be replaced by 50 % DOP as alternative energy source in growing lambs rations contained soybean meal as protein source to reduce the feed cost without negative effect on animal performance and health.

Keywords: *dried orange pulp; corn grains; soybean meal; corn gluten meal; yeast; growing lambs.*

INTRODUCTION

The continuous increases in feed costs specially corn grains, locally produced or import from abroad as a source of energy for human (biofuel), led to search for other alternative feedstuffs or by-products to be used as energy source in animal rations.

Dried citrus pulp, a mixture of peel, inside portions and culled fruits of the citrus family (e.g., orange, lemons and grapefruit), is the main by-product from the citrus-processing industry that is used as a feedstuff for ruminants (Grasser *et al.*, 1995).

Bampidis and Robinson (2006), mentioned that dried citrus pulp contains high concentrations of pectin (22 to 40%) and low concentrations of CP (7.2 %), fat (3 %). Dried citrus pulp is similar to grains in nutritive value (80% TDN) and high in digestible fiber, which makes it an excellent alternative energy supplement. Osman *et al.*, 2007 noted that, citrus pulp contained 90.0 to 94 % DM, 93.5 to 95 % OM, 6 to 16 % CP, 12 to 17.5 % CF, 3.2 to 11.5 % EE, 3.9 to 7.3 % ash and 55.73 to 70 % NFE. Moreover, citrus pulp supplementation may improve nitrogen (N) utilization and performance of ruminants, but it depends on the form of N supplied in the diet (Kim *et al.*, 2007).

Orange peel and dried orange pulp have a relative high nutritive value for feeding ruminant animals and as least-cost formulation ingredients (Nam *et al.*, 2006).

More studies concluded that up to 40% of dietary corn grain could be replaced by dried citrus pulp without any disorders in digestibility, ruminal function, or performance in ruminants (Bueno *et al*.. 2002).

Yeast products especially *Saccharomyces cerevisiae* have been used in ruminant rations for many years to improve their efficiency (Miller-Webster *et al*., 2002 and Fadel, 2007).

So, the aim of this study was to investigate the impact of replacing corn grains by artificial dried orange pulp (DOP) in growing lambs rations contain different protein sources (soybean meal or corn gluten meal) with or without yeast addition on the nutrients digestibility, growth performance, microbial protein synthesis, pathogenic bacteria, blood parameters and economic efficiency.

MATERIALS AND METHODS

This study was carried out at El-Nobaria researches and experimental station of National Research Center, Egypt. And at animal house of Research Institute of Animal Production. Dokki, Cairo.

The DOP was collected locally from Johina factory. The entire pulp, including seeds and peels of orange, was dried artificially after extraction of juice in Febco Factory.

Growth trials:

Animals and Management:

Thirty growing Rahmany male lambs of about 28.9 ± 0.9 kg live body weight and 5-6 months old were kept under veterinary medical care for a preliminary period of 15 days. During this time animals were received alfalfa hay *ad – lib*. At the end of the preliminary period lambs were randomly divided according to their body weights into 6 feeding groups (5 each) for 120 days growth trial.

Experimental rations:

Chemical composition and cell wall constituents of feed Ingredient used in the experimental rations were showed in Table (1), and the six experimental rations (Table, 2) consisted of total mixed ration (TMR), 30 % alfalfa hay plus 70% concentrate feed mixture, were used in this experiment. The first three rations (R1, R2 and R3) contained soybean meal (SBM, 44 % CP, 65 % rumen degradable protein ;RDP; and 35 % rumen undegredable protein ;RUDP) as protein source, while the other three rations (R4, R5 and R6) contained corn gluten meal (CGM, 64.5 % CP, 41 % RDP and 59 % RUDP) was used as another protein source rations. The experimental concentrate rations were as follow: R1 contained SBM and corn, R2 contained 50 % of the corn was replaced by DOP and R3 is similar to R2 plus 3g/h/d. yeast (*Saccharomyces cerevisiae*) was added. R4 contained CGM and corn, R5 contained 50 % of corn was replaced by DOP and R6 is similar to R5 plus 3g/h/d. yeast (*Saccharomyces cerevisiae*) was added.

Table (1): Chemical composition (%) of feed ingredients, on DM basis.

Item	Corn grain	DOP	SBM	CGM	Wheat bran	Hay
DM	90.50	85.8	91.68	92.00	89.74	90.30
OM	98.43	92.95	93.77	94.48	94.17	89.60
CP	8.10	7.2	44.02	64.5	14.11	16.20
CF	2.65	12.2	4.10	8.70	10.30	25.23
EE	4.27	4.50	1.47	1.80	2.97	2.50
Ash	1.57	7.05	6.23	5.52	5.83	10.40
NFE	83.41	69.05	44.18	19.48	66.79	45.67
Cell wall constituents %						
NDF	12.63	27.73	16.18	22	42.21	42.67
ADF	3.45	20.96	11.72	16.1	12.16	37.18
ADL	1.13	2.92	1.84	9.03	3.05	7.80
Hemicellulose	9.18	6.77	4.46	5.9	30.05	5.49
Cellulose	2.32	18.04	9.88	7.07	9.11	29.38

DOP, dried orange pulp; SBM, soybean meal; CGM, corn gluten meal. NDF, neutral detergent fiber; ADF, acid detergent fiber; ADL, acid detergent lignin; hemicellulose = NDF - ADF; cellulose = ADF – ADL.

The experimental rations were isocaloric and isonitrogenous. Rations were offered as the total mixed feeds *ad-lib*, and fresh drinking water was available freely to the animals. Orts, if found, were weighed every day before morning feeding during the experimental period meanwhile, feed intake was daily recorded, while, mean daily body weight gain and feed conversion (feed / gain) were determined biweekly.

Table (2): Feed ingredients and chemical composition of the experimental rations as total mixed ration.

Item	Experimental rations			
	R1	R2, R3	R4	R5, R6
Ingredient, %				
Corn	35.00	17.50	35.00	17.50
Wheat bran	22.61	23.38	24.85	25.69
SBM	9.10	9.10	0.00	0.00
CGM	0.00	0.00	6.65	6.65
DOP	0.00	17.50	0.00	17.50
Hay	30.00	30.00	30.00	30.00
Salt	0.77	0.84	0.84	0.84
Lime stone	2.31	1.47	2.45	1.61
*Mineral and vitamins	0.21	0.21	0.21	0.21
Chemical composition, % (as DM basis)				
DM	90.16	89.72	90.02	89.57
OM	89.71	89.64	89.86	89.85
CP	14.62	14.42	14.64	14.45
CF	11.47	13.29	11.25	13.08
EE	3.30	3.29	3.48	3.42
Ash	6.29	6.36	6.14	6.15
NFE	60.32	58.64	60.49	58.90
Cell wall constituents %				
NDF	26.8	30.1	27.1	32.1
ADF	15.2	17.0	15.7	18.2
ADL	3.60	3.9	4.1	4.4

R1: ration contains SBM + 100 % corn, R2: ration contains SBM + 50 % corn + 50 % dried orange industrial by product (DOP), R3: R2 + 3g/h/d yeast, R4: ration contains gluten feed meal (CGM) + 100 %, and R5: ration contains (CGM) + 50 % corn + 50 % DOP. R6: R5 + 3g/h/d yeast.

**Mineral and vitamins mixture provided (per kilogram of premix): 185g of di calcium phosphate, 54g of potassium sulfate, 24.8 g of manganese sulfate, 10g of zinc oxide, 21g of sulphur, 43.5g of magnesium sulfate, 50.2g of ferrous sulfate, 11.9g of copper sulfate, 50 mg of molasses, 8mg of pantothanic acid, 7mg of vitamin B_1, 3mg of vitamin B_6, 287 mg of cobalt sulfate, 527mg of iodine potassium, 145mg of sodium selitate 600mg of coline chloride, 40mg of niacin, 53mg of vitamin B_2, 6400 IU vitamin A, 64 IU of vitamin E and 60000 IU of D_3 and sodium chloride up to 1 kg.*

Digestibility and nitrogen balance trials:

Eighteen adult sheep (weighed 60 ± 3 Kg) were used in digestion trials (3 for each group) for 21 days, 14 days as preliminary period and 7 days as collection period. Animals were kept in metabolic cage and fed their diets, which provide the maintenance requirements, twice daily in equal parts at 8.00 and 17.00 hr., and water was freely available to them. During the collection period feces and urine were collected daily and samples represented tenth of the voided feces and excreted urine were taken just after collection. Urine was collected from each animal in glass bottles contained 10 ml of 50 % sulphoric acid. Urine samples were stored in tight bottles and refrigerated at 4°C for N determination. Feces samples were dried at 60°C/24 hrs. in a hot air oven. At the end of the collection period, dried samples of feed and feces were finely grounded to pass through 1 mm sieve and kept in tight plastic containers for chemical analysis.

Rumen liquor parameters:

Rumen fluid samples were taken individually from animals at the end of digestibility trials before feeding (zero time), then at 3 and 6 hrs. post feeding using a stomach tube. Samples were filtered through four layers of surgical gauze, then ruminal pH was immediately recorded using digital pH meter. Then, the samples were kept frozen for ruminal parameters determination.

Microbial protein:

Rumen fluid samples were taken individually from animals at the end of the growing trial using a stomach tube. Samples were filtered through four layers of surgical gauze to determine microbial protein g/100 ml rumen liquor (RL).

Pathogenic bacteria:

Feces samples were taken individually from three animals from each group at the end of the growing trials and analyzed for *Salmonella* count and *E. coli.* cfu/ g.

Blood parameters:

Blood samples were collected from the jugular vein of the animal at the end of the growing trials. The blood samples were centrifuged at 4000 r.p.m. for 20 minutes, and then blood plasma was separated and preserved in clean sterile plastic tubes in refrigerator for chemical analysis.

Chemical Analysis:

Chemical composition (dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and nitrogen free extract (NFE)) of feeds and feces and urinary nitrogen were determined according to A.O.A.C. (1990) procedures. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined in ingredients and experimental rations according to Goering and Van Soest (1970). Ruminal ammonia nitrogen (NH_3-N) concentration was determined appling NH_3 diffusion technique Kjeldahle distillation method according to A.O.A.C. (1990). Ruminal total volatile fatty acids (TVFA's) concentration was determined according to Kromann *et al.*, (1967). Microbial protein was determined by the method of Makkar *et al.* (1982).

Salmonella and *E.coli.* count was determined by Laboratory Manual of the isolation and identification of avian pathogens.

Plasma (ALT) Alanine Amino Transaminase and (AST) Aspertate Transaminase (U/ml) determined according to the method described by Retiman and Frankel (1957). Plasma total protein (g/dl) determined according to the method described by Gomal *et al* (1949). Plasma total lipids (mg/dl) determined according to the method described by Zollner and Kirsch (1962). Plasma creatinine (mg/dl) determined according to the method described by Schirmeister (1964). Plasma urea (mg/dl) determined according to the method described by Fawcett and Soctt (1960). Plasma uric acid (mg/dl) determined according to the method described by Barham and Trinder (1972). Plasma cholesterol (mg/dl) determined according to the method described by Richmond (1973).

Statistical analysis:

Data obtained from the present study was statistically analyzed according to SAS (1998). The model used was: $Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij} = experimental observation, μ = general mean, T_i = effect of treatment, e_{ij} = experimental error

While the model used for pH, NH3-N and TVFA were: $Y_{ij} = \mu + L_i + T_j + (L\times T)_{ij} + e_{ij}$

Where: Y_{ij} = experimental observation, μ = general mean, L_j = effect of time level, T_j = effect of experimental rations, (L×T) = the interaction effect due to time and experimental rations, e_{ij} = experimental error.

Differences in means among groups were compared by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCISSION

Data of chemical composition and cell wall constituents of feed ingredients are shown in Table (1). Dried orange industrial by product (DOP) as alternative energy source were almost similar in its chemical composition with corn grains, except for CF, ash and cell wall constituents which were higher in DOP than those of corn grains, which commonly used as energy source in ruminant rations. These results are in agreement with found by Kostas *et al.* (995) that the chemical composition of dried citrus pulp were 90.4

% DM, 83.15 % OM, 7.75 % CP, 11.15 % CF, 4.92 % EE, 16.85 % ash, 59.33 % NFE, 19.4 % NDF and 12.8 % ADF.

Chemical composition of the experimental rations) Table, 2) showed that all the tested rations were almost similar in their chemical composition and were almost isocaloric and isonitrogenous.

Effect of Experimental Rations on Nutrients Digestibility and Nutritive Value:

Data in Table (3) demonstrated that R2 had no significant difference in all nutrients digestibility and nutritive value as TDN and DCP compared with R1. This might be reflect that DOP can be used as alternative source of energy without negative effect on the nutrient digestibilities (Gholizadeh and Naserian, 2010), and might be due to that orange pulp contains high content of readily fermentable carbohydrates (pectin) which could be used as a replacer for starch (Caparra *et al.*, 2007).

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

Item	Experimental rations						
	R1	R2	R3	R4	R5	R6	± SE
a. Digestion Coefficient, %							
DM	75.27^{bc}	74.26^{c}	74.23^{c}	73.65^{c}	79.29^{a}	77.00^{ab}	1.15
OM	77.30^{ab}	75.88^{b}	74.86^{b}	75.15^{b}	78.54^{a}	76.69^{ab}	1.34
CP	71.76^{bc}	70.27^{c}	68.06^{c}	70.09^{c}	74.19^{ab}	72.50^{ab}	1.11
EE	80.09^{bc}	77.23^{c}	81.96^{ab}	78.90^{c}	79.31^{c}	81.58^{ab}	1.44
CF	53.13^{b}	54.40^{b}	53.37^{b}	52.62^{b}	60.16^{a}	58.39^{a}	1.76
NFE	82.95^{b}	81.34^{b}	80.88^{b}	81.0^{b}	87.48^{a}	83.19^{b}	1.60
b. Nutritive Values, % DM basis							
TDN	72.57^{bc}	70.78^{c}	70.40^{c}	71.37^{c}	76.21^{a}	73.39^{b}	0.90
Digestibl	10.49^{ab}	10.13^{bc}	9.82^{c}	10.26^{b}	10.72^{a}	10.48^{ab}	0.18

a, b, c,.... Means on the same row with different superscript are significantly different (P<0.05).

Data also showed that R5 significantly (P<0.05) had improved all nutrient digestibility and nutritive value as TDN and DCP compared with R4.

The improvement in the nutrients digestibility in R5 is agreement with findings of Olmos Colmenero and Broderick, (2006) which found that the increases in fermentable fractions with dried citrus pulp probably reflect increased microbial protein synthesis (MPS), which typically improves digestibility. Therefore, the kind of N supplementation is important for increasing ruminal fermentation and nutrient utilization from dried citrus pulp.

Also the improvement in CF digestibility might be duo to that DOP contains a high concentration of pectin leading to a fast degradation in rumen releasing energy for a rapid microbial growth produces lesser lactate than starch (Hall *et al.*, 1998) and creates better rumen conditions for fiber fermentation while, corn contains readily fermentable carbohydrate which produces lactates in the rumen, leading to a drop in pH value and reduce fiber digestibility (Pereira and González, 2004 and Gholizadeh and Naserian, 2010).

Generally, the comparison between R2 and R5 to study the effect of protein sources on the utilization of DOP showed that R5 recorded better nutrients digestibility and nutritive values compared with those of R2. This result might be due to that gluten has moderate RDP (41 %) less than SBM (65 % RDP) leading to more utilization of DOP, meanwhile, increases the nutrients digestibility for diets containing DOP with CGM than with SBM. These results are agreed with Kim *et al.* (2007) who found that steers fed on dried citrus pulp with soybean meal (65 % RDP) recorded more nutrients digestibility and nutritive value compared with dried citrus pulp with urea (100 % RDP). While the different sources of protein didn't affect the nutrients digestibility of corn grains (R1 and R4).

Concerning the effect of supplemented yeast on the rations contained DOP with different sources of protein (R3 or R6) recorded insignificant difference in nutrients digestibility and nutritive value compared with R2 or R5, respectively. This might be due to yeast played the same role as DOP in stabilizes the pH value and creates better rumen conditions for highly nutrients digestibility (Hall *et al.*, 1998 and Callaway and Martin, 1997).

Effect of Experimental Rations on Rumen Liquor:

Data in Table (4) showed that concerning sampling time, the values of pH before feeding was found to be high, and then decreased at 3 hrs. post feeding then returned to increase at 6 hrs. post feeding for all experimental rations. These result caused by the intensive fermentation process of both nonstructural and structural carbohydrates and the production of volatile fatty acids. This result is in agreement with findings of Khattab *et al.* (1996).

Table (4): Effect of feeding tested rations on some of rumen parameters of the experimental adult sheep.

Item	Sampling time, hrs.	Experimental rations						
		R1	R2	R3	R4	R5	R6	±SE
Values of pH	0	6.77^{abc}	7.03^{ab}	7.17^{ab}	7.03^{ab}	7.10^{ab}	7.27^{a}	0.27
	3	5.4^{g}	5.97^{f}	6.2^{f}	5.5^{g}	6.17^{f}	6.57^{e}	
	6	6.97^{abc}	6.90^{bcd}	6.63^{de}	6.70^{cde}	6.57^{e}	6.67^{cde}	
	Mean	6.38	6.63	6.67	6.41	6.61	6.83	
Concentration of NH_3-N, mg/100 ml RL	0	25.73^{fghi}	24.56^{ghij}	25.92^{hijk}	26.40^{ghij}	22.46^{ijk}	21.27^{jk}	3.33
	3	38.39^{a}	37.25^{ab}	33.88^{b}	35.37^{ab}	35.61^{ab}	35.97^{c}	
	6	30.48^{d}	27.85^{defg}	28.45^{def}	29.45^{de}	26.46^{efg}	27.24^{k}	
	Mean	31.53	29.89	29.42	30.89	28.18	28.16	
Level of VFA's meq/100 ml RL	0	6.07^{e}	6.67^{de}	7.77^{cde}	8.50^{bcd}	8.27^{bcd}	8.50^{bcd}	1.93
	3	11.00^{a}	11.33^{a}	10.77^{a}	10.83^{a}	11.40^{a}	10.33^{abc}	
	6	8.23^{bcd}	9.17^{abc}	8.23^{bcd}	9.27^{abc}	10.17^{ab}	9.53^{bcd}	
	Mean	8.43	9.06	8.92	9.53	9.95	9.65	

a, b, c.... Means on the same column and row with different superscript are significantly different ($P<0.05$).

There were no significant differences among groups in the mean of pH values being 6.38, 6.63, 6.67, 6.41, 6.61 and 6.83 for R1, R2, R3, R4, R5 and R6, respectively. Using DOP and yeast (R2, R3, R5 and R6) improved the pH value. These results may be due to the DOP contains pectin which degraded very rapidly and extensively in the rumen but yield little lactate, causing less decline of rumen pH values (Barrios-Urdaneta *et al.*, 2003), while corn grain contains readily fermentable carbohydrate which produces lactates in the rumen, leading to a drop in pH value (Ahooei *et al.*, 2011).

The opposite trend was observed for rumen ammonia concentrations (NH_3-N) and volatile fatty acids values (TVFA's), which found to be low before feeding, then increased at 3 hrs. post feeding and returned to decrease at 6 hrs. post feeding for all experimental rations. While, there were no significant differences among groups (Assis *et al.*, 2004).

Rations contained DOP (R2, R3, R5 and R6) recorded lower NH_3-N concentrations compared with those contained corn (R1 and R4). The reduction of NH_3-N might be appears to be the result of incorporation of NH_3-N into microbial protein and it was considered as a direct result to stimulate microbial growth (Barrios-Urdaneta *et al.*, 2003).

Using DOP increased ruminal TVFA's in R2 compared with R1 and R5 compared with R4 which reflect that DOP is a better energy source than corn grain for rumen micro-organisms, promoting a higher concentration of total volatile fatty acids and this agreed with findings of Raul Franzolin *et al.* (2010).

Effect of Experimental Rations on Feed Intake and Growth Performance:

Data in Table (5) showed that 50 % corn replacement by DOP didn't affect DMI, where all intakes of the experimental rations were almost similar and ranged from 1378 to 1400 g/h/d. This result indicated that using DOP as alternative source of energy didn't affect voluntary intake of ruminants. This result is in agreement with Lanza, 1984 who reported that DOP as partial or total replacement of corn or barley grain in the concentrates fed to Friesian dairy cattle had no effects on DMI of the ration.

The highest value of TDN intake recorded by R5 being 1063 was due to the improvement of nutrients digestibility of R5 compared with other groups (Table 3).

Results concerning growth performance of lambs (Table, 5) data of R1, R2 and R3 showed insignificant differences among them in total gain (TG) and average daily gain (ADG). On the other hand, R5 and R6 significantly ($P<0.05$) increased TG and ADG compared with R4.

Generally R5, which containing 50 % corn replacement by DOP, followed by R6 recorded the highest values of TG and ADG, while R4 recorded the lowest value. Other rations recorded no significant differences among them. This result might be due the highest nutrients digestibility with R5 compared with other rations (Kim *et al.*, 2007).

Concerning feed conversion as feed / gain data in Table (5) indicated that lambs fed R5 recorded the best value being 6.91 kg feed/kg gain, compared to the other rations. This might be due to better ADG which recorded by R5.

Table (5): Dry matter intake, live weight gain and feed conversion of lambs fed the experimental rations.

Items	Experimental rations						
	R1	R2	R3	R4	R5	R6	± SE
IBW, Kg*	28.00	28.40	29.20	29.80	29.40	28.60	0.57
FBW, Kg*	51.40	51.13	51.76	52.12	53.64	52.17	0.58
TG, Kg*	23.04^{bc}	22.73^{bc}	22.56^{bc}	22.32^{c}	24.24^{a}	23.37^{ab}	0.18
ADG, g	192.0^{bc}	189^{bc}	188.0^{bc}	186.0^{c}	202^{a}	196^{ab}	1.48
Feed intake, g/h/d							
DMI	1400	1380	1378	1390	1395	1387	
TDN	1016	779	970	992	1063	1018	---------
DCP	147	140	135	143	150	145	
Feed conversion, feed / gain							
DMI	7.29	7.30	7.33	7.47	6.91	7.06	
TDN	5.29	5.17	5.16	5.33	5.26	5.18	--------
DCP	0.76	0.74	0.72	0.77	0.74	0.74	

a, b, c..... Means on the same row with different superscript are significantly different (P<0.05).
**IBW: initial body weight, FBW: final body weight, TG: total gain.*

Effect of Experimental Rations on Microbial Protein and Pathogenic Bacteria:

Data in Table (6) showed a significant (P<0.05) increase in the microbial nitrogen (MN) and microbial protein synthesis (MPS) in the rumen of lambs fed rations R2, R3, R5 and R6 compared with R1 and R4. These results might be due to the type carbohydrate source (pectin) from orange pulp appears to promote a different effect on ruminal fermentation depending on its use in a total mixed ration and of the rumen microbes present and the starch in the corn may partially escape the rumen fermentation for enzymatic digestion to glucose in the intestine, while the carbohydrate in the citrus pulp can only be used by microbial fermentation in the rumen (Raul Franzolin *et al.*, 2010). Also, due to the higher ammonia concentration was found in the rumen of R1 and R4, this meaning that less microbial protein synthesis in the rumen, while, DOP contains neutral detergent-soluble fiber (NDSF) provides similar amounts of energy, *versus* starch from corn grain, relative to its ability to support ruminal microbial growth (Barrios-Urdaneta *et al.*, 2003 and Olmos Colmenero and Broderick, 2006).

Table (6): Amount of microbial protein g/100 ml rumen liquor and count of *E. coli* and *Salmonella* in the feces of lambs fed experimental rations.

Item	Experimental rations						
	R1	R2	R3	R4	R5	R6	± SE
MN[1], g/ 100 ml RL	10.75^{b}	12.75^{a}	13^{a}	11^{b}	13.25^{a}	13.3^{a}	0.27
MPS[2], g/ 100 ml RL	67.19^{b}	79.69^{a}	81.25^{a}	68.75^{b}	82.81^{a}	83.13^{a}	1.68
E.coli	$4.33*10^{3a}$	$2.67*10^{3b}$	$3.27*10^{3b}$	$5.00*10^{3a}$	$2.60*10^{3b}$	$3.33*10^{3b}$	$7.77*10^{2}$
Salmonella	0	0		0	0	0	0

a, b, c,.... Means on the same row with different superscript are significantly different (P<0.05). [1] *microbial N,* [2] *microbial protein synthesis = MN*6.25.*

Data on the same Table showed that R2, R3, R5 and R6 rations recorded a significant (P<0.05) decrease in *E. coli*, which considered the pathogenic bacteria, compared with R1 and R4. This might due to orange-oil containing products have antibacterial activity against *E. coli* and *sallmonella* (Neirotti *et al.*, 1996; Kim *et al.*, 1995 and Nannapaneni *et al.*, 2008). And data were obtained showed that all animals in this study didn't contain *Salmonella*, so the effect of DOP didn't appear on decreasing the *Salmonella* concentration.

Effect of Experimental rations on blood parameters:

Data in Table (7) showed that no significant differences were detected for all blood plasma parameters among treatments and the values for all rations were within normal range. These results are in agreement with Gholizadeh and Naserian (2010). These results indicate that DOP can be used as partial corn replacement in ruminant rations without negative effect on the health of ruminants.

Table (7): Mean values of blood constituents recorded for lambs fed the experimental rations.

Item	ALT (U/ml)	AST (U/ml)	Cholesterol (mg/dl)	Total lipid (mg/dl)	Uric acid (mg/dl)	Urea-N (mg/dl)	Total protein (mg/dl)	Creatinine (mg/dl)
R1	18.5	34	163.95	310.57	1.61	4.19	3.85	1.49
R2	21.67	40.67	171.69	336.01	1.40	3.17	4.62	1.52
R3	22.67	38	177.59	319.28	1.54	3.09	5.09	1.36
R4	21.67	41.33	174.00	312.58	1.74	4.26	5.31	1.31
R5	21.67	42.67	186.60	341.29	1.80	4.12	4.32	1.39
R6	21.67	40.67	182.44	325.97	1.84	3.59	4.84	1.38
± SE	4.22	9.91	26.93	120.70	0.59	1.62	1.42	0.24

Economic evaluation:

Data of the economical evaluation of feeding growing lambs on the tested rations were summarized in Table (8) and showed that R2 ration had the lowest feeding cost being 9.71 LE/ Kg gain followed by R5 ration being 9.95 LE/ Kg gain, while R4 ration had the highest feeding cost, due to the high cost of CGM being 11.67 LE/ Kg gain, followed by R1 and R6 rations being 10.63 and 10.56 LE/ Kg gain, respectively.

Table (8): Economical evaluations of the experimental rations.

Rations	Experimental rations					
	R1	R2	R3	R4	R5	R6
Price of feed intake, h/d., L.E*.						
TMR[1]	2.04	1.84	1.84	2.17	2.01	2.0
Yeast	0	0	0.075	0	0	0.075
Feed cost / Kg gain, L.E.	10.63	9.71	10.19	11.67	9.95	10.56

**Based on market prices at beginning of experiment (2010), the prices were as follow: Total mixed ration for rations by order were 1455, 1332, 1332, 1562, 1440, 1440 (corn was 1500, dried orange pulp was 750, wheat bran was 1300, alfalfa hay was 1200, SBM was 2800 and CGM was 5000 L.E./ ton)., yeast was 25 L.E./ Kg. [1] total mixed ration.*

In view of the obtained results, it could be concluded that 50 % corn could be replaced by dried orange pulp as alternative source of energy in growing lambs rations to reduce the cost of rations without negative effect on animal performance and animal health and adding yeast had not effect on the improvement of digestion, utilization and feed efficiency of dried orange pulp.

So, the study recommended using dried orange pulp as alternative energy source by 50 % replacement corn grains in lamb's rations with soybean meal as a protein source to obtained highest performance with lowest cost of feeding. Also, more studies needed to investigate the effect of other protein sources, moderate in the protein degradability and lower in the cost than corn gluten meal, on rations contain DOP.

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التأثير الغذائي و الإقتصادى لإستخدام مخلفات البرتقال الجافة كمصدر للطاقة فى علائق الحملان النامية.

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تم توزيع ٣٠ حمل من ذكور الرحمانى فى عمر ٥- ٦ أشهر و متوسط وزن ٢٨,٩ ± ٠,٩ كجم عشوائيا تبعا لمتوسط الوزن على ستة مجاميع غذائية (٥ حيوانات للمجموعة) فى تجربة نمو استمرت ١٢٠ يوما. كما تم استخدام ١٨ ذكر غنم تام النمو (٣ حيوانات للمجموعة) لاجراء تجارب الهضم و ذلك لمدة ٢١ يوما و ذلك لتقييم إستخدام مخلفات تصنيع البرتقال الجافة كمصدر بديل للطاقة مع مصادر بروتين مختلفة (كسب فول الصويا و كسب جلوتين الذرة) مع إضافة الخميرة أو بدون إضافة .

غذيت الحيوانات عل ستة علائق تجريبية كل منها يحتوى على ٣٠ % برسيم حجازى و ٧٠ % مركزات و كانت المجموعة الأولى (R1) تحتوى على الذرة كمصدر رئيسى للطاقة مع كسب فول الصويا كمصدر رئيسي للبروتين (٤٤,٠٥ %), المجموعة الثانية (R2) كما فى المجموعة الأولى مع استبدال ٥٠ % من الذرة بمخلفات تصنيع البرتقال الجافة كمصدر بديل للطاقة, المجموعة الثالثة (R3) كما فى المجموعة الثانية مع إضافة ٣ جم خميرة / حيوان/ يوم, المجموعة الرابعة (R4) تحتوى على الذرة كمصدر رئيسى للطاقة مع كسب جلوتين الذرة كمصدر رئيسى للبروتين (٦٤,٥ %), المجموعة الخامسة (R5) كما فى المجموعة الرابعة مع استبدال ٥٠ % من الذرة بمخلفات تصنيع البرتقال الجافة كمصدر بديل للطاقة و المجموعة السادسة (R6) كما فى المجموعة الخامسة مع إضافة ٣ جم خميرة / حيوان/ يوم.

و قد وجد أن استبدال ٥٠ % من الذرة بمخلفات تصنيع البرتقال الجافة مع كسب فول الصويا مع أضافة الخميرة أو بدون إضافة (R2 و R3) لم يختلف معنويا مع تلك المحتوية على ١٠٠ % ذرة (R1) و ذلك فى معاملات الهضم و مقاييس سائل الكرش و معدلات النمو و كفاءة تحويل الغذاء و مقاييس الدم. بينما استبدال ٥٠ % من الذرة بمخلفات تصنيع البرتقال الجافة مع كسب جلوتين الذرة مع أضافة الخميرة أو بدون إضافة (R5 و R6) سجل تحسنا معنويا فى كل القياسات السابقة مقارنة بالمجموعة الرابعة (R4).

أظهر النتائج تحسنا معنويا فى معدل تخليق البروتين الميكروبى و كذلك إنخفاض معنوى فى العد البكتيرى للبكتريا الممرضة *E.coli* و ذلك لكل المجاميع المحتوية على مخلفات تصنيع البرتقال كمصدر بديل للطاقة مقارنة بمجاميع الذرة.

كم أظهرت النتائج إنخفاض تكلفة التغذية مع تحسن النمو و بالتالى تحسن الكفاءة الإقتصادية للعليقة المحتوية على مخلفات تصنيع البرتقال كمصدر بديل للطاقة مع كسب فول الصويا كمصدر للبروتين (R2).

و على ذلك يمكن استبدال الذرة بمخلفات تصنيع البرتقال بدون أى تأثير سىء على الحيوان مع انخفاض التكلفة الغذائية و رفع الكفاءة الإقتصادية.