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EFFECT OF EGYPTIAN CLOVER HAY SUBSTITUTION WITH SUGAR BEET PULP ON GROWING RABBITS PERFORMANCE

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ABSTRACT

This work was carried out to study the effect of Egyptian clover hay substitution 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 were randomly allotted into 5 equal groups (16 rabbits each, with 8 replicates each of two rabbits) to study the effect of substituting Egyptian clover hay (CH) by sugar 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 CH in the control diet. Growth performance, carcass traits, digestability coeffecient and feeding values were studied. Results showed that, replacing CH in the control diet with SBP up to 75%, significantly increased ($P < 0.01$) live body weight (LBW) and body weight gain (BWG) of the most ages during the experimental period. Rabbits fed 25, 50 and 75% SBP instead of CH recorded the highest viability values. Daily feed intake (FI) was insignificantly decreased with increasing the most levels of CH substitution with SBP while feed conversion (FC) values were significantly ($P < 0.05$) improved with increasing levels of SBP during the most ages of the experimental period. The inclusion of SBP replacement of CH up to 75% had a significantly ($P < 0.05$) positive effect on the digestibility coefficients of CP and NFE. Each of DCP, TDN and DE were gradually increased ($P < 0.01$) when 25, 50 and 75% SBP replaced CH in 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 for the rabbits fed 75% SBP substitution of CH, followed by 100, 50 and 25% SBP replacements. Results obtained seemed to justly the following conclusion: From the nutritional and economical point of view, using SBP up to 75% substitution for CH (27%) in growing NZW rabbit diets had no adverse effect on each of growth performance, viability rate, digestion coefficients, carcass characteristics and digestive tract measurements.

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

INTRODUCTION

In developing countries, there is a shortage of both energy sources and feedstuffs with acceptable protein content for animal production. In view of the world wide demand for additional feed sources, the exploitation of traditional crops, which often are grown with low inputs, and are largely adapted to the climatic conditions of the developing countries, would be a step towards better resource utilization (Kebede, *et al.,* 2008; Mirzaei-Aghsaghali and Maheri-Sis., 2008).

The soluble fibre (SF) may be considered as a functional nutrient in rabbit diets as it promotes changes in intestinal microbiota and gut barrier and it decreases mortality (Carabaño *et al.,* 2008; Xiccato *et al.,* 2011). However, the mechanism by which SF regulates these effects is not clear. In rabbit diets, sugar beet pulp (rich

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in pectins) is the preferred raw material to increase dietary SF level. However, the physical and chemical complexity of soluble polysaccharides and their interactions with other components of the diet make it difficult to define or isolate the single effects of SF components.

Dried beet pulp, a carbohydrate rich by-product of the sugar industry, has been used as a partial source of energy in the rations of dairy cattle, growing calves; (El-Badawi and El-Kady, 2006) and rabbit's diets (Cobos *et al*., 1995; Volek *et al*., 2002; Zaza, 2005).

Regarding to the chemical analyses of sugar beet pulp, Abedo (2006) concluded that protein content of SBP ranged from 6.6 to 13.3% with an average of 9.9% compared with the requirements of most ruminants and mono gastric animals which are even high. Sugar beet pulp contains high crude fiber from 14.6 to 24.8% with an average 19.7%, the fibrous carbohydrates of SBP are easily digested because of the amorphous structure of its cellulose and low content of its lignin.

However, SBP is deficient in fat, phosphorus, carotene and certain B- vitamins which have been reported as a reason for even lower availability of the nutrients in SBP (Morrison, 1959).

Practically, Garcia *et al.* (1993) reported that inclusion of 15% SBP in finishing rabbit diets decreased dietary energy and CP digestibility by 6% (P<0.001), but non-significant effects were found on growth performance, empty body composition, DE and digestible CP efficiency for growth. High levels of SBP (35 and 50%) led to leaner animals and did not affect DE intake but greatly impaired (P<.001) DE and nitrogen efficiency, intake, growth rate, and dressing percentage in relation to the control diet. Inclusion of SBP increased the weight of gut contents (P<.001) and decreased cecal pH (P<.001), with no significant effect on mortality. 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.

The aim of this work was to evaluate the influence of partial and total replacement Egyptian clover hay by sugar beet pulp in growing rabbit diets on growth performance, carcass traits, metabolic responses and the economical efficiency.

MATERIALS AND METHODS

This work was carried out at a private farm, 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 randomly allotted 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% clover hay (CH), whereas the next four diets contained four levels of SBP (9, 18, 27 and 36%) which represent replacement rates of 25, 50, 75 and 100% of CH 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, 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 clean fresh water was automatically available all the time by stainles steel nipples. Animals were housed in windowed rabbitry, with a three-level pyramid design cages made of galvanized wire net. Each cage measured of 50cm L × 25 cm W × 40 cm H and 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 hrs., of day light was provided throughout the experiment.

Table 1. Composition and chemical analyses of the experimental diets

Item	Control	SBP substitution (%) for CH			
	0	25	50	75	100
Component (%)					
Sugar beet pulp	-	9.00	18.00	27.00	36.00
Clover hay	36.00	27.00	18.00	9.00	-
Yellow corn grain	36.00	28.00	19.00	13.00	8.50
Soybean meal (44%)	15.20	14.90	14.40	14.50	15.00
Wheat bran	6.70	15.00	23.50	29.40	33.40
Soybean oil	-	-	1.00	1.00	1.00
Molases	5.00	5.00	5.00	5.00	5.00
DL-Methionine	0.30	0.30	0.30	0.30	0.30
Vit. & 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	2852	2871	2860	2871
Calcium (%)	0.51	0.47	0.42	0.38	0.34
Phosphor (%)	0.36	0.43	0.51	0.56	0.59
Methionine + cystine	0.65	0.65	0.65	0.66	0.66
Lysine (%)	0.75	0.78	0.80	0.83	0.87
b) Determined analyses (%)					
DM	94.41	94.06	94.19	94.36	94.28
OM	90.15	89.47	90.25	90.45	89.60
CP	16.11	15.87	16.11	16.21	15.97
CF	14.01	14.02	13.99	13.78	13.12
EE	1.64	1.65	1.84	1.78	2.01
NFE	62.65	62.52	62.25	62.59	63.18
Ash	5.59	5.94	5.81	5.64	5.72
Cell wall constituents (%)					
NDF	29.11	29.95	29.95	30.16	30.13
ADF	18.51	20.41	20.15	19.93	19.65
ADL	4.72	4.92	4.61	4.59	4.83
Hemicellulose	10.60	9.54	9.80	10.73	10.48
Cellulose	13.79	15.49	15.54	15.34	14.82
Cost/Kg diet PT, (3)	1.67	1.61	1.53	1.48	1.44

(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).

(3) 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 to 1250.0, 1300.0, 3000.0, 2000.0, 1500.0, 600.0, 35000.0, 10000.0 and 250.0 PT, respectively.

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.

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

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 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. 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 daily taken during the collection period for chemical analyses (crude protein, crude fiber, ether extract and ash) which were 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

Growth Performance

Live body weight and body weight gain

Results in Table 2 show the live body weight (LBW) as affected by the experimental diets. All rabbits have commenced with a nearly similar initial LBW which ranged between 607.50 and 608.13 g. This crated a suitable condition to appraise the effect of dietary treatments on the performance of experimental growing rabbits.

Results cleared that LBW at 11 and 13 weeks of age was significantly (P < 0.01) increased in rabbits fed diets containing SBP. It is clear that the increase in LBW conceded with increasing substitution level of CH with SBP up to 100%.

Table 2. Growth performance of NZW rabbits ($\bar{X}$ ±SE) as affected by SBP substitution of CH during the experimental periods (from 5-13 weeks of age)

Item	SBP substitution (%) for CH:					
	0%	25%	50%	75%	100%	Significance
Live body weight (g) at						
5 weeks (Initial)	607.50±0.94	607.81±0.74	607.82±0.52	608.14±0.91	608.13±0.83	NS
7 weeks	931.50±2.02[d]	937.31±1.18[c]	943.75±1.59[b]	959.19±0.74[a]	927.38±1.27[e]	**
9 weeks	1417.75±2.30[d]	1429.63±0.96[b]	1433.56±2.22[b]	1448.75±6.67[a]	1408.81±1.31[c]	**
11 weeks	2069.00±2.02[c]	2095.88±6.91[bc]	2103.56±8.58[ab]	2125.63±13.91[ab]	2136.69±17.19[a]	**
13 weeks (final)	2469.00±5.35[d]	2545.63±6.79[c]	2603.13±2.74[b]	2664.19±16.10[a]	2517.06±17.73[c]	**
Daily weight gain (g)						
5-7 weeks	23.03±0.20[d]	23.53±0.08[c]	23.99±0.09[b]	25.08±0.04[a]	22.69±0.10[e]	**
7 -9 weeks	34.73±0.23	35.17±0.07	34.99±0.19	34.97±0.45	34.39±0.13	NS
9-11 weeks	45.62±0.91[b]	47.59±0.45[b]	47.86±0.67[b]	48.35±0.92[b]	51.99±1.26[a]	**
11-13 weeks	29.76±1.38[bc]	32.13±0.05[bc]	35.68±0.67[a]	38.47±1.10[a]	28.44±1.35[c]	**
5-13 weeks	33.29±0.13[d]	34.60±0.12[c]	35.63±0.04[b]	36.72±0.28[a]	34.38±0.49[c]	**
Viability rate (%)	93.75±6.25	100.00±0.00	100.00±0.00	100.00±0.00	93.75±6.25	NS

Means in the same row within each classification bearing different letters are significantly (P < 0.05) different.

* P < 0.05, ** P < 0.01

At 7 and 9 weeks of age, replacing CH in the control diet with SBP up to 75% significantly increased (P < 0.01) LBW (Table 2) while the complete replacement (100%) of CH with SBP significantly (P < 0.01) decreased LBW at only 7 weeks of age.

The beneficial effect of SBP may be related to the improvement in the nutrients digestion coefficients (Table 4). Belenguer *et al.* (2004) found that diets which contain SBP were better digested than that contains alfalfa hay.

The present results agree with Tag El-Din (1996) who reported that inclusion of SBP instead of CH in rabbit's diet gradually improved live weight with increasing the level of inclusion up to 30%.

Results in Table 2 show that body weight gain (BWG) during 9-11 and 5-13 weeks of age were significantly (P<0.01) and gradually increased with increasing substitution of CH with SBP up to 100%. However, at 5-7 weeks of age 100% substitution CH with SBP, significantly (P<0.01) decreased BWG. BWG was not significantly affected during 7-9 weeks of age due to substitution of CH with SBP. This indicated age related tolerance to SBP which increased with increasing age of rabbit may be due to fermentation of gut in terms of gut capacity, microbial and digestive enzymes.

In agreement with the present results, Tag El-Din (1996) found that the control group (0% SBP) had the least value of daily BWG and the best one was obtained for the group fed 30% SBP (0% CH) during 8-13 weeks.

Viability rate (Table 2) varied between 93.75 and 100% for rabbits fed diets with different replacements of CH in control diet by SBP during the whole experimental period (5-13 weeks of age).

Results in Table 2 show that rabbits fed control diet (0% SBP) and 100% SBP replacement of CH recorded the lowest value of viability while rabbits fed 25, 50 and 75% SBP instead of CH recorded the highest one of viability.

Feed intake and feed conversion

Data revealed that daily feed intake (FI) was insignificantly decreased with increasing the most levels of CH substitution with SBP (Table 3).

Table 3. Daily feed intake and feed conversion of NZW rabbits ($\bar{X}$ ±SE) as affected by SBP substitution of CH during the experimental periods (from 5-13 weeks of age)

Item	SBP substitution (%) for CH					
	0%	25%	50%	75%	100%	Significance
Daily feed intake (g)						
5-7 weeks	93.96±0.09	93.44±0.14	92.43±0.25	92.34±0.80	91.37±2.09	NS
7 -9 weeks	119.02±1.14	119.22±0.25	117.81±0.78	117.01±0.86	117.86±0.84	NS
9-11 weeks	135.63±3.22	133.68±0.26	133.10±0.53	130.18±0.42	134.73±2.29	NS
11-13 weeks	124.51±2.17	127.43±0.93	126.85±0.47	126.61±0.42	123.66±0.60	NS
5-13 weeks	118.28±1.32	118.44±0.28	117.55±0.37	116.54±0.32	116.91±0.77	NS
Feed conversion (g feed / g gain)						
5-7 weeks	4.08±0.04^{a}	3.97±0.01^{ab}	3.85±0.02^{b}	3.68±0.03^{c}	4.03±0.10^{a}	**
7 -9 weeks	3.43±0.05	3.39±0.01	3.37±0.04	3.35±0.04	3.43±0.02	NS
9-11 weeks	2.98±0.07^{a}	2.81±0.03^{b}	2.79±0.04^{b}	2.70±0.05^{bc}	2.60±0.08^{c}	**
11-13 weeks	4.31±0.16^{a}	3.97±0.03^{b}	3.57±0.07^{c}	3.31±0.10^{c}	4.40±0.15^{a}	**
5-13 weeks	3.70±0.04^{a}	3.53±0.01^{b}	3.39±0.01^{c}	3.26±0.02^{d}	3.61±0.06^{ab}	**

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

Item	Digestion coefficients						Nutritive values (As fed)		
	DM	OM	CP	EE	CF	NFE	DCP	TDN	DE
SBP substitution (%) for CH									
0%	60.63 ± 0.16^{c}	63.83± 0.42	74.50 ±0.09^{c}	78.33±0.17^{a}	34.46 ±0.45^{a}	65.27 ±0.05^{d}	12.79 ±0.17^{d}	50.25 ±0.12^{c}	2,226.08 ±5.17^{c}
25%	61.28 ± 0.02^{abc}	63.72 ±0.77	75.16 ±0.12^{b}	78.55 ±0.06^{a}	32.90 ± 0.10^{b}	66.13 ±0.10^{c}	13.28 ± 0.18^{c}	51.79 ±0.07^{b}	2,294.30 ±3.15^{b}
50%	60.96 ±0.38^{bc}	63.02 ± 0.52	75.50 ±0.18^{b}	77.65 ±0.27^{ab}	33.33 ±0.72^{ab}	66.80 ± 0.22^{b}	13.66 ± 0.07^{b}	52.81 ±0.21^{a}	2,339.59 ±9.10^{a}
75%	61.71 ±0.27^{ab}	64.38 ±0.45	76.05 ±0.16^{a}	77.15 ±0.68^{ab}	32.41 ± 0.24^{b}	67.57 ±0.14^{a}	14.20 ±0.10^{a}	53.40 ± 0.32^{a}	2,365.51 ±14.26^{a}
100%	61.86 ± 0.27^{a}	64.88 ±0.33	74.38 ±0.23^{c}	76.77 ±0.70^{b}	32.30 ± 0.38^{b}	64.92 ±0.11^{d}	13.15 ±0.04^{cd}	50.99 ±0.46^{bc}	2,258.75 ± 20.29^{bc}
Significance	*	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 ** $P < 0.01$

Even, there was a step wise decrease in DE with increasing inclusion level of SBP which would have a promptly effect on feed intake.

The reduction in FI for rabbits fed SBP may be due to high absorbing capacity and swelling capacity 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 increased satiety due to reduced gastric emptying caused by distension of the duodenum (Sellers, 1977). It is worthy noting that SBP is known to have high water-holding capacity (Michel *et al.*, 1988), which was probably responsible for the decreasing ileal digesta DM content of chickens fed on the higher inclusion levels of beet pulp. Similar to the present study, Tag El-Din (1996) reported that SBP in rabbit diet up to 30% had no effect on FI values over all the experimental period (8-13) weeks).

Sugar beet pulp substituted for CH with different levels (25, 50 and 75%) in control diet significantly ($P < 0.05$) improved feed conversion (FC) values of growing rabbits during 5-7, 9-11, 11-13 and 5-13 weeks of age (Table 3), while FC was insignificantly affected during 7-9 weeks of age.

Our results agree with Tag El-Din (1996) who found that the best value of FC was that of the group fed 30% SBP in the diet, the overall means of FC of the control group (0% SBP: 30% CH) and that fed 7.5% SBP were approximately equal and both were significantly less than the other experimental groups. The best value of FC was that of the group fed 30% SBP in the diet.

Digestibility Coefficients and Nutritive Value of the Experimental Diets

Digestibility coefficients

The obtained results of the digestibility trails (Table 4) in the experiment showed that the inclusion of SBP replacement of CH up to 75% had a significantly ($P < 0.05$) positive effect on the digestibility coefficients of CP and NFE. While, inclusion of 100% SBP substitution of CH in control diet had a significantly ($P < 0.01$) effect on the digestibility coefficients of CP and NFE recorded the highest values in rabbits fed 75% SBP substitution of CH as compared to the control diet. On the other hand, digestibility coefficients of CF was decreased gradually ($P < 0.05$) with increasing SBP level up to 100% substitution for CH. Inclusion of SBP did not significantly affect on digestion of OM. Digestibility coefficient of EE was significantly ($P < 0.01$) decreased when the diet included 100% SBP instead of CH.

Nutritive value

The nutritive values of DCP, TDN and DE were significantly ($P < 0.01$) affected by SBP instead of CH in rabbit diet (Table 4).

It is worthy noting that each of DCP, TDN and DE were gradually increased ($P< 0.01$) when 25, 50 and 75% SBP replaced CH in control diet. It is clear that, increasing the substitution of SBP up to 100% by CH insignificantly increased DCP, TDN and DE contents in the diet. In contrary, Tag El-Din (1996) found that there were no significant differences in each of DE, TDN and DCP among feeding treatments due to inclusion SBP instead CH.

Carcass characteristics

All carcass traits studied were not significantly affected by feeding the SBP diets (Table 5). The results were in agreement with Tag El-Din (1996) who found that no significant effect with respect of all carcass traits which were slightly improved with increasing SBP level in the diet from 0 up to 30%. Also, Volek *et al.* (2004) found that dressing percentage was similar in diets containing 35% SBP to the control diet.

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 6. It could be noticed that the substitution of SBP for CH in control diet did not significantly affect the length of each part of the gastrointestinal tract studied (stomach, small intestine and large intestine). However, Arslan and Saatci (2003) showed that the goslings diet replacement by alfalfa, grass and SBP with 5, 10 and 15%, small intestine and caecum lengths of

Table 5. Some carcass traits studied of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of CH at 13 weeks of age

Item	Slaughter Wt. (g.)	Blood (%)	Offal (%)	Liver (%)	Kidneys and Spleen (%)	Heart (%)	Total giblets (%)	Dressing (%)	Carcass (%)
SBP substitution (%) for CH									
0%	2,461.25	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%	2,523.75	3.32 ±0.09	21.60 ±0.40	5.45 ±0.08	2.05 ±0.05	0.75 ±0.02	8.25 ±0.11	56.04 ±0.34	51.77 ±0.35
50%	2,593.75	3.61 ±0.04	21.11 ±0.19	5.64 ±0.12	2.07 ±0.02	0.76 ± 0.02	8.47 ±0.12	56.14 ±0.24	51.75 ±0.10
75%	2,626.75	3.40 ±0.05	21.08 ±0.34	5.72 ±0.16	2.11 ±0.06	0.75 ±0.02	8.58 ±0.16	56.24 ±0.37	51.79 ±0.23
100%	2,503.75	3.49 ±0.07	21.21 ±0.33	5.52 ±0.13	2.04 ±0.03	0.75 ±0.02	8.31 ±0.13	56.23 ±0.10	51.92 ±0.35
Significance		NS	NS	NS	NS	NS	NS	NS	NS

NS= Not-Significant.

Table 6. Digestive system length of NZW rabbits ($\overline{X}$ ±SE) as affected by SBP substitution of CH at 13 weeks of age

Item	Body weight (g.)	Length (cm.)				
		Body	Digestive tract	Stomach	Small intestine	Large intestine
SBP substitution (%) for CH						
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	50.75±1.22	545.45±0.39	30.80±0.66	333.83±0.62	180.83±0.53
50%	2,526.25	50.98±1.26	545.20±1.24	29.64±0.27	334.95±0.62	180.61±1.23
75%	2,485.00	50.83±1.42	545.48±0.63	31.34±0.30	334.18±0.58	179.96±0.58
100%	2,458.75	50.65±0.94	544.71±1.04	30.20±0.40	334.70±0.65	179.81±1.21
Significance		NS	NS	NS	NS	NS

NS= Not-Significant.

groups were also statistically different. On the other hand, Arslan (2005) found that the length of examined gastrointestinal tract sections (small intestine and ceacum) were not affected by feeding regimes (containing 10% SBP) in geese at 6 and 12 weeks of age.

Digestive tract activity (pH values)

The effect of substitution of SBP for CH in rabbit diets on the pH of digestive tract (stomach, small intestine, caecum and colon) were showed in Table 7.

The pH of the content gastrointestinal organs was not affected by SBP substitution for (25, 50, 75 and 100%) CH. On the other hand, Falcaoe *et al.* (2004) found that the pH of caecum contents was significantly affected by the source of fiber being lower in beet pulp diets. El-Abed *et al.* (2011) found that the type of diet didn't affect on growth rate and stomach pH. While the inclusion of SBP or their fractions decreased the caecum pH. Arslan and Saatci (2003) showed that the goslings diet replacement by alfalfa, grass and SBP with 5, 10 and 15%, a part from jejunum pH, pH of glandular stomach, duodenum, ileum and caecum statistically differ between the groups. However, Arslan (2005) found that the pH value of examined gastrointestinal tract sections (small intestine and caecum) content was not affected by feeding regimes (Containing 10% SBP) in geese at 6 and 12 weeks of age.

Gastrointestinal organs weight and their content

The effect of substitution of SBP for CH on gastrointestinal weight and their content are shown in Table 8. From obtained results it is clear that, SBP had no significant effect on empty digestive tract weight or their content. El-Abed *et al.* (2011) reported that SBP diet with their soluble or insoluble fractions, the insoluble fraction seems to be the main responsible of the high total digestive tract weight. They added that the soluble and insoluble fractions of SBP produce different effects on the gastrointestinal tract. Also, Falcaoe *et al.* (2004) reported that beet pulp diets gave heavier stomachs and caecums. Volek *et al.* (2004) found that the weights of digestive organs (stomach, small intestine, caecum and colon) of rabbit fed diets potato pulp, SBP and wheat bran were significantly different in caecum, but, other organs were not significantly affect. In addition, Arslan and Saatci (2003) showed that the weight of glandular stomach, gizzard, small intestine and caecum were significantly different between different groups of goslings diet replaced by alfalfa, grass and SBP with 5, 10 and 15%. However, Arslan (2005) found that, the weight of gastrointestinal tract sections (small intestine and ceacum) was not affected by feeding regimes (containing 10% SBP) in geese at 6 and 12 weeks.

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 return, economical efficiency and relative economical efficiency are presented in Table 9.

Net return (NR)

Feeding dietary treatments resulted in a positive effect of improving NR being 17.792 to 22.211 LE showing that SBP substitution of CH in growing rabbits up to 75% increased NR by 24.8% over the control group, being the highest NR compared to other experimental groups, while the total SBP substitution of CH decreased NR by 11.5% from that of the highest NR group (75% substitution). This advantage may be due to their current lower price compared to the control.

The feed cost to produce one LE of meat ranged from 0.303 to 0.383 LE/LE showing that the highest feed cost to produce one LE of meat was recorded for rabbits received the control diet, while the least one was that of incorporation of 27% (75% substitution level) SBP in the growing diets.

The net return from one LE feed cost was the least for rabbits received the control diet (2.611 LE/LE), while it was the highest (3.30 LE/LE) for rabbits received 27% SBP in growing diets recording 26.4% more than that of the control diet.

Table 7. Digestion tract content pH of NZW rabbits ($\bar{X}$ ±SE) as affected by SBP substitution of CH at 13 weeks of age

Item	pH value of the content			
	Stomach	Small intestine	Large intestine	
			Caecum	Colon
SBP substitution (%) for CH				
0%	1.68±0.03	7.18±0.03	6.10±0.04	6.53±0.03
25%	1.65±0.06	7.18±0.05	6.10±0.09	6.50±0.04
50%	1.65±0.06	7.20±0.04	6.13±0.09	6.50±0.07
75%	1.68±0.03	7.23±0.05	6.08±0.05	6.50±0.09
100%	1.65±0.06	7.28±0.11	6.08±0.09	6.53±0.06
Significance	NS	NS	NS	NS

NS= Not-Significant.

Table 8. Digestive tract organs weight of NZW rabbits ($\bar{X}$ ±SE) as affected by SBP substitution of CH at 13 weeks of age

Item	Slaughter Wt. (g)	Digestive tract Wt. (%)		Stomach Wt. (%)		Small intestine Wt. (%)		Large intestine Wt. (%)	
		Empty	Content	Empty	Content	Empty	Content	Empty	Content
SBP substitution (%) for CH:									
0%	2461.25	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%	2493.75	5.11±0.02	13.94±0.04	1.09±0.01	2.47±0.02	1.97±0.02	0.87±0.02	2.73±0.01	14.12±0.07
50%	2526.25	5.12±0.04	14.02±0.08	1.10±0.03	2.45±0.03	1.96±0.02	0.89±0.02	2.74±0.02	14.20±0.09
75%	2485.00	5.14±0.02	14.14±0.17	1.10±0.03	2.45±0.08	1.97±0.02	0.88±0.04	2.73±0.01	14.33±0.09
100%	2458.75	5.13±0.03	13.93±0.07	1.10±0.01	2.46±0.03	1.98±0.02	0.87±0.02	2.73±0.01	14.09±0.04
Significance		NS	NS	NS	NS	NS	NS	NS	NS

NS= Not-Significant.

Table 9. Economical evaluation of NZW rabbits as affected by SBP substitution of CH during the period from 5-13 weeks of age

Item	Unit	Control (0%)	SBP substitution (%) for CH			
			25%	50%	75%	100%
Average FI / rabbit (5-13 weeks)	Kg	6,624	6,633	6,583	6,526	6,547
Price/kg diet	LE	1.67	1.61	1.53	1.48	1.44
Total feed cost / rabbit	LE	11,061	10,679	10,072	9,658	9,427
Average BWG (5-13 weeks)	Kg	1,862	1,938	1,995	2,056	1,909
Selling price / meat	LE	28,853	30,036	30,927	31,869	29,589
NR	LE	17,792	19,357	20,856	22,211	20,161
Economical efficiency		1.61	1.81	2.07	2.30	2.14
Relative economical efficiency	(%)	100	112.59	128.57	142.86	132.92
Feed cost to produce one LE of meat	LE/LE	0.383	0.356	0.326	0.303	0.319
Relative change of feed cost/LE of meat	(%)	100	93.0	85.1	79.1	83.3
NR from One L.E feed cost	LE/LE	2.611	2.813	3.071	3.300	3.140
Relative change of NR	(%)	100	107.7	117.6	126.4	120.3

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

It is worthy noting that, 75% substitution of CH with SBP was more economically than that of 75% substitution of YCG. This increase obtained with SBP substitution of CH draws the attention towards SBP substitution of CH at 27% as a practical level of inclusion.

Economical efficiency

Feeding growing rabbits on control diet gave the lowest economical efficiency value (1.61), whereas the best efficiency value (2.30) was for the rabbits fed 75% SBP substitution of CH, followed by 25, 50 and 100% SBP replacement for CH being, 1.81, 2.07 and 2.14, respectively over the control.

These results are supported by those of feed conversion, in which rabbits fed on dietary SBP diets utilized feed more efficiently than the control diet (0% SBP). The relative economical efficiency was superior (142.86) of the group fed 75% SBP substitution of CH, followed by those of 100, 50 and 25% being, 132.92, 128.57 and 112.59, respectively over the control.

In general, it may be concluded that growing rabbits can tolerate SBP even at a level of 27% (75% substitution of CH) improving economical efficiency.

It is worthy noting that the highest economical efficiency (2.30%) in case of this experiment is lower than that of CH experiment at the same substitution level of SBP showing that from practical and economical substitution of SBP for CH is more preferable than that for cereals.

Recommendation

From practical and economical point of view further investigations are advisable to test complete substitution of CH 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.

AOAC (1990). Official Methods of Analysis 16th 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.

Arslan, C. and M. Saatci (2003). Bulky feeds in the intensive fattening of goslings. 1. Effects of grass, alfalfa and sugar beet pulp on growth slaughter performance and some blood parameters in geese. Revue Med. Vet., 154 (10): 633-638.

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.

Carabaño, R.I., S. Badiola, A.I. Chamorro, P. Garcia, M.S. Garcia-Ruiz, A. Garcia-Rebollar, I. Gomez-Conde, N. Gutierrez, M.J. Nicodemus, J.C. Villamide and E. de Blas (2008). New trends in rabbit feeding: Influence of nutrition on intestinal health. Span. J. Agric. Res., 6:15-25.

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

Cheeke, P.R., N.M. Patton and G.S. Tempelton (1982). Rabbit Production 5th 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.

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. and R.I. El-Kady (2006). Effect of partial replacement of concentrates with sugar beet pulp on performance, carcass characteristics and energy utilization of growing sheep. J. Agri. Biol., 8 : 3.

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.

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

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

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.

Kebede, T., T. Lemma, E. Tadesse and M. Guru (2008). Effect of level of substitution of sweet potato (*Ipomoea batatas* L.) vines for concentrate on body weight gain and carcass characteristics of browsing Arsi-Bale goats. J. Cell and Anim. Biol., 2 (2) : 036-042.

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.

Mirzaei-Aghsaghali, A. and N. Maheri-Sis (2008). Nutritive value of some agro-industrial by-products for ruminants - A review. World J. Zool., 3 (2): 40-46.

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

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

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. Georgia Univ., Press Athens, Georgia, USA, 423.

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

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

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.

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.

Volek, Z., V.M. Skrivanova, S.M. Marounek and P. Klein (2002). Performance, digestive anatomy and caecal parameters in rabbits fed diets differing in digestible fiber content. 53rd Ann. Meet. EAAP, Cairo.

Xiccato, G., A. Trocino, D. Majolini, M. Fragkiadakis and M. Tazzoli (2011). Effect of decreasing dietary protein level and replacing starch with soluble fibre on digestive physiology and performance of growing rabbits. Anim., 5 (8):1179-1187.

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. on Rabbit Prod. in Hot Climate, Sharm El- Sheikh, Egypt, 267-274.

تأثير استبدال دريس البرسيم المصري بتفل بنجر السكر علي أداء الأرانب النامية

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أجري هذا البحث لدراسة تأثير استبدال دريس البرسيم المصري بتفل بنجر السكر علي 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 دريس البرسيم المصري 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 الأولى غذيت على عليقة الكونترول بينما غذيت الأربع مجموعات الأخرى على علائق تحتوي ٩ ، ١٨ ، ٢٧ و ٣٦ % تفل بنجر السكر على الترتيب والتي تبين معدلات استبدال تفل بنجر السكر محل دريس البرسيم بمستويات استبدال هي ٢٥ ، ٥٠ ، ٧٥ و١٠٠% من عليقة الكونترول، وبينت النتائج أن استبدال دريس البرسيم بتفل بنجر السكر بمستويات حتي ٧٥% أدى إلى زيادة الوزن الحي ومعدل الزيادة اليومية معنويا في معظم الفترات التجريبية، سجلت الأرانب التي غذيت علي مستويات إحلال لتفل بنجر السكر بنسب ٢٥ ، ٥٠ و ٧٥ % أعلي قيم للحيوية، انخفض الغذاء المأكول انخفاضا غير معنويا، بينما تحسنت قيم تحويل الغذاء معنويا بزيادة نسبة إحلال تفل بنجر السكر محل دريس البرسيم خلال معظم الفترات التجريبية. تأثرت قيم معاملات هضم البروتين الخام والكربوهيدرات الذائبة إيجابياً ومعنوياً بزيادة نسب إحلال دريس البرسيم بتفل بنجر السكر حتى ٧٥%، زادت معنوياً القيم الغذائية للبروتين الخام المهضوم والمركبات الكلية المهضومة والطاقة المهضومة تدريجياً بزيادة نسب إحلال دريس البرسيم بتفل بنجر السكر (٢٥ ، ٥٠ ، ٧٥%)، إحلال تفل بنجر السكر محل دريس البرسيم لم يؤثر معنوياً على كل الصفات المدروسة للذبيحة، طول وقيم pH كل أجزاء القناة الهضمية، كانت أفضل كفاءة اقتصادية للأرانب التي تغذت على تفل بنجر السكر نسبة ٧٥% من دريس البرسيم يليها مستويات الإحلال ١٠٠، ٥٠ و٢٥% تفل بنجر سكر محل دريس البرسيم، تُرشدنا نتائج الدراسة من الوجهة الغذائية والاقتصادية أنه يمكن استخدام تفل بنجر السكر حتى نسبة إحلال ٧٥ % محل دريس البرسيم (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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