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INFLUENCE OF PARTIAL AND TOTAL SUBSTITUTION YELLOW CORN GRAINS WITH SUGAR BEET PULP ON GROWING RABBITS PERFORMANCE

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ABSTRACT

This work was carried out to study the effect of substitution yellow corn grains with sugar beet pulp on growing rabbits performance, carcass traits, digestability of nutrients, feeding values and economical efficiency. Eighty unsexed New-Zealand White (NZW) growing rabbits of 5 weeks of age were allotted randomly into 5 equal groups (16 rabbits each, with 8 replicates each of two rabbits) to study the effect of substituting yellow corn grain (YCG) by suger beet pulp (SBP) at different rates on growing rabbits performance. Five diets were fed to NZW rabbits from 5-13 weeks of age. The first group was fed the basal diet as a control, while the other four groups were fed diets contaning 9, 18, 27 and 36% SBP, respectivaly which represents replacment rate of 25, 50, 75 and 100% of YCG in the control diet. Results showed that live body weight (LBW) was significantly increased while body weight gain (BWG) insignificantly increased with increasing SBP in the diets up to 75% (27% SBP) substitution for YCG during the most ages of the experimental periods. Rabbits fed on 100% SBP replacement of YCG recorded the lowest value of viability while rabbits fed 75% SBP instead of YCG recorded the highest one of viability. Daily feed intake (FI) was insignificantly decreased with increasing the level of corn grain substitution with SBP up to 100% during the periods of 7-9, 9-11 and 5-13 weeks of age. The level of SBP substituted YCG in the control diet (25, 50 and 75%) resulted in a significantly better feed conversion (FC) values of growing rabbits during the periods of 5-7, 11-13 and 5-13 weeks of age than the other levels. Inclusion of SBP replacement of YCG up to 75% had a significantly ($P<0.05$ or 0.01) positive effect on the digestibility coefficients of DM, CP and NFE. Digestibility coefficients of OM were gradually increased ($P<0.01$) while digestibility coefficients of CF were decreased gradually ($P<0.01$) with increasing the level of SBP up to 100% substitution of YCG. Total digestible nutrient (TDN) and digestible energy (DE) gradually increased ($P<0.01$) when 25, 50 and 75% SBP replaced YCG as compared in the control diet. All carcass characteristics studied, length of each part of the gastrointestinal tract and pH of digestive tract were not significantly affected by feeding the SBP diets. The best efficiency value was recorded by the rabbits fed 75% SBP substitution of YCG, followed by 100, 50 and 25% SBP replacement for YCG. The obtained results seemed to justly the following conclusion: From the nutritional and economical point of view, using SBP up to 75% substitution for YCG (27% of the growing rabbit diet) in growing NZW rabbit diets had no adverse effect on growth performance, viability rate, digestion coefficients, carcass characteristics and digestive tract measurements.

Key words: Rabbits, growth performance, carcass charactersitic, digestiblity coefficient, substitution, corn, sugar beet pulp.

INTRODUCTION

The feed is the most expensive item of the animal raising. Shortage of conventional feed ingredients is considared a major obstacle that is facing poultry industry development in many tropical and sub-tropical countries. Promoting the search for other suitable raw materials "ingredients" to provide required nutrients for the animal. Then, new ingredients are continually searched with the intention to reduce costs and keep or even improve the productive

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responses, guaranteeing the raising activity success. Incorporation of such products in poultry feed would help alleviating the problem of the scarcity of feed supply and may also reduce pollution problems.

Currently sugar beet pulp (SBP) is considered to be such a good ingredient that could partially overcome feed shortage. This product could be incorporated in rabbit diets as a cheap untraditional feedstuffs to reduce feeding costs and alleviate pollution problem.

In the recent years, cultivation of SB in Egypt increase because its water requirement is less than sugar cane, therefore, increasing quantities of SBP are now available as a by-product from SB industry (Talha *et al.,* 2002).

It has been estimated that there are about 135.623 faddans cultivated annually by SBP, producing about 2.888.770 tons of tubercles. Dried SBP which is left-off after sugar extraction represents about 174.000 ton/year, which could be supply 156.000 tons DM, 113.000 tons TDN and 6.708 tons DCP (Agriculture Economics, 2009/2010).

Although SBP contains approximatly 50% neutral detergent fibre (NDF), its physical and digestion characteristics (high water holding capacity, small propation of long particles and indigestible fibre, low rate of passage, high caical retention time), make it of limited value to meet fibre requirements.

Consequently SBP should be considered mainly an energy concentrate feed in rabbits, because of its content of highly digestible fibre, pectins and sugars (De Blas and Carabano, 1996). Sugar beet pulp has a very low starch concentration, so that its substitution for cereal grains implies major changes in the site of nutrient digestion.

Replacing starch with digestible fibre leads to an increase on the fermentative activity in the hindgut, as 40% of the dry matter content of SBP is digested in the caecum (Marino and Carabano, 1992) when included in the diet.

Data obtained from diets in which barley was substituted by SBP indicated that the energy value of SBP is 72% of that of barley and near 2250 Kcal/Kg DM. The energy value of SBP in isofibrous diets (15% CF) was higher. The inclusion of modirate amounts of SBP seems to have a synergistic effect on alfalfa fibre digestibility in the same way as occurs in ruminants (Silva *et al.,* 1989). Hussein *et al.* (2016) suggests utilizing new by–product of processed sugar and it can be included in poultry diets to enhance growth performance in areas where an abundance of this sugar mill by-product is available.

Therefore, the present study was carried out to evaluate the influence of partial and total substitution of yellow corn grains by dried SBP as energy source in feeds for growing rabbits.

MATERIALS AND METHODS

This work was carried out at a private rabbit's farm at, Sharkia Governorate and the chemical analyses were undertaken at the laboratories of Poultry Department, Faculty of Agriculture, Zagazig University, Egypt.

Eighty unsexed weanling NZW growing rabbits of 5 weeks of age with an average initial weight (610 g) were allotted randomly to 5 equal groups. Each group contained 16 rabbits, with 8 replicates, each of two rabbits.

Five experimental diets were formulated for NZW rabbits from 5-13 weeks of age to cover all essential nutrient requirements for growing rabbits according to NRC (1977) as follows: The control diet (without SBP) contained 36% yellow corn grains (YCG), whereas the next four diets contained four levels of SBP (9, 18, 27 and 36%) which represents replacement rates of 25, 50, 75 and 100% of YCG in the control diet. Each experimental group of rabbits was allotted on one of the experimental diets.

All diets had nearly iso-nutritive value but were different in their components according to the purpose of study. Dried pelleted SBP was purchased from Dakahlia Sugar Company, Belkas manufacture, Dakahlia Governorate, Egypt. The composition and chemical analyses of all experimental diets are shown in Table 1.

All rabbits were kept under similar managerial and environmental conditions and were offered experimental diets *ad lib.* in pellet form, while tap fresh water was automatically available all the time by stainles steel nipples.

Table 1. Physical composition and chemical analyses of the experimental diets

Item	Control	SBP substitution (%) for YCG			
	0	25	50	75	100
Components (%)					
Sugar beet pulp	0.00	09.00	18.00	27.00	36.00
Yellow corn grain	36.00	27.00	18.00	9.00	0.00
Clover hay	36.00	30.00	22.00	14.00	6.00
Soybean meal (44%)	15.20	14.80	14.50	14.00	13.60
Wheat bran	6.70	13.10	20.40	28.90	36.80
Soybean oil	-	-	1.00	1.00	1.50
Molases	5.00	5.00	5.00	5.00	5.00
DL-Methionine	0.30	0.30	0.30	0.30	0.30
Vit. and Min. Premix (1)	0.30	0.30	0.30	0.30	0.30
Salt (Nacl)	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Chemical analyses					
a) Calculated analyses (2)					
DE, Kcal / Kg	2891	2814	2826	2765	2740
Calcium (%)	0.51	0.50	0.47	0.43	0.40
Phosphor (%)	0.36	0.40	0.47	0.55	0.62
Methionine + cystine	0.65	0.65	0.65	0.64	0.64
Lysine (%)	0.75	0.78	0.81	0.84	0.87
b) Determined analyses (%)					
DM	94.41	94.25	93.99	94.16	93.89
OM	90.15	90.70	89.97	90.21	90.05
CP	16.11	16.09	16.04	16.12	15.98
CF	14.01	14.42	14.15	14.25	14.62
EE	1.64	1.71	1.74	1.65	1.59
NFE	62.65	62.03	62.06	62.14	61.70
Ash	5.59	5.75	6.01	5.84	6.11
Cell wall constituents (%)					
NDF	29.11	30.15	30.16	30.55	30.48
ADF	18.51	20.35	18.95	19.14	19.44
ADL	4.72	4.81	4.11	4.19	4.76
Hemicellulose	10.60	8.80	11.21	11.41	11.04
Cellulose	13.79	15.54	14.84	14.95	14.68
Cost/Kg diet PT, (2)	1.67	1.58	1.50	1.42	1.34

(1) Grower Vit. and Min. Premix: Each Kg contains: vit. A 2.000.000 IU, vit. D3 150.000 IU, vit. E 8.33 g, vit. K 0.33 g, vit. B1 0.33 g, vit. B2 1.0 g, vit. B6 0.33 g, vit. B12 1.7 mg, pantothenic acid 3.33 g, Biotin 33 mg, Folic acid 0.83 g, Choline chloride 200 g, Zn 11.7 g, Mn 5 g, Fe 12.5 g, Cu 0.5 g, I 33.3 mg, Se 16.6 mg, and Mg 66.7 g.

(2) Calculated according to NRC (1977).

(2) calculated according to the price of feed ingredients when the experiment was started. Based upon each unit weight (Kg) of SBP, CH, soybean meal, YCG, wheat bran, molases, DL-methionine, Vit. and Min. premix and salt (Nacl) equals to1250.0, 1300.0, 3000.0, 2000.0, 1500.0, 600.0, 35000.0, 10000.0 and 250.0 PT, respectively.

Animals were housed in windowed rabbitry, with a three-level pyramid design cages made of galvanized wire net, those cages measured 50cm L × 25 cm W × 40 cm H. Each cage was equipped with an automatic drinker nipple and a manual feeder. Before starting the experiment, all cages were cleaned and disinfected by fire. A photo-period of 14-16 hr., of day light was provided throughout the experiment.

Using a high standard hygiene and careful management, the incidence of dangerous diseases was largely avoided and rabbits have never been treated with any kind of systematic vaccination or medication. The experimental period lasted for 13 weeks.

Individual live body weight, feed intake, daily weight gain, feed conversion ratio and viability rate were biweekly recorded during the experimental period.

Economical efficiency (EE) was calculated as the ratio between income (price of weight gain) and cost of feed consumption during the experimental period (Abd-Ella *et al.,* 1988). The price of each Kg of the experimental diet was calculated according to the price of ingredients in the local market at the time of the experiment.

$$\mathrm{EE}\ (\%) = \frac{\text{gain price} - \text{total cost}}{\text{total cost}} \times 100$$

Where:

Gain price = weight gain × price of Kg meat (15.5 LE) and total cost = feed intake × cost of Kg feed.

At the end of the experimental period (at 13 weeks of age), 4 rabbits were randomly chosen from each treatment. Assigned rabbits were fasted for 12 hours before slaughtering and were individually weighed as pre-slaughtering weight. Animals were slaughtered by cutting the jugular veins of the neck by sharp knife, upon the completion of bleeding, measured along the body, after skinning, the carcass was opened down and organs of digestive tract, stomach, small intestine and large intestine were removed, contents pH value was measured and recorded by the pH meter, lengths and weights (full and empty) were measured, weights were proportioned to the live pre-slaughtering weight.

Also, at the end of the experimental period, one metabolism trail was conducted to estimate the digestibility coefficients of the five groups. Also, an indirect digestion trail was carried out to evaluate the digestibility coefficient of nutrients and calculate the nutritive values of SBP nutrients. Three rabbits from each group were individually housed in metabolic cages. Digestibility trail lasted 15 days (10 days as a preliminary period and 5 days as a collection period. Coprophagy was not prevented. Samples from both feed offered and dried faeces of each animal were taken daily during the collection period for chemical analyses (crude protein, crude fiber, ether extract and ash) which was carried out according to AOAC (1990). The total digestible nutrients (TDN) (%) and digestible crude protein (DCP) was calculated according to Cheeke *et al.* (1982). The digestible energy (DE) was calculated according to Schneider and Flatt (1975) by using the following equation: DE (kcal/kg) = TDN × 44.3. Cell wall constituents which were analyzed according to Goering and Van Soest (1970).

Data were subjected to analysis of variance, using the General Linear Model (GLM) procedure of SAS program (SAS, 2002). The model was assessed for different traits according to Snedecor and Cochran (1982). Differences among means within the same factor were tested by using Duncan's New Multiple Range Test (Duncan, 1955).

The statistical model used was:

$$X_{ij} = \mu + B_i + E_{ij}$$

Where:

X_{ij} = an observation, μ = the overall mean, B_i = effect of dietary treatment (I = 1, 2 , … and 5) and E_{ij} = random error.

RESULTS AND DISCUSSION

Chemical Composition, Digestion Coefficients and Nutritive Values of Sugar Beet Pulp

Chemical composition of sugar beet pulp

Chemical composition of the evaluated SBP is summarized in Table 2. The results show that SBP contained 89.68, 93.92, 8.6, 23.11, 0.51, 61.7 and 6.08% DM, OM, CP, CF, EE, NFE and ash, respectively. It is worthy to note that SBP has a considerable amount of NFE and CF, but it showed lower values of CP (8.6%) and EE (0.51%). Morisson (1959) reported that SBP is considered low in protein content, high in fiber content and deficient in fat which have been reported as a reason for lower ME/DE SBP. The SBP contained higher values of CF and ash, but nearly equal content of CP and DM compared with YCG (Abedo, 2006). He added that, at 10% CP and 18% CF, beet pulp sits high on the edge between being forage and an energy feed.

Cell wall constituents of sugar beet pulp

The SBP contained 50.60, 27.47, 2.01, 23.13, and 25.46% for NDF, ADF, ADL, Hemicellelose, and cellulose, respectively. The present values are comparable with that of the previous investigators as shown in Table 2.

Similarly to the present results, Nigam (1994) reported that the SBP contained 20% cellulose, 30% hemicellulose, 16% pectin and 4% lignin. In addition, Shwarz *et al.* (1995) mentioned that SBP contains mainly easily degradable structure carbohydrate (cellulose, hemicellulose, pectin pentosans), while the main carbohydrate in maize and wheat or oats is starch.

Sun and Hughes (1998) pointed that SBP on a dry weight basis contains 65-80% polysaccharides, consisting roughly of 40% cellulose, 30% hemicellulose and 30% pectin. Varhegyi *et al.* (2002) found that SBP contained 64.2% NDF, 33.3% ADF and 2.5% ADL, 13.6% acid detergent insoluble protein (ADSP) as percentage of total CP. The present results showed that diets for SBP substitution (%) for YCG recorded higher NDF, ADF, ADL, hemicellulose and cellulose than that of control diet (Table 1).

Nutrients digestibility and feeding value of Sugar beet pulp

Results in Table 2 show that digestibility coefficients of nutrients in SBP were 50.91, 56.54, 74.69, 75.09, 26.55 and 65.88% for DM, OM, CP, EE, CF and NFE, respectively.

The nutritive values of the evaluated SBP were 50.59%, 2241 kcal/kg and 6.84% for TDN, DE and DCP, respectively. A similar variation (2.15 *vs* 2.67 kcal of DE/g) was previously reported (DE Blas and Villamide, 1990) when the DE content of SBP was determined by substituting basal diets containing medium or low levels of fiber, respectively. The increase DE content with increasing level of inclusion of SBP could be explained by a longer retention time of the digesta in the gut, as observed by other authors (Candau *et al*., 1979; Fioramonti *et al.*, 1997 ; Fraga *et al.*, 1991).

Growth Performance

Live body weight and body weight gain

Effects of feeding either commercial diet (control) or tested on LBW and BWG of growing rabbits throughout the experimental growth periods (5-13 weeks of age) are elucidated in Table 3. All rabbits have commenced with a nearly similar initial LBW which ranged between 607.50 and 608.44 g. This created a suitable condition to appraise the effect of dietary treatments on the performance of growing rabbits.

Data obtained in Table 3 show that replacing YCG in the control diet with SBP up to 75% (27:0% SBP) did not exert any detrimental effect on body weight at 7, 9 and 11 weeks of age and daily weight gain during 5-7, 7-9, 9-11 and 11-13 weeks of age as shown in Table 3. Complete replacement of YCG in growing rabbits diet (36% SBP) resulted significant ($P < 0.01$) decrease in body weight at 7, 9, 11 and 13 weeks of age and daily weight gain through 5-7 and 5-13 weeks of age when compared with the control diet (0% SBP).

It is worthy noting that growth performance (LBW and BWG) were insignificantly increased with increasing SBP in the diets up to 75% (27% SBP) substitution for YCG during the most ages of the experimental periods.

The beneficial effect of SBP may be related to improving feed utilization (Table 4) and to some extent digestion (Table 5). In agreement with the present results, Cobos *et al.* (1995) found, insignificant differences in growth rate of rabbits fed barley based diet or with diet contained 15% SBP substitution barley, however growth rate was decreased when SBP substituted barley by 50%. Garcia *et al.* (1993) reported that inclusion of 15% SBP institution of barley grains did not affect growth performance.

Table 2. Chemical composition, digestibility coefficients and feeding values of sugar beet pulp

Item	Chemical composition (% DM basis)	Digestibility coefficient (%)
Determined Composition		
DM	89.68	50.91
OM	93.92	56.54
CP	8.60	74.69
EE	0.51	75.09
CF	23.11	26.55
NFE	61.7	65.88
Ash	6.08	--
Cell wall constituents (%)		
NDF	50.60	
ADF	27.47	
ADL	2.01	
Hemicellulose	23.13	
cellulose	25.46	
Feeding value (as fed):		
TDN (%)		50.59
DE (Kcal/kg)		2241.14
DCP (%)		6.84

Table 3. Growth performance of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG during the experimental periods (from 5-13 weeks of age)

Item	SBP substitution (%) for YCG					
	0%	25%	50%	75%	100%	Significance
Live body weight (g) at						
5 weeks (Initial)	607.50±0.94	608.13±0.91	608.44±0.66	608.13±1.48	608.13±1.48	NS
7 weeks	931.50±2.02^{a}	935.63±3.13^{a}	937.69±3.96^{a}	937.06±4.48^{a}	917.81±2.33^{b}	**
9 weeks	1417.75±2.30^{a}	1416.19±3.45^{a}	1420.69±4.91^{a}	1427.19±4.33^{a}	1393.81±2.29^{b}	**
11 weeks	2069.00±02.02^{a}	2075.81±09.89^{a}	2085.19±14.72^{a}	2099.31±07.57^{a}	2024.94±22.35^{b}	**
13 weeks (final)	2469.00±05.35^{c}	2501.25±09.65^{bc}	2530.31±14.80^{ab}	2544.69±07.54^{a}	2416.25±22.49^{d}	**
Daily weight gain (g) from						
5-7 weeks	23.03±0.20^{a}	23.40±0.26^{a}	23.52±0.30^{a}	23.50±0.39^{a}	22.19±0.06^{b}	**
7 -9 weeks	34.73±0.23	34.77±0.64	34.50±0.29	35.01±0.37	34.00±0.01	NS
9-11 weeks	45.62±0.91	46.03±1.32	45.26±1.47	48.01±0.76	43.09±1.18	NS
11-13 weeks	29.76±1.38	31.48±1.09	31.79±0.23	31.81±0.02	29.14±1.24	NS
5-13 weeks	33.29±0.13^{b}	33.92±0.23^{ab}	33.77±0.36^{b}	34.58±0.11^{a}	32.10±0.25^{c}	**
Viability rate (%)	93.75 ± 6.25	93.75 ± 6.25	93.75 ± 6.25	100.00 ± 0.00	87.50 ± 8.18	NS

Means in the same row within each classification bearing different letters are significantly ($P < 0.05$) different.
NS= Not significant and ** $P < 0.01$

Table 4. Daily feed intake and feed conversion of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG during the experimental periods (from 5-13 weeks of age)

Item	SBP substitution (%) for YCG					
	0%	25%	50%	75%	100%	Significance
Daily feed intake (g) from						
5-7 weeks	93.96±0.09[a]	92.90±0.19[ab]	91.54±1.17b[c]	89.91±0.64[c]	94.20±0.17[a]	**
7 -9 weeks	119.02±1.14	117.21±1.84	116.92±1.99	117.41±0.98	118.39±1.83	NS
9-11 weeks	135.63±3.22	135.11±2.93	134.87±2.17	134.87±0.49	128.24±0.58	NS
11-13 weeks	124.51±2.17	124.89±1.79	126.52±0.75	127.23±0.37	127.38±4.01	NS
5-13 weeks	118.28±1.32	117.53±1.24	117.46±0.99	117.36±0.37	117.05±1.33	NS
Feed conversion (g feed/g gain) from						
5-7 weeks	4.08±0.04[b]	3.98±0.04[bc]	3.89±0.06[cd]	3.83±0.06[d]	4.24±0.01[a]	**
7 -9 weeks	3.43±0.05	3.39±0.10	3.39±0.04	3.36±0.05	3.48±0.05	NS
9-11 weeks	2.98±0.07	2.95±0.10	3.00±0.07	2.82±0.05	2.99±0.09	NS
11-13 weeks	4.31±0.16[ab]	4.05±0.11[bc]	3.92±0.07[c]	4.00±0.01[bc]	4.54±0.18[a]	**
5-13 weeks	3.70±0.04[b]	3.59±0.04[c]	3.55±0.02[c]	3.50±0.01[c]	3.82±0.04[a]	**

Means in the same row within each classification bearing different letters are significantly ($P < 0.05$) different. NS= Not significant and ** = $P < 0.01$

Table 5. Digestibility coefficients of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG at 13 weeks of age

Item	Digestion coefficient						Nutritive value (As feed)		
	DM	OM	CP	EE	CF	NFE	DCP	TDN	DE
SBP substitution (%) for YCG									
0%	60.63±0.16[b]	63.83±0.42[b]	74.50±0.09[c]	78.33±0.17	34.46±0.45[a]	65.27±0.05[d]	12.79±0.17	50.25±0.12[c]	2,226.08±5.17c
25%	62.49±0.14[a]	65.09±0.28[a]	75.37±0.19[b]	78.48±0.17	33.24±0.14[b]	66.11±0.16[c]	12.69±0.17	51.31±0.23[b]	2,272.92±10.24[b]
50%	62.41±0.07[a]	65.05±0.32[a]	75.73±0.16[ab]	78.76±0.12	33.23±0.51[b]	66.51±0.09[b]	12.85±0.11	52.17±0.48[a]	2,311.24±21.42[a]
75%	63.36±0.73[a]	64.84±0.42[ab]	75.93±0.15[a]	78.88±0.19	32.50±0.25[b]	66.90±0.03[a]	12.50±0.09	51.72±0.02[ab]	2,291.20±1.04[ab]
100%	60.98±0.49[b]	65.20±0.22[a]	74.13±0.14[c]	78.53±0.07	32.53±0.27[b]	64.38±0.05[e]	12.96±0.15	49.90±0.09[c]	2,210.46±3.90[c]
Significance	**	*	**	NS	**	**	NS	**	**

Means in the same column within each classification bearing different letters are significantly ($P<0.05$) different. NS= Not significant, * $P < 0.05$ and ** $P < 0.01$

On the other hand, Mangood (1994) found that relative BWG results showed a significant difference ($P < 0.05$) during the period from 9-13 weeks, while best values were obtained with 7.5% and 15% SBP. However, collective data for the whole growing period (5-13 weeks) did not reveal such differences. Volek *et al.* (2004) reported that inclusion of 20% DBP substitute of wheat bran with or without 4% inulin sugar in diets of early weaned rabbits did not affect the average BWG. Zaza (2005) reported that, the groups fed diets contained 50% and 75% biologically treated SBP substitution of corn grain were significantly heavier in the final live LBW and BWG than the control (0% SBP). Similar results were reported by Shehata and Bahgat (2006) who reported that no significant differences in the average daily weight gain were detected when rabbits fed basal diet alone or 25% SBP instead of basal diet. Recently, El-Taweel (2010) found that, inclusion of 25 and 50% SBP instead of grains diet did not significantly ($P<0.05$) affect BWG of rabbits during the overall experimental period and replacement 75% of grains diet by SBP led to significantly ($P<0.05$) decreasing in daily BWG than that of control one.

Viability rate

Viability rate (Table 3) varied between 87.5 and 100% for rabbits fed diets with different replacement levels of corn grains in the control diet by SBP during the whole experimental period (5-13 weeks of age).

It is clear that, rabbits fed on 100% SBP replacement of YCG recorded the lowest value of viability while rabbits fed 75% SBP instead of YCG recorded the highest value of viability. Our results indicate that incorporation (SBP) in rabbit diets up to 75% had no effect on viability rate of rabbits.

Results of Mangood (1994) showed that the inclusion of SBP with ratio of 7.5 and 15% improved viability of the fattening rabbits. The relatively high mortality rate was observed in the control group (0% SBP).

Feed intake and feed conversion

Data in Table 4 show that, daily FI was insignificantly decreased with increasing the level of corn grain substitution with SBP up to 100% during 7-9, 9-11 and 5-13 weeks of age. While, it was insignificantly increased during 11-13 weeks of age. However, there was a reduction ($P < 0.01$) in FI of rabbits fed diets contained 50 and 75% SBP substitution for YCG during 5-7 weeks of age. Even through, the decrease in DE in the experimental diets may have a conflict effect on the data of feed intake as animal on the low energy diet seems to consumed more feed to compensate to fulfilled their energy requirements.

The reduction in FI for rabbits fed SBP may be due to high absorbing capacity (870 ml water/100g) and swelling capacity (380% of SBP) causing reducing rate of passage (Cheeke, 1987). Also, a reduced FI of chickens fed on diets with high inclusion levels of beet pulp, which could be accounted for be increased satiety due to reduced gastric emptying caused by distension of the duodenum (Sellers, 1977). In pectin fed rats the digesta were found to be paste-like and the intestines were distended (Luick and Penner, 1991).

Pectins derived from beet pulp have also been shown to be soluble in the small intestine of cannulated pigs (Graham *et al.,* 1986), there by possibly creating a viscous environment. However, beet pulp pectin generally has lower gelling power and lower molecular weight in comparison with, for example, apple or citrus pectin (McGinnis and Sequeira, 1982).

Furthermore, SBP is known to have a high water-holding capacity (Michel *et al.*, 1988), which was probably responsible for the decreasing ileal digesta DM content of chickens fed on the high inclusion levels of beet pulp.

These differences in feed efficiency of rabbits fed barley based diet agreed with those reported by El-Taweel (2010) who reported that, feeding different levels of SBP (0.0, 25, 50 and 75%) instead of (corn and barley) grains fed to slightly in case of FI over all the experimental period. Shehata and Bahgat (2006) reported that SBP increased FI of growing rabbits when 25% of basal diet was replaced by SBP. On the other hand, Belenguer *et al*. (2004) and Volek *et al.* (2004) found that SBP reduced FI of rabbits when compared with alfalfa hay and wheat bran. The differences between results may be due type of basal diet and the levels of inclusion used and/or DE of the experimental diets (De Blas and Carabano, 1996).

The level of SBP substituted YCG in the control diet (25, 50 and 75%) resulted in a significantly better FC values of growing rabbits during 5-7, 11-13 and 5-13 weeks of age than the other levels (Table 4). However, rabbits fed on SBP replaced 100% of YCG in the control diet showed the poorest ($P<0.05$) FC values during aforementioned periods. This might be related to increase energy losses associated to increase of the fermentative activity in the hindgut as 40% of the DM content of SBP is digested in the caecum (Marino and Carabano, 1992).

Furthermore, the end products of microbial digestion (Volatile fatty acids) might be metabolized less efficiency than the glucose arising from starch digestion in rabbits (Low, 1985).

Our results agree with these obtained by Cobos *et al.* (1995) who found that no significant effect for diet contained 15% SBP in substitution of barley on FC, however FC increased when SBP substituted barley by 50%. Also, Shehata and Bahgat (2006) found that feeding rabbits on SBP with or without molasses imposed FC where the obtained values were 3.99, 4.39 and 4.56 for groups fed the diets of control, SBP without or with molasses, respectively. Along the same line, Zaza (2005) found that, rabbits fed 50% biologically treated SBP replacement of corn grains had higher FC than those fed 75% SBP and control (0% SBP). However, no significant differences were found among the three groups (25, 50 and 75%) in average FI. However, Mangood (1994) found that inclusion of SBP in rabbit diets seemed to improve efficiency of feed utilization significantly on basis of the collective data from 5-13 weeks.

In contrary to the present ridings, Garcia *et al.*, (1993) reported that substitution of 0, 30, 70 and 100% barley grains (50% of diet ingredients) by SBP impaired FC which was 100, 96, 87.4 and 72%, respectively. Recently, El-Taweel (2010) stated that, inclusion of 25 and 50% SBP instead of grains (corn and barley) diet impaired FC, which was positively correlated with increasing the SBP level.

Digestibility Coefficients and Nutritive Value of the Experimental Diets

Digestibility coefficients

The effect of SBP instead of YCG on digestibility coefficients of DM, OM, CP, EE, CF, and NFE are shown in Table 5.

The data revealed that, inclusion of SBP replacement of YCG up to 75% had a significantly ($P<0.05$ or $P<0.01$) positive effect on the digestibility coefficients of DM, CP and NFE. However, inclusion of 100% SBP substitution of YCG in control diet had insignificantly effect on DM and CP digestibility while significantly ($P<0.01$) decreased NFE. Digestibility coefficients of OM were gradually increased ($P<0.01$) with increasing the level of SBP up to 100% substitution of YCG. On the other hand, digestibility coefficients of CF were gradually decreased ($P<0.01$) with increasing SBP level up to 100% substitution for YCG. Inclusion of SBP did not affect significantly on digestion of EE.

It is worthy noting that, the digestion coefficients of DM, CP and NFE were the highest in rabbits fed 75% SBP substitution of YCG as compared to the control. Increasing of digestion coefficients for rabbits fed diets contained SBP may be correlated with increasing retention time in the gut (De Blas and Villamide, 1990). However, results of digestibility coefficients of Mangood (1994) indicated that DM, NFE and DE did not show any significant difference among diets. However, a slight increase in digestion coefficients with increasing the proportion of SBP in the diet was observed. On the other hand, CF digestibility significantly increased with increasing level of the SBP. While each of CP and EE digestibilities were decreased.

The present results were in a good agreement with those illustrated by El-Taweel (2010) who found that digestibility of DM and OM were increased ($P<0.05$) with 25% SBP replacement for grains diet (barley and corn) in comparison with the control one. The look of significant effect of SBP on EE digestibility agreed with those found by Shehata and Bahgat (2006) who reported that substitution of 25% of basal rabbit diet by SBP affect on EE digestibility. El-Badawi *et al.* (2007) indicated that, all nutrients digestibility were significantly ($P < 0.05$) increased hen rabbits fed fungal treated SBP at either 25 or 50% compared with groups fed control diet.

Contrary to the present findings, El-Taweel (2010) indicated that, inclusion of 50% SBP instead of grains diet had no effect on DM and OM digestibilities, while 75% replacement significantly ($P<0.05$) decreased DM compared with the control one. Along the same line, Shehata and Bahgat (2006) reported that, substitution of 25% of basal rabbit diets by SBP did not affect DM, OM, CP, CF and NFE digestibilities. Also, Gomez *et al.* (2004) stated that protein digestibility was not affect by SBP addition. Zaza (2005) found that, the group fed 75% biologically treated SBP replacement of corn grain was significantly superior in the digestibility of DM, OM, CP, CF, ash and NFE of the tested rations followed by group fed 50% biologically treated SBP replaced of corn grain and the lowest values were recorded by the control one (0% SBP of corn grains).

Nutritive value

The nutritive values as TDN and DE were significantly ($P < 0.01$) affected by SBP instead of corn grains in rabbits diet (Table 5).

It is worthy noting that TDN and DE gradually increased ($P<0.01$) when 25, 50 and 75% SBP replaced YCG as compared in the control diet. It is clear that, increasing the substitution of SBP up to 100% by corn grains insignificantly decreased TDN and DE content in the diet. This is contradicting the results obtained by El-Taweel (2010) and Shehata and Bahgat (2006) who found that, inclusion of SBP did not affect TDN. Zaza (2005) found that, the highest value of TDN was significantly recorded by the two groups fed biologically treated SBP (50% and 75%) substitution of corn grains as compared with the control (0% SBP). He added that, the group fed 75% biologically treated SBP substitution of corn grain was higher in DCP values than the other two tested groups (control and 50%).

Data in Table 5 show that, DCP was not affected significantly by incorporation of SBP instead of corn grain in control diet. Similar results were obtained by El-Taweel (2010).

Carcass characteristics

All carcass characteristics studied were not significantly affected by feeding the SBP diets (Table 6). Contradicting results were obtained by El-Badawi *et al.* (2007) who found that edible giblets percentage, especially liver was significantly higher for rabbits fed 50% SBP when compared with control. However, Mangood (1994) reported that no significant differences could be obtained with respect to all carcass quality traits.

Cobos *et al.* (1995) found detectable ($P < 0.05$) effects if the total substitution of barley by was done by SBP for carcass weight, dressing percentage and DM from animals slaughtered at a live weight of 2000 g. They added that no significant differences ($P > 0.05$) among batches were observed when slaughter weight was 2500g. They found in general that, rabbit diets formulated with 50% barley and 0% SBP, 30% barley and 0% SBP or 15% barley and 15% SBP had no effect on carcass traits. However, Zaza (2005) reported that the rabbits fed 50% biologically treated SBP diet resulted in ($P<0.05$) higher total edible parts as compared with control. But, Volek *et al.* (2004) found that dressing percentage was similar in diets containing 35% SBP. The use of dried SBP in rabbit diets up to 22.5% caused no significant differences in all carcass traits (Mangood, 1994). Tag El-Din (1996) found insignificant effect on carcass traits, due to increasing SBP level in the diet from 0 up to 30%. Amber *et al.* (2002) showed that dressing percentage values were significantly lower for rabbits fed diets contained SBP, sweet potato tops or mung bean hay than those received the control diet or that contained rice straw.

Gastrointestinal Tract Segments, Organs Weight and pH Values

Digestive tract length

The results obtained on gastrointestinal tract segments at 13 weeks of age are presented in Table 7.

It could be noticed that the substitution of SBP for YCG in control diets did not significantly affect the length of each part of the gastrointestinal tract (stomach, small intestine and large intestine). In contrary, Azzazy (1990) and Amber *et al.* (2002) reported a significant

Table 6. Some carcass traits studied of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG at 13 weeks of age

Item	Slaughter Wt.	Blood (%)	Offal (%)	Liver (%)	Kidneys and Spleen (%)	Heart (%)	Total giblets (%)	Dressing (%)	Carcass without head (%)
SBP substitution (%) for YCG									
0%	2461.25	3.33±0.10	21.20±0.16	5.46±0.15	2.03±0.06	0.74±0.03	8.23±0.19	56.40±0.35	52.12±0.22
25%	2493.75	3.51±0.05	21.50±0.19	5.47±0.06	2.00±0.04	0.74±0.03	8.20±0.09	55.97±1.01	51.73±0.17
50%	2526.25	3.57±0.11	20.92±0.42	5.50±0.06	2.03±0.03	0.74±0.01	8.26±0.08	56.55±0.29	52.24±0.21
75%	2485.00	3.47±0.05	21.08±0.28	5.45±0.07	2.00±0.06	0.73±0.02	8.19±0.11	56.50±0.21	52.22±0.24
100%	2458.75	3.67±0.11	21.30±0.09	5.53±0.07	2.07±0.01	0.75±0.03	8.34±0.09	55.97±0.12	51.66±0.16
Significance		NS	NS	NS	NS	NS	NS	NS	NS

NS= Not significant

Table 7. Digestive tract length of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG at 13 weeks of age

Item	Body weight (g)	Length (cm.)				
		Body	Digestive tract	Stomach	Small intestine	Large intestine
SBP substitution (%) for YCG						
0%	2,461.25	50.83±1.39	544.51±0.86	29.96±0.22	333.90±0.49	180.65±0.69
25%	2,493.75	50.68±1.37	543.85±0.77	30.88±0.55	333.64±0.58	179.34±0.62
50%	2,526.25	51.58±0.95	545.68±1.12	29.85±0.14	334.09±0.56	181.74±1.75
75%	2,485.00	50.85±1.25	542.85±0.47	31.27±0.98	334.20±0.56	177.38±1.17
100%	2,458.75	50.50±1.45	545.65±0.81	31.73±1.37	334.28±0.46	179.65±1.88
Significance	NS	NS	NS	NS	NS	NS

NS= Not significant

increase in gastrointestinal tract relative weight as rabbits were fed higher digestible fiber diets. Asar *et al.* (2010) found highly significant increase in the length of small intestine in rabbits fed diets contained corn cobs meal plus alfalfa hay (30 : 25%), whereas caecum percent and length were higher for rabbits fed barley plus alfalfa hay (30 : 25%) which had the best CF digestibility. This may be due to the higher digesta er fermentation time (Garcia *et al.* 1996). Also, results obtained by Mangood (1994) showed that dietary SBP seemed to have an effect on the morphological structure of the alimentary canal on basis of filled or empty weight of the stomach and ceacal weight and length.

Digestive Tract activity (pH values)

The effect of substitution of SBP for corn grain in rabbit diets on the pH of digestive tract (stomach, small intestine, caecum and colon) are shown in Table 8. There were no significant effects of SBP level on the pH values of each part of digestive tract. However, Falcaoe *et al.* (2004) found that the pH of caecal contents was significantly lower in rabbits fed diets contained SBP. Also, El-Abed *et al.* (2011) found that the inclusion of SBP or their fractions decreased the caecal pH.

Table 8. Digestion tract content pH of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG at 13 weeks of age

Item	pH value of the content			
	Stomach	Small intestine	Large intestine	
			Caecum	Colon
SBP substitution (%) for YCG				
0%	1.68±0.03	7.18±0.03	6.10±0.04	6.53±0.03
25%	1.55±0.06	7.18±0.03	6.05±0.06	6.50±0.07
50%	1.58±0.03	7.23±0.09	6.18±0.06	6.50±0.08
75%	1.68±0.05	7.25±0.09	6.10±0.06	6.50±0.00
100%	1.65±0.06	7.23±0.09	6.08±0.05	6.50±0.04
Significance	NS	NS	NS	NS

NS= Not significant.

Gastrointestinal organs weight and their content

Effect of substitution of SBP for YCG on gastrointestinal organs weight and their content are shown in Table 9. It is clear that, SBP had no significantly effect on empty digestive tract weight or their content. Falcaoe *et al.* (2004) reported that beet pulp contained diets gave heavier stomachs and caecums. Also, Volek *et al.* (2004) found that the weights of digestive organs (stomach, small intestine, caecum and colon) of rabbit fed diets of potato pulp, SBP and wheat bran were significantly differences in caecum, and insignificantly in other organs. Arslan (2005) found that, the weight of examined gastrointestinal tract sections (small intestine and ceacum) was not affected by feeding regimes (containing 10% SBP) in gees at 6 and 12 weeks of age.

Economical evaluation

According to guide of economical evaluation, average FI per rabbit, price per kg., diet, total feed cost per rabbit, average BWG, price per Kg. body weight, selling price, net revenue, economical efficiency and relative economical efficiency are presented in Table 10.

Net return (NR)

The net return of rabbits during the whole experimental period (5-13 weeks) ranged from 18.945 to 20.685 LE showing that SBP substitution of YCG in growing rabbits up to 75% increased NR by 16.26% over the control group while the total SBP substitution recorded only 8.1% showing that the total substitution of YCG by SBP impaired NR. It is worthy noting that the increase in 75% substitution of CH with SBP was more economic than that of 75% substitution of YCG. This increase obtained with SBP substitution draws the attention towards further investigations on fungal treatment of SBP to increase its protein content by converting the addition inorganic nitrogen to organic nitrogen as a microbial protein by fungi and partially by liberated the acid insoluble protein from cell wall constituents of SBP.

The feed cost to produce one LE of meat ranged from 0.311 to 0.383 LE/LE showing that the lowest cost of feed to produce one LE of meat was that of incorporation of 27% (75% substitution level) SBP in growing diets.

The net return from one LE feed cost was the highest (3.217 LE) for rabbits received 27% (75% substitution level) SBP in their growing diets, while the lowest one (2.611 LE) was that of rabbits received the control diet.

Economical efficiency

Feeding growing rabbits on control diet gave the lowest economical efficiency value (1.61), whereas the best efficiency value (2.22) was for

Table 9. Digestive tract organs weight of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of YCG at 13 weeks of age

Item	Slaughter Wt.	Digestive tract Wt. (%)		Stomach Wt. (%)		Small intestine Wt. (%)		Large intestine Wt. (%)	
		Empty	Content	Empty	Content	Empty	Content	Empty	Content
SBP substitution (%) for YCG									
0%	2,461.25	5.13±0.01	13.94±0.09	1.10±0.01	2.46±0.03	1.97 ± 0.01	0.87±0.02	2.73±0.01	14.05±0.10
25%	2,493.75	5.10±0.02	13.92±0.03	1.11±0.02	2.44±0.04	1.97 ± 0.02	0.87±0.02	2.70±0.03	14.15±0.06
50%	2,526.25	5.12± 0.08	13.85±0.08	1.10±0.03	2.45±0.03	1.96 ± 0.05	0.88±0.02	2.73±0.01	13.92± 0.01
75%	2,485.00	5.11±0.02	13.84±0.11	1.10±0.02	2.46±0.04	1.96 ± 0.02	0.88 ±0.01	2.72 ±0.02	13.92± 0.08
100%	2,458.75	5.12± 0.02	13.95±0.11	1.10±0.01	2.43±0.02	1.97 ±0.02	0.87 ±0.03	2.74±0.01	14.19±0.12
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS= Not significant.

Table 10. Economical evaluation of NZW rabbits as affected by SBP substitution of YCG during the period from 5-13 weeks of age

Item	Unit	Control	SBP substitution (%) for YCG			
		(0)	25%	50%	75%	100%
Average FI / rabbit (5-13 weeks)	Kg	6,624	6,582	6,578	6,572	6,555
Price/kg diet	LE	1.67	1.58	1.50	1.42	1.34
Total feed cost / rabbit	LE	11.061	10.399	9.867	9.332	8.784
Average BWG (5-13 weeks)	Kg	1.862	1.893	1.922	1.937	1.808
Selling price	LE	28.853	29.343	29.789	30.017	28.026
NR	LE	17.792	18.945	19.922	20.685	19.242
Economical efficiency		1.61	1.82	2.02	2.22	2.19
Relative economical efficiency	(%)	100	113.04	125.47	137.89	136.03
Feed cost to produce one LE of meet	LE/LE	0.383	0.354	0.331	0.311	0.314
Relative change of feed cost/LE of meat	%	100	92.43	86.42	81.20	81.94
NR from One LE feed cost	LE/LE	2.611	2.824	3.022	3.217	3.195
Relative change of NR	(%)	100	108.16	115.75	123.21	122.37

Price / kg body weight: 15.5 LE as the market at time of the experiment.

the rabbits fed 75% SBP substitution of YCG, followed by 100, 50 and 25% SBP replacement for YCG, 2.19, 2.02 and 1.82 respectively over the control.

These results are supported by those of FC, in which rabbits fed on dietary treatments utilized feed more efficiently than the control diet (0% SBP) the relative economical efficiency was superior (137.89) for the growing rabbits that fed 75% SBP substitution of YCG, followed by these of 100, 50 and 25% being, 136.03, 125.47 and 113.04 respectively over the control. Similarly, El-Taweel (2010) showed that, replacement all grains in diets up to 75% by SBP (30% of total ingredients) in growing rabbit diet did not have any adverse effects on its performance and the economical efficiency. In addition, El-Badawi *et al.* (2007) indicated that, the highest economic efficiency was achieved with the group that fed on 50% treated SBP with fungal, followed by the group that fed 75% treated SBP and then by the control group (without SBP). Also, Zaza (2005) reported that the highest economical efficiency was achieved by the group fed 50% biologically treated SBP (145.89%) followed in a decreasing order by group fed 75% biologically treated SBP (115.3%) and the least was from the control (78.99%).

Recommendation

From practical and economical point of view further investigations are advisable to test complete substitution of YCG with biologically or chemically treated SBP in formulating does and grower rabbit diets under local conditions.

REFERENCES

Abd-Ella, M.M., G.A.E. El-Sayaad, M.K. Hathout and M.A. Khalil (1988). Effect of feeding ammoniated rice straw with El-Mufeed on performance of lambs. Ann. Agric. Sci., Moshtohor, 36 (3): 1405 -1417.

Abedo, A.A. (2006). A study on the use of sugar beet pulp in the feed mixtures for ruminants. Ph.D. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Agriculture Economics (2009/2010). Institute of Agriculture Economics Ministry of Agriculture, Egypt.

Amber, K.H., N.S. Isshak and N.M. El-Abd (2002). Effect of dietary fiber source on performance of growing New Zealand White rabbits. Egypt. Poult. Sci., 22: 127 – 146.

AOAC (1990). Official Methods of Analysis 16^{th} Ed. Published by the AOAC Washington, DC.

Arslan, C. (2005). Effects of feeding by diets supplemented with grass meal and sugar beet pulp meal on growth slaughter performance and some blood parameters in geese. Revue Med. Vet., 156 (10): 475-481.

Asar, M.A., M. Osman, H.M. Yakout and A. Safo (2010). Utilization of corn-cob meal and faba bean straw in growing rabbits diets and their effects on performance, digestibility and economical efficiency. J. Egypt. Poult. Sci., 30 (2): 415-442.

Azzazy, A.A.A. (1990). Effect of dietary components on some digestive system characters. M.Sc. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Banha Branch, Egypt.

Belenguer, A., J. Bal Cells, L. Abecial and M. Decoux (2004). Effect of carbohydrate type on milk production and caecal environments in lactating rabbits. World Rabbit Sci., 12:119-132.

Candau, M., G. Delpon and J. Fioramonti (1979). Influence of the nature of cell wall carbohydrates on the anatomic functional development of the digestive tract in the rabbit. Ann. Zootech. (Park), 28: 127-136.

Cheeke, P.R. (1987). Rabbit Feeding and Nutrition. Academic Press, Orlando, FL.

Cheeke, P.R., N.M. Patton and G.S. Tempelton (1982). Rabbit Production 5^{th} Ed Int. Print. And Publ. Danville II.

Cobos, A., L. Hoz, M.I. Cambero and J.A. Ordonez (1995). Sugar beet pulp as an alternative ingredient of barley in rabbit diets and its effect on rabbit meat. Meat Sci., 39:113-117.

De Blas, C. and R. Carabano (1996). A review on the energy value of sugar beet pulp for rabbits. World Rabbit Sci., 4 (1): 33-36.

De Blas, C. and M.J. Villamide (1990). Nutritive value of beet and citrus pulps for rabbits. Anim. Feed Sci. Technol., 31: 239-246.

Duncan, D.B. (1955). Multiple Range and Multiple F-test. Biomet., 11:1-42.

El-Abed, N., R. Delgado, R.I. Abad, C. Romero, A. Fernandez and M.J. Villamide (2011). Effect of sugar beet pulp fibre fractions on growth performance, fecal digestibility and digestive physiology in rabbits around weaning. Giornate di Coniglicoltura ASIC, 75-77.

El-Badawi, A.Y., A.A. Hassan and A.A. Abedo (2007). Growth performance of New Zealand White rabbits fed diets containing different levels of untreated or fungal treated sugar beet pulp. 58th EAAP Meeting. Dublin.

El-Taweel, A.A.F. (2010). Studies on using sugar beet pulp in rabbit diets. Msc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Falcaoe, C.L.P.H., J.P.B. Freire and L. Castro-Solla (2004). Effects of alfalfa hay, wheat bran or beet pulp, with or without sunflower oil, on caecal fermentation and on digestibility in the rabbit. Anim. Feed Sci. and Technol., 117: 131- 149.

Fioramonti, E., R.D. Semlitsch, H.U. Reyer and K. Fent (1997). Effects of triphenyltin and pH on the growth and development of *Rana lessonae* and *Rana esculenta* tadpoles. Environm Toxicol Chemi., 16: 1940–1947.

Fraga, M.J., P.P., Ayala, R. Carabano and J.C. De. Blas (1991). Effect of type of fibre on the rate of passage and on the contribution of soft faeces to nutrient intake of finishing rabbits. J. Anim. Sci., 69: 1566-1574.

Garcia, G., J.F. Galvez and J.C. De Blas (1993). Effect of substitution of sugar beet pulp for barley in fishing rabbits diets on growth performance and on energy and nitrogen efficiency. J. Animal. Sci., 71: 1823-1830.

García, J., M.J. Villamide and J.C. De Blas (1996). Nutritive value of sunflower hulls, olive leaves and NaOH-treated barley straw for rabbit's 6th world Rabbits Congress, Toulouse, 1: 181–185.

Goering, H.K. and P.J. Van Soest (1970). Forage Fiber Analysis'. Agriculture Handbook No. 379, USDA-ARS. (US Government Printing Office: Washington, DC).

Gomez, C.M.S., S. Chamorro, N. Codemus, J.C. DE Blas, J. Garcia and R. Carabano (2004). Effect of fibre type in the feeding of early weaned young rabbits. World Rabbits Sci., 12:119-132.

Graham, H., K. Hesselman and P. Aman (1986). The influence of wheat bran and sugar beet pulp on the digestibility of dietary components in a cereal- based pig diet. J. Nut., 116 (2): 242- 251.

Hussein, A.S., J. Al Ghurair, P.G.K. John, H.M. Habib and M. Sulaiman (2016). Graded levels of sugar syrup in broiler rations and its effect on growth performance and blood biochemical parameters. Anim. Nut., 3: 1-6.

Low, A.G. (1985). The role of dietary fibre in digestion, absorption and metabolism. In: Proc. 3rd Int. Seminar on Digestive Physiol. Copenhagen, 157 – 159.

Luick, B.R. and M.H. Penner (1991). Nominal response of passage rates to fiber particle size in rats. J. Nut. 121 : 1940 -1947

Mangood, A.A.H. (1994). Productive and reproductive performance of rabbits fed rations containing sugar beet pulp. Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh. Tanta Univ.

Marino, J. and R. Carabano (1992). Effect of type of fibre on ileal and faecal digestibility. J. Appl. Rabbit Res., 15: 931- 937.

McGinnis, R.A. and R.M. Sequeira (1982). The sugar beet and chemistry. B. Chemistry of the beet and processing materials. In Beet-Sugar Technol., [R.A. McGinnis, Ed.]. Fort Collins, Colorado: Beet Sugar Develop. Found., 25-64

Michel, F., J.F. Thibault and J.L. Barry (1988). Preparation and characterisation of dietary fibre from sugar beet pulp. J. Sci. Food and Agric., 42: 77-85.

Morrison, F.B. (1959). Feeds and Feeding. 22nd Ed. The Morrison Publishing Company, Clinton, Iowa, USA.

NRC (1977). National Research Council. Nutrient requirements of domestic animals. Nutrient requirements of rabbits. Nat. Acad. Sci., Washington, DC., USA.

Nigam, P. (1994). Processing of sugar beet pulp in simultaneous saccharification and fermentation for the production of protein enriched product. Proc. Biochem., 29: 331-336.

SAS (2002). SAS Institute Inc., Cary, NC, USA. NOTE: SAS Proprietary Software Version 9.00 (TS M0).

Schneider, B.H. and W.P. Flatt (1975). The evaluation of feed through digestibility experiments. Univ. Georgia Press Athens, Georgia, USA, 423.

Sellers, A.F. (1977). Genesis and propagation of motor activity in the digestive tract. In Duke's Physiology of Domestic Animals, [M. J. Swenson, Ed.]. New York: Ithaca, 233-239

Shehata, S.A. and L.B. Bahgat (2006). Effect of sugar beet pulp and molasses on growth of rabbits. Zagazig J. Agric. Res., 33(5): 903-913.

Shwarz, F.J., J. Haffner and M. Tirchgessner (1995). Supplementation of zero-grazed dairy cows with molasses sugar beet pulp, maize or a cereal rich concentrate. Anim. Feed Sci. and Tech., 54: 237-248.

Silva, A.T., J.D.F. Greenhalgh and E.R. Orskov (1989). Influence of ammonia treatment and supplementation on intake, digestibility and weight gain of sheep and cattle on barley straw diets. Anim. Prod., 4 (8): 99-108.

Snedecor, G.W. and W.G. Cochran (1982). Statistical Methods. 7th Ed. Iowa stat Univ., Press. Ames. Iowa, USA.

Sun, R. and S. Hughes (1998). Fractional extraction and physical chemical characterization of cellulose from sugar beet pulp carbohydrate polymers, 36 : 293-299.

Tag El-Din, T.H. (1996). Productive performance of meat rabbits as affected by partial replacement of clover hay by okra and sugar beet processing by products. J. Agric. Sci., Mansoura Univ., 21 (12): 4339 – 4350.

Talha, M.H., R.I. Moawad, G.H. Zaza and E.E. Ragheb (2002). Effect of partial substitution of corn grains by dried sugar beet pulp in growing lambs rations on their productive performance J. Agric. Sci. Mansoura Univ., 27 (8): 5193 – 5199.

Varhegyi, G., P. Szabo and M.J. Antal (2002). Kinetics of the thermal decomposition of cellulose under the experimental conditions of thermal analysis. Theoretical extrapolations to high heating rates. Biomass Bioenergy, 7: 69 -74.

Volek, Z., V. Skrivanova, M. Marounek and L. Zita (2004). Replacement of starch by pectin and chicory- inulin in the starter diets of early weaned rabbits. Effect on growth, health status, caecal traits and iscosity of the small intestinal content. Czech J. Anim. and Feed Sci., 1022- 1028.

Zaza, G.H.M. (2005). Effect of incorporation of biologically treated sugar beet pulp. as a non-conventional feed-stuff in the diets of growing rabbits. The 4th Int. Conf. Rabbit Prod. in Hot Climate, Sharm El- Sheikh, Egypt, 267-274.

تأثير الاستبدال الجزئي والكلي لحبوب الأذرة الصفراء بتفل بنجر السكر على أداء الأرانب النامية

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أجرى هذا العمل لدراسة تأثير استبدال حبوب الأذرة الصفراء بتفل بنجر السكر على أداء الأرانب النامية، صفات الذبيحة، معاملات الهضم، القيم الغذائية والكفاءة الاقتصادية، استُخدم في هذا البحث ٨٠ أرنب نيوزيلاندي أبيض غير مجنس عمر ٥ أسابيع، وزعت عشوائياً إلى ٥ مجموعات متساوية (كل مجموعة ١٦ أرنب قُسمت إلى ٨ مكررات بكل منها ٢ أرنب) لدراسة تأثير استبدال حبوب الأذرة الصفراء بتفل بنجر السكر بمستويات مختلفة علي أداء الأرانب النامية، غُذيت الأرانب النيوزيلاندي الأبيض علي خمس علائق في الفترة من ٥-١٣ أسبوع من العمر، المجموعة الاولي غذيت علي عليقة الكونترول بينما غذيت الأربع مجموعات الأخرى علي علائق تحتوي ٩ ،١٨ ، ٢٧ و ٣٦ % تفل بنجر السكر علي الترتيب والتي تبين معدلات استبدال تفل بنجر السكر محل حبوب الأذرة الصفراء بمستويات استبدال هي ٢٥ ، ٥٠ ، ٧٥ و ١٠٠% من عليقة المقارنة، وبينت النتائج زيادة الوزن الحي معنويا بينما انخفض معدل الزيادة اليومية انخفاضا غير معنويا بزيادة استبدال حبوب الأذرة الصفراء بتفل بنجر السكر بمستويات حتي ٧٥% في معظم الفترات التجريبية، سجلت الأرانب التي غذيت علي مستويات إحلال لتفل بنجر السكر بنسبة ١٠٠% أقل قيم حيوية بينما سجلت الأرانب التي غذيت علي نسبة إحلال ٧٥% لتفل بنجر السكر محل حبوب الأذرة الصفراء أعلي قيم للحيوية. انخفض الغذاء المأكول انخفاضا غير معنويا بزيادة نسبة إحلال تفل بنجر السكر محل حبوب الأذرة الصفراء حتي مستوي ١٠٠% خلال الفترات ٧-٩ ، ٩-١١ و ٥-١٣ أسبوع من العمر، حقق إحلال تفل بنجر السكر محل حبوب الأذرة الصفراء بنسب ٢٥ ، ٥٠ و ٧٥% أفضل قيم تحويل الغذاء معنويا للأرانب النامية خلال الفترات ٥-٧ ، ١١-١٣ و ٥-١٣ أسبوع من العمر مقارنة بالمستويات الأخرى، تأثرت قيم معاملات هضم المادة الجافة والبروتين الخام والكربوهيدرات الذائبة إيجابياً ومعنوياً بزيادة نسب إحلال حبوب الأذرة الصفراء بتفل بنجر السكر حتى ٧٥%، أزداد تدريجياً معامل هضم المادة العضوية زيادة معنوية بينما أنخفضت تدريجياً قيم معاملات هضم الألياف الخام إنخفاضاً معنوياً بزيادة نسب إحلال حبوب الاذرة الصفراء بتفل بنجر السكر حتى ١٠٠%، ازدادت تدريجيا ومعنوياً القيم الغذائية للمركبات الكلية المهضومة والطاقة المهضومة بزيادة نسب إحلال حبوب الاذرة الصفراء بتفل بنجر السكر (٢٥ ، ٥٠ ، ٧٥%) مقارنة بعليقة المقارنة، لم يؤثر معنوياً إحلال تفل بنجر السكر محل حبوب الاذرة الصفراء على كل الصفات المدروسة للذبيحة، طول وقيم pH لكل أجزاء القناة الهضمية. كانت أفضل كفاءة إقتصادية للأرانب التي تغذت على تفل بنجر السكر نسبة ٧٥% من حبوب الأذرة الصفراء يليها مستويات الاحلال ١٠٠، ٥٠ و٢٥% تفل بنجر سكر محل حبوب الذرة الصفراء، تُرشدنا نتائج الدراسة من الوجهة الغذائية والإقتصادية أنه يمكن استخدام تفل بنجر السكر حتى نسبة إحلال ٧٥ % محل حبوب الاذرة الصفراء (٢٧ % من مكونات العليقة) في علائق الأرانب النيوزيلاندي النامية دون أي تأثير ضار على كفاءة النمو والحيوية ومعاملات هضم المواد وصفات الذبيحة وكذلك قياسات الجهاز الهضمي.

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