Advances in Biological Research 15 (1): 01-13, 2021
ISSN 1992-0067

DOI: 10.5829/idosi.abr.2021.01.13

Impact of Instead Yellow Corn by Orange Juice Wastes on Growth, Digestion, Nutritive Values, Nitrogen Balance, Ruminal Fermentation and Blood Constituents of Growing Sheep

[1]Hamed A.A. Omer and [2]Mohamed F. El-Karamany

[1]Animal Production Department, National Research Centre,
33 El-Bohouth Street, P.O. Box: 12622, Dokki, Giza, Egypt
[2]Field Crops Research Department, National Research Centre,
33 El-Bohouth Street, P.O. Box: 12622, Dokki, Cairo

Abstract: In order to meet the high demand for animal feed, efficient use of available feed resources, enlargement of the feed resource base and a quest for novel feed resources, particularly those not competing with human food, is pivotal for sustainable development of the livestock sector. So, this study search for cheap source of energy to be alternative for grains. A total number twenty five growing Rahmani male lambs aged 5-6 months with an initial live body weight 23.72±0.111 kg approximately were randomly divided into five experimental groups. Experimental animals were housed in semi-open pens and fed as group feeding for 105 days. The five tested rations were formulated to replace 0, 12.5, 25, 37.5 and 50 % of portion of yellow corn in the first[1st] tested ration that contained 40% yellow corn and considered as control (R_1), meanwhile, second, third, fourth and fifth tested rations were replaced 12.5, 25, 37.5 and 50 % of yellow corn in control ration (R_1) sun dried orange juice wastes (SDOJW) for R_2, R_3, R_4 and R_5, respectively. The results showed that sun dried orang juice by-product (SDOJW) seemed to be an adaquet or a good source of protein (9.35% CP) vs. (9.12% CP) in yellow corn (YC), in addition to SDOJW was also, good source of energy (6.18% EE) vs. (3.88%) EE in YC. Morove, SDOJW suprior in their contents of crude fiber (10.60% CF) vs. (2.36% CF) in YC and it have a modrate potrion of NFE that recorded (64.27%) vs. 83.01% NFE in YC. Incorporation SDOJW at different levels causing a significantly ($P<0.05$) increasing in their values of final weight, total body weight gain and Average daily gain. Also, It realized a significantly ($P<0.05$) increasing in dry matter intake, total digestible nutrients intake and digestible crude protein intake. Also, feed conversion expressed as g. intake / g. gain of dry matter intake, total digestible nutrients intake and digestible crude protein intake were significantly ($P<0.05$) improved. Dietary treatments causing a significantly ($P<0.05$) increasing in their nutrient digestibility coefficients that includes (DM, CP, CF, EE and NFE); cell wall constituents digestibility includes (NDF, ADF, hemicellulose and cellulose) and TDN value. All experimental groups recorded a positive nitrogen retention, also, with increasing level of SDOJW, the values of nitrogen retention (NR as percentages of NI and NR as percentages of DN were significantly ($P<0.05$) increased. Dietary treatment significantly ($P<0.05$) increased rumminal pH, but it significantly ($P<0.05$) decreased both values of ammonia nitrogen and total volatile fatty acids concentration compared to the control. All values of lipids parameters includes (total cholesterol, triglycerides and total lipids); values of liver functions parameters includes (GPT and GOT) and values of kidneys functions parameters includes (urea, alkaline phosphatase and createnin) were significantly ($P<0.05$) decreased when YC replaced by SDOJW at different levels of replacements. It can be mentioned that sun dried orange juice wastes (SDOJW) can be used as alternative source of the main source of energy that used in sheep rations (yellow corn) that used in sheep rations formulation without occurring any adverse effects on their growth, digestion, nutritive values, nitrogen balance, ruminal fermentation and blood constituents. Also, incorporation SDOJW considered a good and cheap alternative source for the yellow corn be used safety and successful with occurring improving in their health through out decreasing their values of lipid parameters, values of liver functions parameters and values of kidneys functions parameters.

Corresponding Author: Hamed A.A. Omer, Animal Production Department, National Research Centre,
33 El-Bohouth Street, P.O. Box: 12622, Dokki, Giza, Egypt.

Key words: Orange Juice Wastes · Lambs · Growth · Digestibility · Nutritive Values · Nitrogen Balance · Ruminal Fermentation · Blood Parameters

INTRODUCTION

Animal ration formulations depending on corn grain as a main sours of energy, while corn grain is very expensive and increase the costs of animal rations. So, it must be search for on a cheap source of energy to use as an alternative for grains. Increased disposal costs in many parts of the world have increased interest in utilization of by-product feedstuffs as alternative feeds for ruminants [1]. Also, they noted that about 24% of world production of citrus is in the Mediterranean countries of Spain, Italy, Greece, Egypt, Turkey and Morocco, with Brazil (24%) and the USA (21%) being major individual citrus producing countries.

In order to meet the high demand for animal feed, efficient use of available feed resources, enlargement of the feed resource base and a quest for novel feed resources, particularly those not competing with human food, is pivotal for sustainable development of the livestock sector. The organized food processing sector generate approximately 1.81, 6.53, 32.0 and 15.0 million tones of fruit and vegetable wastes respectively in India, the Philippines, China and the USA, which are either composted or dumped in landfills or rivers, causing environmental hazards [2].

The citrus pulp contains 60-65% peel, 30-35% internal tissues and up to 10% seeds [3]. Due to the high moisture and sugar contents and presence of mould and yeast, citrus pulp gets rapidly deteriorated [4, 5] and may cause environmental pollution. Therefore, it should be sun dried and pelleted to increase density or should be ensiled. While drying, generally lime is added to neutralize the free acids, bind the fruit pectin and release water [6].

The dried pulp is primarily a carbonaceous feedstuff as it contains 5-10% CP and 6.2% EE, 10-40% soluble fiber (pectin), 54% water-soluble sugars, 1-2% calcium due to the addition of lime and 0.1% phosphorus. Carotene content is low [3, 7].

Dried citrus pulp is used as a cereal substitute in concentrate diets because of its high OM digestibility (85-90%) and energy availability (2.76-2.9 Mcal ME/kg DM and 1.66-1.76 Mcal NE/kg DM) for lactating dairy cows. The ME availability is 85–90% that of maize and comparable to barley [1, 8]. Unlike cereals, its energy is not based on starch but on soluble carbohydrates and digestible fiber. Citrus pectin are easily and extensively degraded, producing acetic acid, which is less likely than lactic acid to cause a pH drop and result in acidosis [6].

Due to its high fiber content, the long rumination of citrus pulp produces large quantities of saliva that has a buffering effect on rumen pH. Citrus pulp is therefore considered as a safer feed than cereals for animals fed high-concentrate, low-roughage diets as is practiced in high yielding dairy cows [3]. Dried citrus pulp can replace 20% concentrate in lactating dairy cattle [9]. and up to 30% in lactating ewes [10] without adversely affecting DM intake, rumen metabolites, digestibility, milk yield or milk protein and fat contents. Animals should be adapted gradually because it contains limonin in the seeds and peels, which has a bitter taste. At higher levels in diets (>40%), it depresses palatability [11] and overall performance with ruminal parakeratosis [12]. Large amounts of butyric acid produced as a result of the high-level feeding cause rumen papillae to become enlarged and keratinized, restricting nutrient absorption and impairing animal performances [13]. Citrus pulp has a low content of vitamin A; green leafy roughage is an important ingredient in rations with high levels of citrus pulp [14].

So, this work aimed to study the nutritional impact of replacing yellow corn by sun dried orange juice by-products at different levels in Rahmani sheep rations on their nutrient digestibility coefficients, nutritive values, ruminal fermentation, blood parameters.

MATERIALS AND METHODS

This study was carried out in Co-operation work between Animal Production Department, Division of Agriculture Researches, National Research Center, Dokki, Giza, Egypt and Field Crops Department, Division of Agriculture Researches, National Research Center, Dokki, Giza, Egypt. The present work aiming to studying the impact of partial replacement yellow corn by sun dried orange juice wastes (SDOJW) in Rahmani sheep rations on their, growth, digestion coefficients, nutritive values, nitrogen balance, ruminal fluid parameters and some blood constituents.

Animals and Feeds: After feeding trial that continuous for 105 days using twenty five growing Rahmani male lambs aged 5-6 months with an initial live body weight 23.72±0.111 kg approximately. The animals were randomly divided into equal five groups. Experimental animals were housed in semi-open pens and fed as group feeding, the experimental rations were offered in form of complete feed mixture that formulated to cover the requirements of growing sheep according to the NRC [15] Lambs were received one of the experimental rations that assigned as follows:

R_1: 1st experimental ration assigned as control and it contained 40% yellow corn.
R_2: 2nd experimental ration replace 12.5% of yellow corn in control ration by sun dried orange juice by-products (SDOJW).
R_3: 3rd experimental ration replace 25% of yellow corn in control ration by SDOJW.
R_4: 4th experimental ration replace 37.5% of yellow corn in control ration by SDOJW.
R_5: 5th experimental ration replace 50% of yellow corn in control ration by SDOJW.

Each group lambs received one of the five tested rations at 4% of their live body weights and it was adjusted every 2 weeks according to body weight changes. Rations were offered twice daily in two equal portions at 8.00 a.m. and 14.00 p.m. hours, while feed residues were daily collected, sun dried and weekly weighed. In addition to, fresh water was freely available at all times in plastic containers. Individual body weight change was recorded weekly before receiving the morning ration.

The composition and chemical analysis of the experimental rations is presented in Table (1).

Apparent Digestibility, Nutritive Values and Nitrogen Balance: At the end of feeding trial, three animals in each treatment were housed in individual metabolic cages. Cages allowed catching feces separately from the urine which was collected in attached glass containers containing 50 ml sulphoric acid 10%. The digestibility trial consisted of 7 days as a preliminary period followed by 5 days for feces and urine collection. Animals were received their tested rations and drinking water as mentioned before as described throughout the feeding period system. During the collection period, feces and urine were quantitatively collected from each animal once a day at 7.00 a.m. before feeding. Actual quantity of feed intake and water consumption were recorded. A sample of 10% of the collected feces from each animal was sprayed with 10 % sulphoric acid and 10% formaldehyde solutions and dried at 60°C for 24 hrs. Samples were mixed and stored for chemical analysis. Composite samples of feeds and feces were finely ground prior to analysis. Also 10% of the daily collected urine from each animal was preserved for nitrogen determination. The nutritive values expressed as the total digestible nutrient (TDN) and digestible crude protein (DCP) of the experimental rations was calculated by classical method that described by Abou-Raya [16].

Rumen Fluid Parameters: Rumen fluid samples were collected from three animals at the end of the feeding trial before feeding (0 hrs) and 3 hrs post feeding via stomach tube and strained through four layers of cheesecloth. Samples were separated into two portions, the first portion was used for immediate determination of ruminal pH and ammonia nitrogen (NH_3-N) concentration, while the second portion was stored at-20°C after adding a few drops of toluene and a thin layer of paraffin oil till analyzed for volatile fatty acid's (TVFA's).

Blood Parameters: Blood samples were collected at the end of feeding trial from 15 animals (Three animals from each group) 3 hours post feeding from the left jugular vein in heparinized test tubes and centrifuged at 5.000 rpm for 15 minutes. Plasma was kept frozen at -20°C for subsequent analysis.

Analytical Procedures: Chemical analysis of experimental ration samples, feces and urine were analyzed according to AOAC [17] methods. Meanwhile, cell wall constituents includes {neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL)} were evaluated according to Goering and Van Soest [18]) and Van Soest *et al.* [19]. In addition to, hemicellulose content was calculated as the difference between NDF and ADF, while, cellulose content was calculated as the difference between ADF and ADL. Ruminal pH was immediately determined using digital pH meter. Ruminal ammonia nitrogen (NH_3-N) concentrations were determined applying NH_3 diffusion technique using Kjeldahle distillation method according to AOAC [17]. On the other hand, ruminal total volatile fatty acids (TVFA's) concentrations were determined by steam distillation according to Warner [20].

Blood samples of glucose, hemoglobin were evaluated according to the method described by Weiss and Wardrop [21], plasma total protein was determined according to Armstrong and Carr [22] and Witt and Trendelenburg [23]; albumin was determined according to Doumas *et al.* [24] and Tietz [25]; triglycerides were determined according to Fossati and Principe [26]; total lipids were determined according to Postma and Stroes [27]; total cholesterol was determined according to Allain *et al.* [28] and Pisani *et al.* [29]; alkaline phosphates' activity was measured according to the method of Beliefield and Goldberg [30]; urea according to Patton and Crouch [31]; createnine was determined according to Husdan [32]; plasma glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) activities were determined as described by Reitman and Frankel [33] and Harold [34]; meanwhile globulin was calculated by difference between total protein and albumin. Albumin: globulin ratio (A: G ratio) was also calculated.

Statistical Analysis: Data collected of live weight, average daily gain, feed intake, feed conversion, nutrient and cell wall constituent digestibilities, nutritive values, nitrogen balance and blood parameters were subjected to statistical analysis as one-way analysis of variance according to SPSS [35]. Duncan's Multiple Range Test Duncan [36] was used to separate means when the dietary treatment effect was significant according to the following model:

$Y_{ij} = \mu + T_i + e_{ij}$ Where: Y_{ij} = observation. μ = overall mean. T_i = effect of experimental rations for i = 1-5, 1 = (R_1 contained 40% yellow corn and considered as control), 2 = (R_2 experimental ration replace 12.5% of yellow corn in control ration by sun dried orange juice wastes (SDOJW), 3 = (R_3 experimental ration replace 25% of yellow corn in control ration by SDOJW and 4 = (R_4 experimental ration replace 37.5% of yellow corn in control ration by SDOJW, 5 = (R_5 experimental ration replace 50% of yellow corn in control ration by SDOJW.
e_{ij} = the experimental error.

Meanwhile, data of rumen fluid parameters includes (ruminal pH, NH_3-N and TVFA's) concentrations were statistically analyzed as two factors-factorial analysis of variance according to the following model:

$Y_{ijk} = \mu + T_i + S_j + (TS)_{ij} + e_{ijK}$

where:
T_i = effect of experimental rations for i = 1-5, 1 = (R_1 contained 40% yellow corn and considered as control), 2 = (R_2 experimental ration replace 12.5% of yellow corn in control ration by SDOJW, 3 = (R_3 experimental ration replace 25% of yellow corn in control ration by SDOJW and 4 = (R_4 experimental ration replace 37.5% of yellow corn in control ration by SDOJW, 5 = (R_5 experimental ration replace 50% of yellow corn in control ration by SDOJW.
S_j= the effect of sampling time for j =1-2, 1= before feeding (0 hrs) and 2= 3hrs post feeding.
$(TS)_{ij}$ = the interaction of experimental rations (T) and sampling time (S).
e_{ij} = the experimental error.

RESULTS AND DISCUSSION

Results illustrated in Table (1) cleared that sun dried orang juice by-product (SDOJW) seemed to be an adaquet or a good source of protein (9.35% CP) vs. (9.12% CP) in yellow corn (YC), in addition to SDOJW was also, good source of energy (6.18% EE) vs. (3.88%) EE in YC. Morove, SDOJW suprior in their contents of crude fiber (10.60% CF) vs. (2.36% CF) in YC and it have a modrate potrion of NFE that recorded (64.27%) vs. 83.01% NFE in YC.

Furthermore the other components can be used safely in ration formulation of sheep as alternative or replacement from yellow corn. On ther other hand, chemical analysis of different experimental rations were fremulated to iso-nitrogenous and iso-caloric that varied from 16.86% to 16.90% in their cotents of CP and varied from 62.56% to 66.32% in their cotents of NFE and varied from 3.59% to 4.06% in their cotents of EE.

Also, values of cell wall constituents includes (NDF, ADF, ADL, hemicellulose and cellulose) were nearing among the five experimental rations. The present results of sun dried orang juice wastes (SDOJW) were comparable in their chemical analyis that recorded for citrus pulp by many authors [37-51] they reported that citrus pulp contained 90.00 to 94.20% dry matter, 93.7 to 95.00% organic matter, 6.00 to 16.67% crude protein, 12.00 to 17.70% crude fiber, 3.20 to 11.71% ether extract, 3.90 to 7.30% ash; 55.73 to 70.10% nitrogen free extract. Moreover, some variations in the chemical composition of dried citrus pulp can be expected because variation in production site, citrus variety, proportion of seeds & peel and manufacturing processes used [41].

The present results of chemical analysis of tested rations were in agreement with those recorded by Omer and Tawila [49] who fed Baladi goats on rations contained 50% yellow corn (YC) and replace at 12.5 and 50% of YC by dried citrus by-product.

Growth Performance of the Experimental Groups: Data of growth performance that presented in Table (2) showed that instead of 25, 37.5 and 50% of YC in control ration (R_1) by SDOJW (R_3, R_4 and R_5) causing a significantly ($P<0.05$) increasing in their values of final weight (FW), total body weight gain (TBWG) and Average daily gain (ADG), the best values were recorded with R_5 that replaced 50% of YC in control (R_1).

Table 1: Composition and chemical analysis of the experimental rations

Item	SDOJW	YC	Experimental rations R_1	R_2	R_3	R_4	R_5
Replacing level of yellow corn by SDOJW	Sun dried orange juice wastes (SDOJW)	Yellow corn (YC)	0 %	12.5%	25%	37.5%	50%
Composition (kg/ ton)							
Yellow corn			400	350	300	250	200
Sun dried orang juice by-product (SDOJW)			-	50	100	150	200
Soybean meal			170	170	170	170	170
Wheat bran			100	100	100	100	100
Peanut vein hay			300	300	300	300	300
Lime stone			18	18	18	18	18
Sodium chloride			7	7	7	7	7
Anti toxic			1	1	1	1	1
Vitamin and mineral mixture[1]			4	4	4	4	4
Chemical analysis (%)							
Moisture	10.08	9.81	9.75	9.76	9.78	9.79	9.81
Chemical analysis on DM basis (%)							
Organic matter (OM)	90.40	98.37	94.68	94.28	93.88	93.48	93.08
Crude Protein (CP)	9.35	9.12	16.86	16.87	16.89	16.89	16.90
Crude fiber (CF)	10.60	2.36	7.91	8.33	8.74	9.15	9.56
Ether extract (EE)	6.18	3.88	3.59	3.71	3.82	3.94	4.06
Nitrogen free extrct (NFE)	64.27	83.01	66.32	65.37	64.43	63.50	62.56
Ash	9.60	1.63	5.32	5.72	6.12	6.52	6.92
Cell wall constituents (%)							
Neutral detergent fiber (NDF)	35.89	30.47	33.25	33.53	33.80	34.07	34.34
Acid detergent fiber (ADF)	19.10	11.58	16.37	16.75	17.12	17.51	17.88
Acid detergent lignin (ADL)	3.32	1.92	2.82	2.89	2.96	3.03	3.09
Hemicellulose[2]	16.79	18.89	16.88	16.78	16.68	16.56	16.46
Cellulose[3]	15.78	9.66	13.55	13.86	14.16	14.48	14.79
Cell soluble-NDF[4]	64.11	69.53	66.75	66.47	66.20	65.93	65.66

[1]Vitamin & Mineral mixture: Each kilogram of Vit. & Min. mixture contains: 2000.000 IU Vit. A, 150.000 IU Vita. D, 8.33 g Vit. E, 0.33 g Vit. K, 0.33 g Vit. B_1, 1.0 g Vit. B_2, 0.33g Vit. B_6, 8.33 g Vit.B_5, 1.7 mg Vit. $B1_2$, 3.33 g Pantothenic acid, 33 mg Biotin, 0.83g Folic acid, 200 g Choline chloride, 11.7 g Zn, 12.5 g Fe, 16.6 mg Se, 16.6 mg Co, 66.7 g Mg and 5 g Mn. SDOJW: sun dried orange juice wastes.

[2]Hemicellulos = NDF – ADF. [3]Cellulose = ADF – ADL. [4]Cell soluble-NDF = 100 – NDF.

R_1: first[1st] experimental ration assigned as control and it contained 40% yellow corn.

R_2: second[2nd] experimental ration replace 12.5% of yellow corn in control ration by SDOJW.

R_3: third[3th] experimental ration replace 25% of yellow corn in control ration by SDOJW.

R_4: fourth[4th] experimental ration replace 37.5% of yellow corn in control ration by SDOJW.

R_5: fifth[4th] experimental ration replace 50% of yellow corn in control ration by SDOJW.

Table 2: Growth performance of the experimental groups

Item	Experimental rations R_1	R_2	R_3	R_4	R_5	SEM
Replacing level of yellow corn by SDOJW	0 %	12.5%	25%	37.5%	50%	
Live body weight, g						
Initial weight (kg)	23.100	24.000	23.600	24.100	23.800	0.111
Final weight (FW, kg)	42.500^{c}	43.950^{bc}	44.600^{ab}	45.600^{ab}	45.800^{a}	0.373
Total body weight gain (TBWG, kg)	19.400^{c}	19.950^{bc}	21.000^{ab}	21.500^{a}	22.000^{a}	0.310
Experimental duration period	105 days					
Average daily gain (ADG, g/day)	185^{c}	190^{bc}	200^{ab}	205^{a}	210^{a}	2.926
Feed intake expressed as						
Dry matter intake (DMI), g	1200^{d}	1251^{b}	1230^{c}	1280^{a}	1220^{c}	7.698
Total digestible nutrients intake (TDNI), g	861^{c}	913^{b}	905^{b}	947^{a}	903^{b}	7.552
Digestible crude protein intake (DCPI), g	152^{c}	161^{a}	158^{b}	165^{a}	156^{b}	1.218
Feed conversion expressed as g. intake / g. gain of						
Dry matter	6.49^{c}	6.58^{c}	6.15^{b}	6.24^{b}	5.81^{a}	0.074
Total digestible nutrients	4.65^{c}	4.81^{d}	4.53^{b}	4.62^{c}	4.30^{a}	0.046
Digestible crude protein	0.82^{c}	0.85^{d}	0.79^{b}	0.80^{b}	0.74^{a}	0.001

a, b c and d: Means in the same row having different superscripts differ significantly ($P<0.05$).

SEM: Standard error of mean. SDOJBP: Sun dried orang juice by-product.

R_1: first[1st] experimental ration assigned as control and it contained 40% yellow corn.

R_2: second[2nd] experimental ration replace 12.5% of yellow corn in control ration by SDOJW.

R_3: third[3th] experimental ration replace 25% of yellow corn in control ration by SDOJW.

R_4: fourth[4th] experimental ration replace 37.5% of yellow corn in control ration by SDOJW.

R_5: fifth[4th] experimental ration replace 50% of yellow corn in control ration by SDOJW.

meanwhile, instead of 12.5% of YC in control ration (R_1) by SDOJW (R_2) in significantly (P>0.05) increased the same parameters that mentioned above (FW, TBWG and ADG) in comparison with the control one (R_1). These results in agreement with those noted by Omer and Tawila [49] who noted that when Baladi goat kids received ration replaced 25 or 50% of yellow corn by citrus by-product (R_2 and R_3). They found that ADG insignificantly (P>0.05) improved by 16% and 10% for R_2 and R_3 in comparison with the control one and rate of weight gain will be directly related to the level of TDN intake. On the other hand, Koutsotolis and Nikolaou [52] studied the effect of replacing maize grain with dried citrus pulp (DCP) in various proportions (20, 40 and 60%) of the diets using local Epirus mountainous breed of sheep on the performance of fattening lambs for 12 weeks. They reported that DCP can replace maize grain in fattening lambs at a level up to 40% from weaning age (at 42 days) until the age of 126 days without observing significant differences in growth of lambs. Furthermore Scerra *et al.* [53] noted that no differences were noticed for live weight between lamb's treatments. Also, as noted by Lanza *et al.* [54] who used carob pulp and orange pulp in replacement of cereal grains in lamb fattening diets that not affected on final live weight, average daily weight gain of lambs Moreover, Peacock and Kirk [44] reported that there were no significant differences in gain of steers fed citrus pulp, corn feed meal and ground snapped corn when combined with adequate protein and other essential nutrients in a ration for young growing steers. Also, Lanza [55] found that half replacing of corn grain by dried orange pulp concentrates fed to Friesian heifers, from 6 to 18 month, did not negatively affect body weight. On the other hand, Jingzhi *et al.* [56] noticed that inclusion citrus pulp in rabbit rations at 0, 7%, 14% and 21% did not affect the daily feed intake, average daily gain and feed conversion ratio.

Also data of Table (2) cleared that incorporation SDOJW in sheep rations as alternative source of YC realized a significantly (P<0.05) increasing in dry matter intake (DMI), total digestible nutrients intake (TDNI) and digestible crude protein intake (DCPI), the highest value of DMI, TDNI and DCPI were recorded by R_4 that replaced 37.5% of YC in control (R_1) by SDOJW. These results in disagreement with those obtained by Omer and Tawila [49] who noted that when Baladi goat kids fed ration replaced 25 or 50% of yellow corn by citrus by-product had no significant (P>0.05) effect on feed intake that calculated as DMI, TDNI and DCPI. These indicate that, the sun dried citrus by product had no adverse effect on palatability. Also, Lanza [55] observed that, when the corn or barley grain partially or completely replacing by dried orange pulp or dried lemon pulp in the concentrates that fed to Friesian dairy cattle was not effect on their feed intake. Replacement of cereal grains by orange pulp in lamb fattening diets based on faba bean did not affect dry matter intake [54].

In addition to, Bueno *et al.* [43] noted that when Saanen kids fed rations replaced corn with dehydrated citrus pulp at (0, 33, 66 and 100%), feed intake realized a quadratic effect (P<0.05) with the increasing the level of replacement.

On the other hand, data of Table (2) showed that feed conversion expressed as g. intake / g. gain of DMI, TDNI and DCPI were significantly (P<0.05) improved when YC in control (R_1) replaced by SDOJW at different portions 12.5%, 25%, 37.5% or 50% (R_2, R_3, R_4 and R_5). Generally all feed convertion that expressed as g. intake / g. gain of DMI, TDNI and DCPI were significantly (P<0.05) improved with increasing the level of replacement of YC by SDOJW. The highest improvement value of feed convertion was recorded with R_5 that replaced 50% of YC in control ration (R_1) by SDOJW. These results in agreement with those obtained by Omer and Tawila [49] who noted that when Baladi kids fed ration replaced 25 of yellow corn by citrus by-product caused an improving in their feed efficiency (g. gain/ g. intake) reach to 16% comparing to control one. Moreover, Pascual and Carmona [57] and Pascual and Carmona [58] received growing lambs diets containing 0, 15, 30, 45 and 60% citrus pulp and 10-15% alfalfa hay, they reported that feed efficiency were not altered significantly up to 30% of citrus pulp that inclusion in the concentrate. No differences watched among different treatments in their feed conversion when ration replaced corn grain with dried citrus pulp in bulls diets [59]. Also, Bueno *et al.* [43] studied the effect of replacing corn with dehydrated citrus pulp in growing Saanen kid's diets at levels 0, 33, 66 and 100%, they mentioned that feed conversion showed a quadratic effect (P<0.05) with the increasing levels of replacement.

Nutrients & Cell Wall Digestibility Coefficients and Nutritive Values: Data presented in Table (3) showed that dietary treatment had significant effect (P<0.05) on all nutrient digestibility coefficients except for OM digestibility; cell wall constituents digestibility and TDN value, meanwhile DCP was not affected (P>0.05). Generally inclusion SDOJW as alternative source of YC in sheep rations showed a significantly (P<0.05) increasing

Table 3: Nutrients & cell wall digestibility coefficients and nutritive values of the experimental rations

Item	Experimental rations					SEM
	R_1	R_2	R_3	R_4	R_5	
Replacing level of yellow corn by SDOJW	0 %	12.5%	25%	37.5%	50%	
Nutrient digestibility (%) of						
Dry matter (DM)	70.18^{b}	72.12^{a}	72.76^{a}	71.90^{a}	72.35^{a}	0.27
Organic matter (OM)	71.35	72.83	72.89	72.14	72.81	0.24
Crude protein (CP)	75.11^{c}	76.09^{ab}	76.23^{ab}	76.85^{a}	75.88^{bc}	0.18
Crude fiber (CF)	53.80^{c}	54.12^{c}	55.41^{b}	55.92^{ab}	56.37^{a}	0.28
Ether extract (EE)	84.61^{d}	86.17^{c}	87.21^{b}	88.14^{b}	89.37^{a}	0.45
Nitrogen-free extract (NFE)	73.92^{c}	74.17^{c}	75.09^{b}	75.83^{a}	76.12^{a}	0.24
Cell wall constituents digestibility of						
Neutral detergent fiber (NDF)	65.24^{d}	67.13^{c}	67.75^{bc}	68.31^{ab}	68.72^{a}	0.34
Acid detergent fiber (ADF)	69.18^{c}	70.34^{b}	70.92^{ab}	71.11^{ab}	71.65^{a}	0.24
Hemicellulose	61.16^{c}	61.64^{bc}	62.09^{b}	62.58^{a}	62.90^{a}	0.18
Cellulose	71.40^{d}	72.18^{c}	72.93^{b}	73.11^{b}	73.65^{a}	0.22
Nutritive values (%)						
Total digestible nutrient (TDN)	71.77^{c}	73.01^{b}	73.57^{ab}	73.96^{a}	73.99^{a}	0.23
Digestible crude protein (DCP)	12.66	12.83	12.85	12.88	12.82	0.03

a, b, c and d: Means in the same row having different superscripts differ significantly ($P<0.05$).
SEM: Standard error of mean.
R_1: first^{1st} experimental ration assigned as control and it contained 40% yellow corn.
R_2: second^{2nd} experimental ration replace 12.5% of yellow corn in control ration by SDOJW.
R_3: third^{3th} experimental ration replace 25% of yellow corn in control ration by SDOJW.
R_4: fourth^{4th} experimental ration replace 37.5% of yellow corn in control ration by SDOJW.
R_5: fifth^{4th} experimental ration replace 50% of yellow corn in control ration by SDOJW.

Table 4: Nitrogen utilization by sheep fed the experimental rations.

Item	Experimental rations					SEM
	R_1	R_2	R_3	R_4	R_5	
Replacing level of yellow corn by SDOJW	0 %	12.5%	25%	37.5%	50%	
Nitrogen intake (NI)	32.37^{c}	33.74^{ab}	33.24^{bc}	34.59^{a}	33.00^{bc}	0.23
Fecal nitrogen (FN)	10.21^{c}	10.56^{b}	9.90^{d}	11.14^{a}	9.36^{e}	0.16
Digested nitrogen (DN)Main e	22.16^{b}	23.18^{a}	23.34^{a}	23.45^{a}	23.64^{a}	0.17
Urinary nitrogen (UN)	9.36^{a}	8.95^{ab}	8.71^{bc}	8.50^{c}	8.66^{bc}	0.09
Total nitrogen extraction (TNE)	19.57^{a}	19.51^{a}	18.61^{b}	19.64^{a}	18.02^{b}	0.19
Nitrogen retention (NR)	12.80^{b}	14.23^{a}	14.63^{a}	14.95^{a}	14.98^{a}	0.23
NR, % of NI	39.54^{d}	42.18^{c}	44.01^{ab}	43.22^{bc}	45.39^{a}	0.55
NR, % of DN	57.76^{c}	61.39^{b}	62.68^{ab}	63.75^{a}	63.37^{a}	0.61

a, b, c, d and e: Means in the same row having different superscripts differ significantly ($P<0.05$).
SEM: Standard error of mean.
R_1: first^{1st} experimental ration assigned as control and it contained 40% yellow corn.
R_2: second^{2nd} experimental ration replace 12.5% of yellow corn in control ration by SDOJW.
R_3: third^{3th} experimental ration replace 25% of yellow corn in control ration by SDOJW.
R_4: fourth^{4th} experimental ration replace 37.5% of yellow corn in control ration by SDOJW.
R_5: fifth^{4th} experimental ration replace 50% of yellow corn in control ration by SDOJW.

in their nutrient digestibility coefficients that includes (DM, CP, CF, EE and NFE); cell wall constituents digestibility includes (NDF, ADF, hemicellulose and cellulose) and TDN value. Meanwhile it in significantly ($P>0.05$) increased both OM digestibility and value of DCP. The nutritional value of citrus pulp is high owing to its high content of readily fermentable carbohydrates and contains a variety of energy substrates for ruminal microbes, including both soluble carbohydrates and a readily digestible neutral detergent fiber (NDF) fraction.

Therefore, when citrus by-product feedstuffs substituted for starchy feeds, NDF and acid detergent fiber (ADF) digestibility coefficients are increased [51]. When citrus by-product feedstuffs substituted for starchy feeds, DM and OM digestibility coefficients tend to remain unaffected, while CP digestibility decreases and NDF and ADF digestibility coefficients increased. Lanza [55] noted that citrus by-product feedstuffs improve utilization of dietary fibrous fractions, possibly due to positive effects on rumen micro flora. Moreover, when straw is used as the basal feed for ruminants, the diet is improved by offering citrus BPF to correct nutrient deficiencies of the straw and to increase the digestion of its nutrients [46]. Supplementation with increasing amounts of pelted CP tended to result in a linear increase in digestibility of total diet DM and OM and suggest that high levels of CP to beef cattle can lower forage intake, but increase total energy intake. High levels of CP supplementation could be beneficial in combination with forages high in rumen degradable protein [60].

Nitrogen Utilization: Data illustrated in Table (4) showed that dietary treatment had significantly ($P<0.05$) effecting on nitrogen intake (NI), fecal nitrogen (FN), digested nitrogen (DN), urinary nitrogen (UN), total nitrogen extraction (TNE), nitrogen retention (NR), NR, % of NI and NR, % of DN. All experimental groups were recorded a positive nitrogen retention, in addition to with increasing level of substitution of YC by SDOJW, the values of nitrogen retention (NR); NR, % of NI and NR, % of DN were significantly ($P<0.05$) increased (R_2, R_3, R_4 and R_5) in comparison with the control one (R_1). These results were in agreement with those obtained by Dawson and Hopkins [61]; Fondevila *et al*. [62]; Paryad and Rashidi [63]; Omer and Abdel-Magid [64]. The more retention of nitrogen in sheep fed SDOJW can explain by reduced ammonia concentrations in the rumen that appeared to result from increased incorporation of ammonia into microbial protein that probably were the direct result of stimulated microbial activity.

Rumen Fluid Parameters: Data illustrated in Table (5) mentioned that level of replacement of YC by SDOJW had significantly ($P<0.05$) effecting on values of ruminal pH, NH_3-N and TVFA's concentrations. Dietary treatment significantly ($P<0.05$) increased rumminal pH, but it significantly ($P<0.05$) decreased both concentrations of ammonia nitrogen (NH_3-N) and total volatile fatty acids (TVFA's) concentration in comparison with the control (not contained SDOJW).

On the other hand sampling at 3 hrs post feeding realized a significantly ($P<0.05$) decreasing in value of ruminal pH, meanwhile, it significantly ($P<0.05$) increased values of NH_3-N and TVFA's comparing to before feeding.

Data of Table (6) mentioned that there were no interaction between level of replacement and sampling time on ruminal pH and ruminal NH3-N concentration, meanwhile, it is noticed an interaction between level of replacement and sampling time on TVFA's concentration.

Mould and Ørskov [65]; Wanapat *et al.* [66] noted that cellulose digestion is limited when ruminal pH reaches values below 6.0. Ruminal total VFA's concentrations and fermentation rates are correlated [67]. In contrast Koster *et al.* [68] observed that that TVFA's increased dramatically in response to supplemental rumen degradable protein fed to beef cows. Ruminal pH is one of the most important factors affecting the fermentation and influences its functions. It varies in a regular manner depending on the nature of the diet and on the time, it is measured after feeding and reflects changes of organic acids quantities in the ingesta.

The level of NH_3-N and TVFA's as end products of fermentation and breakdown of dietary protein has been used as parameters of ruminal activity by Abou-Akkada and Osman [69]. The results of ruminal fermentations showed that decreasing in values of TVFA's might be related to the less utilization of dietary energy and negative fermentation in the rumen. The reduction of ammonia nitrogen in the rumen liquor appears to be the result of increased incorporation of ammonia nitrogen into microbial protein and it was considered as a direct result to stimulated microbial activity. When occurring an increasing in TVFA's this might be related to the more utilization of dietary energy and positive fermentation in the rumen. The addition of more fermentable carbohydrate to ruminant rations causes a decrease in rumen ammonia [70] probably due to a greater uptake of ammonia by rumen microorganisms in support of enhanced microbial growth. The rate of TVFA’s production may in this situation exceed the rate of TVFA’s absorption through the rumen epithelium and TVFA’s concentration in the rumen juice is increased [71]. It should be mentioned that TVFA’s concentration in the rumen is governed by several factors such as dry matter digestibility, rate of absorption, rumen pH, transportation of the digesta from the rumen to the other parts of the digestive tract and the microbial population in the rumen and their activities [72]. Increasing of ruminal TVFA’s concentration is an indicator for better utilization of dietary carbohydrate as described by [73].

Blood Parameters: Data presented in Table (7) cleared that except for glucose contents in blood, the other values of blood constituents determined or calculated includes

Table 5: Main Effect of level of replacement or sampling time on rumen fluid parameters of the experimental rations

Item	Replacing level of yellow corn by SDOJBP							Sampling time			
	0 % R_1	12.5% R_2	25% R_3	37.5% R_4	50% R_5	SEM	P<0.05	Before feeding	3 hrs post feeding	SEM	P<0.05
pH	5.71[d]	5.81[c]	5.94[b]	6.05[a]	6.13[a]	0.088	*	6.37[a]	5.48[b]	0.088	*
NH_3-N (mg/dl)	19.27[a]	19.06[ab]	18.98[ab]	18.83[bc]	18.52[c]	0.187	*	17.98[b]	19.88[a]	0.187	*
TVFA's (meq/dl)	8.72[a]	8.57[b]	8.39[c]	8.18[d]	7.97[e]	0.116	*	7.80[b]	8.92[a]	0.116	*

a, b, c, d and e: Means in the same row within each treatments having different superscripts differ significantly (P<0.05).
SEM: standard error of the mean. *: significant at (P<0.05). NH_3-N: Ammonia nitrogen concentration. TVFA's: Total volatile fatty acids concentration.
R_1: first[1st] experimental ration assigned as control and it contained 40% yellow corn. R_2: second[2nd] experimental ration replace 12.5% of yellow corn in control ration by SDOJBP.
R_3: third[3th] experimental ration replace 25% of yellow corn in control ration by SDOJBP. R_4: fourth[4th] experimental ration replace 37.5% of yellow corn in control ration by SDOJBP.
R_5: fifth[4th] experimental ration replace 50% of yellow corn in control ration by SDOJBP.

Table 6: Effect of interaction between level of replacement and sampling time on rumen fluid parameters of the experimental rations

Item	Sampling time: Before feeding					3 hrs post feeding					SEM	P<0.05
	0 % R_1	12.5% R_2	25% R_3	37.5% R_4	50% R_5	0 % R_1	12.5% R_2	25% R_3	37.5% R_4	50% R_5		
pH	6.19[c]	6.25[bc]	6.36[b]	6.49[a]	6.55[a]	5.22[g]	5.36[f]	5.51[e]	5.60[de]	5.71[d]	0.088	NS
NH_3-N (mg/dl)	18.32[c]	18.11[c]	18.01[c]	17.95[cd]	17.51[d]	20.21[a]	20.00[ab]	19.95[ab]	19.70[ab]	19.52[b]	0.187	NS
TVFA's (meq/dl)	8.12[e]	8.02[f]	7.95[f]	7.61[g]	7.31[h]	9.31[a]	9.11[b]	8.82[c]	8.75[c]	8.63[d]	0.116	*

a, b, c, d, e, f, g and h: Means in the same having different superscripts differ significantly (P<0.05).
SEM: standard error of the mean. NS: not significant *: significant at (P<0.05). NH_3-N: Ammonia nitrogen concentration. TVFA's: Total volatile fatty acids concentration.
R_1: first[1st] experimental ration assigned as control and it contained 40% yellow corn. R_2: second[2nd] experimental ration replace 12.5% of yellow corn in control ration by SDOJBP.
R_3: third[3th] experimental ration replace 25% of yellow corn in control ration by SDOJBP. R_4: fourth[4th] experimental ration replace 37.5% of yellow corn in control ration by SDOJBP.
R_5: fifth[4th] experimental ration replace 50% of yellow corn in control ration by SDOJBP.

Table 7: Blood parameters of the experimental groups

Item	Experimental rations R_1	R_2	R_3	R_4	R_5	SEM
Replacing level of yellow corn by SDOJW	0 %	12.5%	25%	37.5%	50%	
Glucose (mg/dl)	68.12	68.15	68.36	68.46	68.53	0.135
Hemoglobin (g/dl)	12.16[c]	12.19[bc]	12.21[abc]	12.23[ab]	12.25[a]	0.010
Total protein (g/ dl)	6.27[d]	6.30[cd]	6.33[bc]	6.36[ab]	6.38[a]	0.012
Albumin (g/ dl)	3.16[c]	3.14[c]	3.23[b]	3.21[b]	3.26[a]	0.012
Globulin (g/ dl)	3.11[b]	3.16[a]	3.10[b]	3.15[a]	3.12[b]	0.007
Albumin: globulin ratio	1.02[b]	0.99[c]	1.04[a]	1.02[b]	1.04[a]	0.005
Lipids parameters						
Total cholesterol (mg/dl)	62.12[a]	61.69[b]	61.35[c]	61.17[d]	61.06[d]	0.104
Triglycerides (mg/dl)	31.16[a]	30.22[b]	30.03[c]	29.96[c]	29.75[d]	0.124
Total lipids (mg/dl)	319[a]	316[ab]	312[ab]	308[bc]	303[c]	1.780
Liver functions						
GPT (U/I)	31.26[a]	31.08[ab]	30.95[bc]	30.90b[c]	30.82[c]	0.047
GOT (U/I)	20.18[a]	20.09[ab]	20.02[abc]	19.96[bc]	19.89[c]	0.034
Kidneys functions						
Urea (mg/dl)	19.33[a]	19.16[b]	19.15[b]	19.10[bc]	19.05[c]	0.027
Alkaline phosphatase (U/I)	63.77[a]	63.52[b]	63.46[bc]	63.31[cd]	63.22[d]	0.056
Createnin (mg/dl)	1.31[a]	1.26[ab]	1.23[b]	1.16[c]	1.10[d]	0.210

a, b c and d: Means in the same row having different superscripts differ significantly (P<0.05).
SEM: Standard error of mean.
GOT: Glutamic oxaloacetic transaminase.
GPT: Glutamic pyruvic transaminase..
R_1: first[1st] experimental ration assigned as control and it contained 40% yellow corn.
R_2: second[2nd] experimental ration replace 12.5% of yellow corn in control ration by SDOJW.
R_3: third[3th] experimental ration replace 25% of yellow corn in control ration by SDOJW.
R_4: fourth[4th] experimental ration replace 37.5% of yellow corn in control ration by SDOJW.
R_5: fifth[4th] experimental ration replace 50% of yellow corn in control ration by SDOJW.

(hemoglobin, total protein, albumin, globulin, albumin: globulin ratio; total cholesterol, triglycerides, total lipids, GPT, GOT, urea, alkaline phosphatase and createnin) were affected by replacing YC by SDOJW. The largest values of hemoglobin, total protein, albumin and albumin: globulin ratio were recorded when sheep fed ration replaced 50% of YC in control ration (R_1) by SDOJW. On the other hand, all values of lipids parameters includes (total cholesterol, triglycerides and total lipids); values of liver functions parameters includes (GPT and GOT) and values of kidneys functions parameters includes (urea, alkaline phosphatase and createnin) were significantly ($P<0.05$) decreased when YC replaced by SDOJW at different levels of replacements. Fed untraditional ration as compared to traditional ration in crossing calves decreased albumin and increased globulin concentrations while total protein values were not affected due to type of feeding and concluded that untraditional ration increased the immunity, especially, under hot summer season [51].

In addition to Habeeb *et al.* [74] fed untraditional ration to crossing calves decreased GOT and γGT activities and attributed that untraditional ration may be decrease the heat load on animals during hot summer season and concluded that using agro-industrial by-products mixtures as feed components for ruminants is reasonable and is not expected to change the enzymatic activity in the ruminants. Both urea-N and glucose concentrations in crossing calves were lower significantly in calves fed untraditional ration as compared to traditional ration and the percentages decrease values were 30.0 and 16.0, respectively. Blood plasma glucose slightly increased in group fed 50% concentrate feed mixture+50% vegetable fruit market wastes silage treated with lactic acid bacteria; and group fed 50% concentrate feed mixture + 50% vegetable and fruit market wastes with silage treated formic acid compared to the group which was fed concentrate feed mixture and the roughage source was Darawa as noted by [75]. Serum GOT and GPT were not significantly different from control rations and agro-industrial by products mixtures [76]. No significant differences in blood concentration of total protein, albumin and globulin in cows fed on DCP than in those fed on the control diet [77]. Total lipids, total cholesterol and triglycerides concentrations in crossing calves were higher significantly in group intake traditional ration than that fed the untraditional [74]. Plasma cholesterol recorded a significant increase in the group that fed 50% concentrate feed mixture+50% vegetable fruit market wastes silage treated with lactic acid bacteria and group was fed 50% concentrate feed mixture + 50% vegetable and fruit market wastes with silage treated formic acid compared to the group which was fed concentrate feed mixture and the roughage source was Darawa [75]. No significant differences were observed in blood concentration of triglycerides, while serum concentration of cholesterol was higher in cows fed on dried citrus pulp than in those fed on the control diet [77]. No significant differences in concentrations of T4, T3, cortisol and parathormone hormones due to type of rations [74].

CONCLUSION

Under conditions that available during carrying out of this work the presents results obtained cleared that sun dried orange juice wastes (SDOJW) can be used as alternative source of the main source of energy that used in the control (yellow corn) that considered the main source of energy in sheep rations formulation without occurring any adverse effects on their growth, digestion, nutritive values, nitrogen balance, ruminal fermentation and blood constituents. Also, incorporation SDOJW considered a good and cheap alternative source for the yellow corn be used safety and successful with occurring improving in their health through out decreasing their values of lipid parameters contents, values of liver functions parameters and values of kidneys functions parameters.

ACKNOWLEDGMENT

This work was supported by scientific project section, National Research Centre (Project ID: 12050110) under title "Modern application of hydro gel in agriculture".

REFERENCES

1. Bampidis, V.A. and P.H. Robinson, 2006. Citrus by-products as ruminant feeds: A review. Anim, Feed Science and Technology, 128: 175-217.
2. Wadhwa, M. and M.P.S. Bakshi, 2013. Utilization of fruit and vegetable wastes as livestock feed and as a substrate for generation of other value added products. Makkar HPS, editor. Food and Agriculture Organization of the United Nations. RAP Publication, Bangkok, Thailand; 2013/04. Page 56.
3. Crawshaw, R., 2004. Co-product Feeds: Animal Feeds from the Food and Drinks Industries. Nottingham University Press, Nottingham, UK.

4. Ashbell, G., Z.G. Weinberg and A. Arieli, 1988. Effect of blanching on loss reduction in orange peel storage. Journal Science and Food Agriculture, 45: 195-201.
5. Nam, I.S., P.C. Garnsworthy and J.H. Ahn, 2009. Effects of freeze-dried citrus peel on feed preservation, aflatoxin contamination and *in vitro* ruminal fermentation. Asian Australasian Journal of Animal Science, 22: 674-80.
6. Wing, J.M., 2003. Citrus Feedstuffs for Dairy Cattle. Florida Agric. Exp. Stn. Bull. 829. Gainesville. 2003. Available at: http://edis.ifas.ufl.edu.
7. Bakshi, M.P.S. and M. Wadhwa, 2013. Nutritional evaluation of cannery and fruit wastes as livestock feed. Indian Journal of Animal Sciences, 83: 84-89.
8. NRC, 2001. Nutrient Requirements of Dairy Cattle. 7th revised ed. National Research Council, National Academy of Sciences, Washington, DC, USA.
9. Assis, A.J., J.M.S. Campos, S. Filho, A.C. Queiroz, R. Lana, R.F. Euclydes, *et al.,* 2004. Citrus pulp in diets for milking cows. 1. Intake of nutrients, milk production and composition. Revista Brasileira de Zootecnia, 33: 242-50.
10. Fegeros, K., G. Zervas, S. Stamouli and E. Apostolaki, 1995. Nutritive value of dried citrus pulp and its effect on milk yield and milk composition of lactating ewes. Journal of Dairy Science, 78: 1116-21.
11. Bhattacharya, A.N. and M. Harb, 1973. Dried citrus pulp as a grain replacement for Awasi lambs. Journal of Animal Science, 36: 1175-80.
12. Martinez Pascual, J. and J. Fernandez Carmona, 1980. Citrus pulp in diets for fattening lambs. Animal Feed Science and Technology, 5: 11-22.
13. Brugére-Picoux, J., 2004. Maladie des moutons. France Agricole Editions, pp: 133-137.
14. Göhl B., 1982. Les aliments du bétail sous les tropiques. FAO, Division de Production et Santé Animale, Roma, Italy; 1982.
15. NRC, 1985. Nutrient Requirements of Sheep. 6th ed. National Research Council, National Academy Press, Washington, DC. USA.
16. Abou-Raya, A.K., 1967. Animal and Poultry Nutrition. 1st Ed. Pub. Dar El-Maarif, Cairo (Arabic text book).
17. AOAC (2005). Official Methods of Analysis, 18th ed. Association of Official Analytical Chemists, Washington, DC, USA.
18. Goering, H.K. and P.J. Van Soest, 1970. Forge fiber analysis (apparatus, reagents, procedure and some applications). Agric. Hand book 379, USDA, Washington and DC., USA.
19. Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal performance. Journal of Dairy Science, 74: 3583-3597.
20. Warner, A.C., 1964. Production of volatile fatty acids in the rumen, methods of measurements. Nutr. Abstr. And Rev., 34: 339.
21. Weiss, D.J. and K.J. Wardrop, 2010. Schalm's Veterinary Hematology. 6th ed., Blackwell Publishing Ltd, Ames, Iowa, USA.
22. Armstrong, W.D. and C.W. Carr, 1964. Physiological Chemistry: Laboratory directions 3: 75. Buger Puplishing Co, Minneapolis.
23. Witt, I. and C. Trendelenburg, 1982. A method for the rapid determination of total protein plasma. J. Clin Biochem., 20: 235.
24. Doumas, B.L., T.W.A. Watson and T. Biggs, 1971. Albumin standards and measurement of serum with bromocresol green. Clin. Chem. Acta, 31: 87.
25. Tietz, N.W., 1986. A method for the rapid determination of albumin of blood plasma. P.589 in textbook of clinical chemistry. W.B Saunders Company, Philadelphia.
26. Fossati, P. and L. Prencipe, 1982. Serum Triglycerides Determined Colorimetrically with an Enzyme that Produces Hydrogen Peroxide. Clin Chem., 28: 2077-2080.
27. Postma, T. and J.A. Stroes, 1968. Lipids screening in clinical chemistry. Clin Chim. Acta, 22: 569.
28. Allain, C.C., P.C.S. Chan, W. Richmond and P.C. Fu, 1974. Enzymatic determination of total serum cholesterol. Clin. Chem., 20: 470-475.
29. Pisani, T., G.P. Gebski and E.T. Leary, 1995. Accurate direct determination of low- density lipoprotein, cholesterol assay. Arch. Pathol. Lab. Med., 119: 1127.
30. Beliefield, A. and D.M. Goldberg, 1971. Estimation of serum alkaline phosphates. Enzyme, 12: 561.
31. Patton, C.J. and S.R. Crouch, 1977. Spectrophotomattic and kinetics investigation of the Berthelot reaction for the determination of ammonia. Anal. Chem., 49: 464.
32. Husdan, H., 1968. Chemical determination of creatinine with deproteinization. Clin Chem., 14: 222.
33. Reitman, S. and S. Frankel, 1957. Calorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvate transaminase. An. J. Clin. Path, 28: 56.
34. Harold, V., 1975. Colorimetric determination of glutamate pyruvate and oxaloacetic transaminase, practical Clin Biochem, 4th Ed, pp: 294.

35. SPSS, 2008. Statistical package for Social Sciences, Statistics for Windows, Version 17.0. Released 2008. Chicago, U.S.A.: SPSS Inc.
36. Duncan, D.B., 1955. Multiple Rang and Multiple F-Test Biometrics, 11: 1- 42.
37. Gad, Sawsan M., M.A. Tawila and M. Salman Fatma, 1998. Dried citrus pulp in sheep nutrition. J. Agric. Sci. Mansoura Univ., 23(9): 3707-3714.
38. Nouel, G. and J. Combellas, 1999. Live weight gain of growing cattle offered maize meal or citrus pulp as supplements to diets based on poultry litter and restricted grazing of low quality pastures. Livestock Research for Rural Development, 11(1).
39. Aregheore, E.M., 2000. Chemical composition and nutritive value of some tropical by-product feedstuffs for small ruminant- *in vivo* and in *vitro* digestibility. Animal Feed Science and Technology, 85: 99-109.
40. Chapman, Jr H.L., C.B. Ammerman, F.S. Baker Jr, J.F. Hentges, B. Hayes and T.J. Cunha, 2000. Citrus Feeds for Beef Cattle. Department of Animal Science, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. http:// edis.ifas.ufl.edu.
41. Arthington, J.D., W.E. Kunkle and A.M. Martin, 2002. Citrus pulp for cattle. The Veterinary Clinics, Food Anim. Pract., 18: 317-326.
42. Blezinger, S.B., 2002. Feed supplements come in several different forms. Cattle to day, part 4. webmaster@cattletoday.com or sblez@peoplescom.net.
43. Bueno, M.S., E. Ferrari Jr, D. Bianchini, F.F. Leinz and C.F.C. Rodriques, 2002. Effect of replacing corn with dehydrated citrus pulp in diets of growing kids. Small Rumin. Res., 46: 179-185.
44. Peacock, F.M. and W.G. Kirk, 2003. Comparative feeding value of dried citrus pulp, corn feed meal and ground snapped corn for fattening steers in dry lot Animal Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. The EDIS Web Site at http://edis.ifas.ufl.edu.
45. Rossi, J., 2004. Using citrus pulp in beef cattle diets. Livestock newsletter Animal and Dairy Science Department, Rhodes Center for Animal and Dairy Science http://www.ces.uga.edu/Agriculture/asdsvm/beef-home.html.
46. Villarreal, M., R.C. Cochran, A. Rojas-Bourrillón, O. Murillo, H. Muñoz and M. Poore, 2006. Effect of supplementation with pelleted citrus pulp on digestibility and intake in beef cattle fed a tropical grass-based diet (*Cynodon nimfuuensis*). Animal Feed Science and Technology, 125(1-2): 163-173.
47. Osman, A.A., E.S. Soliman, F.Z. Swidan and A.N. Ismail, 2007a. Evaluation of different rations of citrus and some crop residues silages. Egyptian J. Nutrition and Feeds, 10(2)Special Issue: 231-243.
48. Osman, A.A., E.S. Soliman, F.Z. Swidan and A.N. Ismail, 2007b. Effect of feeding silages contained citrus pulp and some crop residues on digestibility and rumen parameters of sheep. Egyptian J. Nutrition and Feeds, 10(2) Special Issue: 245-262.
49. Omer, H.A.A. and M.A. Tawila, 2009. Response of Baladi goats to diets containing different levels of citrus by-product. Egyptian J. Nutrition and Feeds, 12(1): 75-88.
50. Okoruwa, M.I., 2015. Predicting rumen microbial population and volatile fatty acids in growing rams fed avocado seeds with orange peels meal as replacement for guinea grass. Journal of Agriculture and Life Sciences, 2(1): 166-172. ISSN 2375-4214 (Print), 2375-4222 (Online).
51. Alnaimy, A., A.E. Gad, M.M. Mustafa, M.A.A. Atta and H.A.M. Basuony, 2017. Using of citrus by-products in farm animals feeding. Open Access Journal of Science, 1(3): 58-67. DOI: 10.15406/oajs.2017.01.00014.
52. Koutsotolis, K. and E. Nikolaou, 1995. Utilization of dried citrus pulp in replacement of corn grains in the rations of fattening lambs. Agricultural Research, 19: 57-60 (in Greek, English summary).
53. Scerra, V., P. Caparra, F. Foti, M. Lanza and A. Priolo, 2001. Citrus pulp and wheat straw silage as an ingredient in lamb diets: effects on growth and carcass and meat quality. Small Rumin. Res., 40(1): 51-56.
54. Lanza, M., A. Priolo, L. Biondi, M. Bella and H.B. Salem, 2001. Replacement of cereal grains by orange pulp and carob pulp in Faba bean-based diets fed to lambs: effects on growth performance and meat quality. Anim. Res., 50: 21-30.
55. Lanza, A., 1984. Dried citrus pulp in animal feeding. In: J. Holló, Editor, Proceedings of the International Symposium on Food Industries and the Environment Budapest, Hungary, Elsevier Pulishers, New York, NY, USA, pp: 189-198.
56. Jingzhi Lu, Xianghua Long, Zhifei He, Yingchun Shen, Yanhong Yang, Yuanqing Pan, Jiahua Zhang and Hongjun Li, 2018. Effect of dietary inclusion of dried citrus pulp on growth performance, carcass characteristics, blood metabolites and hepatic antioxidant status of rabbits, Journal of Applied Animal Research, 46:1, 529-533. https://doi.org/10.1080/09712119.2017.1355806.

57. Pascual, J.M. and J.F. Carmona, 1980a. Composition of citrus pulp. Anim. Feed Sci. Technol., 5(1): 1-10.
58. Pascual, J.M. and J.F. Carmona, 1980b. Citrus pulp in diets for fattening lambs. Anim. Feed Sci. and Technol., 5(1): 23-31.
59. Henrique, W., P.R. Leme, D.P.D. Lanner, JL.V. Coutinho-Filho, R.M. Peres, CL;. Justo, P.A. De Siqueira and G.F. Alleoni, 1998. Replacement of starch for pectin in diet with different concentrate levels. 1. Animal performance and carcass characteristics. Rev. Bras. Zootec., 27: 1206-1211.
60. Habeeb, A.A.M., A.E. Gad, M.M. Mustafa, M.A.A. Atta and H.A.M. Basuony, 2017. Using of Citrus By-Products in Farm Animals Feeding. IJSRST, 3(6): 428-441. Print ISSN: 2395-6011, Online ISSN: 2395-602X
61. Dawson, K.A. and D.M. Hopkins, 1991. Differential effects of live yeast on the cellulolytic activities of anaerobic ruminal bacteria. Journal of Animal Science, 69: 531.
62. Fondevila, M., J.A. Guada, J. Gasa and C. Castrillo, 1994. Tomato pomace as a protein supplement for growing lambs. Small Ruminant Research, 13(2): 117-126.
63. Paryad, A. and M. Rashidi, 2009. Effect of yeast (*Saccharomyces cerevisiae*) on apparent digestibility and nitrogen retention of tomato pomace in sheep. Pakistan Journal of Nutrition, 8: 273-278.
64. Omer, H.A.A. and S. Abdel-Magid Soha, 2015. Incorporation of dried tomato pomace in growing sheep rations. Global Veterinaria, 14(1): 01-16. DOI: 10.5829/idosi.gv.2015.14.01.9256 ISSN 1992-6197.
65. Mould, F.L. and E.R., Ørskov, 1993. Manipulation of rumen fluid pH its influence on cellulysis *In Sacco*, dry matter degradation and the rumen microflora of sheep offered either hay or concentrate. Anim. Feed Sci. and Technol., 10: 1-14.
66. Wanapat, M., O. Pimpa, A. Petlum and C. Wachirapakorn, 2000. Participation scheme of smallholder dairy farmers in the NE, Thailand on improving feeding systems. Asian-Aus. J. Anim. Sci., 13: 830-836.
67. McDonald, P., R.A. Edwards and J.F.D. Greenhalgh, 1995. Animal Nutrition. 5th Ed. Singapore, Longman Singapore Publishers.
68. Koster, H.H., R.C. Cochran, E.C. Titgemeyer, E.S. Vanzant, D. Aldelgadir and G.S. Jean, 1996. Effect of increasing degradable protein intake on intake and digestion of low quality, tall grass-prairie forage by beef cows. J. Anim. Sci., 74: 2473-2482.
69. Abou-Akkada, A.R. and H.E. Osman, 1967. The use of ruminal ammonia and blood urea as an index of the nutritive value of proteins in some feedstuffs. J. Agric. Sci., 69: 25-31.
70. Tagari, H., Y. Driori, L. Ascarelli and A. Bondi, 1964. The influence of level of protein and starch in rations for sheep on utilization of protein. Br. J. Nutr., 18: 333.
71. Van'tKlooster, A.T., 1986. Pathological aspects of rumen fermentation. In: Neimann-Sorensen A (ED) New developments and future perspectives in research on rumen function. Commission of the European Communities, Luxembourg, pp: 259-276.
72. Allam, S.M., A.K. Abou-Raya, E.A. Gihad and T.M. El-Bedawy, 1984. Nutritional studies by sheep and goats fed NoaH treated straw. 1st Egyptian British conference on Animal and Poultry Production, Zagazig, 11-13 Sep. pp: 53.
73. Fadel, J.G., D.U. Den and D.H. Robinson, 1987. Effect of nitrogen, energy supplementation on intake and digestion of oat straw by non lactating ruminant dairy cows. J. Agric. Sci., 106: 503.
74. Habeeb, A.A.M., A.E. Gad and A.A. El-Tarabany, 2011. Effect of two climatic conditions and types of feeding on body weight gain and some physiological and biochemical parameters in crossing calves. Zagazig Vet. J., 39(3): 34-48.
75. Khattab, M.S., 2008. Preparation of silage from vegetable and fruits market wastes treated with some additives and its effect on the productive performance of lactating animals. Thesis Fac of Agric Ain-Shams University, Egypt; 2008.
76. El-Sayed, I.M., 1994. Nutritive value evaluation of some crops, vegetable and fruit residues. M.Sc. Thesis, Fac of Agric, Cairo, Univ, Egypt.
77. Belibasakis, N.G. Tsirgoyianni, 1996. Effects of dried citrus pulp on milk yield, milk composition and blood components of dairy cows. Animal Feed Science and Tech., 60(1-2): 87-92.