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EFFECT OF REPLACEMENT OF BARLEY GRAINS BY SUGAR BEAT PULP IN GROWING RABBIT RATIONS

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Forty five of weaning New Zealand White (NZW) Rabbits, six weeks old with an average live body weight (BW) of 757 g were randomly distributed into five equal groups (nine rabbits each). Rabbits were fed five formulated experimental rations. The 1st ration (R_1) was used as a control and contained : 14% clover hay + 8 % bean straw + 20 % wheat bran + 10 % yellow corn + 20 % barley + 22 % soybean meal + 3 % sugar cane molasses + 1.20 % limestone + 0.5 % sodium chloride + 1 % calcium diphosphate + 0.3 % mineral-vitamins mixture. Sugar beet pulp (SBP) was used to replace barley grains at levels of 25, 50, 75, and 100 % in the other four experimental rations, R_2, R_3, R_4, and R_5, respectively.

The results of the present study revealed that the apparent digestibility coefficients of all nutrients and feeding value of the ration expressed as TDN, ME, and DCP were not differed significantly ($P<0.05$) by substitution of barley grains at different levels of SBP up to 20% of the total ration.

Blood serum levels of glucose, total protein and globulin tended to be lower ($P<0.05$), whereas levels of urea-N, uric acid, creatinine, cholesterol, triglycerides, high density lipoprotein (HDL), low density lipoprotein (LDL) and alkaline phosphatase trended to higher ($P<0.05$) with increasing level of SBP in the ration. The AST and ALT levels activities were decreased when feeding on SBP rations compared with the control. Growth performance parameters at 13 weeks of age, including live body weight, body weight gain and feed conversion rate were not significantly affected by feeding different levels of SBP in the ration. Carcass traits expressed as dressing and hot carcass (%) were statistically similar in all rabbit groups. Economic efficiency was the highest with those rabbits fed rations containing SBP up to 15 – 20 %.

Dried sugar beet pulp (SBP) is considered a good alternative source of energy and can be included up to 20 % of the total balanced ration of growing rabbits to replace 100 % of the barley grains without any adverse effects on growth performance.

Key words : Sugar beet pulp, barley grains, digestibility and carcass characteristics.

In Egypt, the shortage of cereal grains for human feeding makes it necessary to seek for alternative cheap carbohydrate sources for animal feeding. Inclusion of agro-industrial by-products such as dried sugar beet pulp, sugar can molasses, date palm seeds and broken macaroni could be used as alternative sources of energy in the animal diets(Abdelhamid, 1988 and 1992) and El-Shinnawy *et al.*, 1986. Sugar beet pulp (SBP) contains a high proportion (70 – 80 %) of low lignified cell wall components, and a low content of starch (1 – 2 %) and sugars (7 – 10%); so, SBP is maily used as an energy source in rabbit rations (Garcia *et al*, 1992[b]).

Rabbits are usually weaned at 35 day of age in commercial farms in Egypt. However, early weaning at 25 day of age decreased growth rate and increased diarrhea incidence (Lebas, 1993) when young rabbits were fed commercial fattening diets. These effects could be related to a low nutrient intake and to an insufficient development of digestive and absorptive capability in the post weaning period (De Blas *et al.*, 1999). Consequently, designing appropriate starter feeds seems to be necessary.

A major obstacle for formulating these special diets is determining the best source of carbohydrates. Amylase and disaccharidase activities increase with age but remain low during the period from 25 to 35 day of age (Scapinello *et al.*, 1999). As a consequence, the amount of starch reaching the cecum and mortality percentage during the postweaning period increase with increasing dietary starch concentration (De Blas and Gidenne, 1998).

The objective of this study was to investigate the effect of feeding growing rabbits on dried sugar beet pulp, as replacement of barley on nutrient digestibility, some blood parameters, productive performance and carcass characteristics. The economic efficiency was also studied.

MATERIALS AND METHODS

The experiment of the present study was carried out at the Experimental Station of the Poultry Production Department; while, the chemical analyses were performed at the Laboratory of the Animal Production Department, Faculty of Agriculture, Mansoura University. The experimental period extended from March to August 2006.

Experimental animals:

Forty five, 6 weeks old weaning New Zealand White (NZW) rabbits were randomly distributed into 5 equal groups. Rabbits were housed in separate cages with the following dimensions (50 x 50 x 45cm) for length, width and height, respectively. Feed and water were offered *ad libitum* throughout the experimental period. Live body weight and feed intake were recorded weekly. The rabbits were offered a commercial diet for seven days before starting the experiment.

Experimental rations:

The experimental groups were fed one of five formulated pelleted rations. The 1st experimental rations (R_1) was used as a control and contained : 14% clover hay + 8 % bean straw + 20 % wheat bran + 10 % yellow corn + 20 % barley + 22 % soybean meal + 3 % sugar cane molasses + 1.20 % limestone + 0.5 % sodium chloride + 1 % calcium diphosphate + 0.3 % mineral-vitamins mixture. Sugar beet pulp (SBP) was used to replace barley grains at levels of 25, 50, 75, and 100 % in the other four experimental rations R_2, R_3, R_4, and R_5, respectively. All rations were formulated to be nearly isonitrogenous, isocaloric, and meet the nutrient requirements for growing rabbits according to NRC, 1977 recommendations. Ingredients and chemical compositions of experimental rations are presented in Table 1.

Digestibility trials:

Three New Zealand White (NZW) rabbits were randomly chosen from each group at the end of the 7th week of experiment to determine the digestibility coefficients and feeding values of the tested rations. Rabbits were kept in metabolic cages to collect faeces and urine separetely. All rabbits were given their daily feed allowances at 10 a.m. *ad libitum*. Drinking water was available at all times.

The feed intake (*ad libitum*) and the total faecal output were recorded daily for each rabbit for 5 days. Samples of each ration were taken for chemical analysis at the beginning of experimental period. A faeces sample from each individual animal was also taken daily and dried firstly at 60?C overnight, then at 105?C for 3 hours.

Table 1. Ingredients and formulation of the experimental rations offered to the growing rabbits from 6 to 13 weeks of age.

Ingredients (%)		Experimental rations				
		R1	R2	R3	R4	R5
Clover hay	**(CH)**	14	14	14	14	14
Bean straw	**(BS)**	8	8	8	8	8
Sugar beet pulp	**(SBP)**	--	5	10	15	20
Wheat bran	**(WB)**	20	20	20	20	20
Yellow corn	**(C)**	10	10	10	10	10
Barley	**(B)**	20	15	10	5	--
Soya bean meal	**(SBM)**	22	22	22	22	22
Sugar cane molasses	**(SCM)**	3	3	3	3	3
Limestone		1.20	1.20	1.20	1.20	1.20
Sodium chloride		0.50	0.50	0.50	0.50	0.50
Calcium diphosphate dibasic		1.00	1.00	1.00	1.00	1.00
Vitamins and mineral mixture*		0.30	0.30	0.30	0.30	0.30
Total		**100**	**100**	**100**	**100**	**100**

* A vitamin- mineral mixture was obtained from Misr Feed Additive Co.. Contents per kg of the Premix were Vit A, 4800000 IU; Vit D_3, 1200000 IU; Vit E,400 mg; Vit K_3, 1000 mg; Vit B_1, 1000 mg; Vit B_2, 2000 mg; Vit B_6, 600 mg; Vit B_{12}, 8 mg; Niacin, 16000 mg; Ca D-panlothenate, 4000 mg; Folic acid, 400 mg; Biotin, 20 mg; Zin, 24 g; Copper, 2 g; Iodin, 0.2 g; Manganese, 32 g; Iron, 18 g; Cobalt, 0.04 g; and Selenium, 0.12 g. The inclusion rate was 3 Kg/ ton of feed to cover the requirements of growing rabbits according to NRC (1977) recommendations.

At the end of the digestibility trial, composite samples of the dried faeces for each animal was taken for chemical analysis. Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were determined in samples of rations and faeces according to Goering and Van Soest (1970).

Some blood serum constituents:

At the last day of digestibility trial, blood samples were collected from the ear vein of 3 animals in each group. The whole blood was divided into two portions for each rabbit, one part was centrifuged at 4000 rpm for 20 minutes and used for glucose and enzymes determinations, while the other part was directed to other biochemical analysis. The serum samples were frozen at -20°C until analysis. The blood constituents were determined, using commercial kits (Biodiagnostic) for total proteins (Doumas *et al.*,1981), albumin (Hill and Wells, 1983), urea-N (Freidman *et al.,* 1980), creatinine (Ullmann, 1976), AST and ALT (Reitman and Frankel, 1957), cholesterol (Ratlliff and Hall, 1973) and alkaline phosphatase (EL-Merzabani *et al.*, 1977).

Carcass evaluation:

Three rabbits from each group were randomly chosen for slaughter test at the end of the trial. Rabbits were fasted for approximately 18 hours before slaughtering and then individually weighed and slaughtered by severing the neck with a sharp knife according to Islamic religion. The different edible organs (liver, heart and kidneys) were removed and immediately weighed to the nearest gram and recorded. The rest of body (carcass) for each rabbit was weighed. Dressing percentage (DP) was calculated using the following equation:

DP= Carcass weight + head weight + giblets weight/ Live body weight× 100

Where: Giblets weight including the weight of liver, heart and kidneys.

Economic efficiency:

The price of daily body weight gain and daily feed cost were calculated depending on the prevailing local prices during 2006 : Price of kg body weight = 16.00 LE, Price (LE)/kg of fresh ingredients: Clover hay = 0.55, bean straw = 0.12, sugar beet pulp = 0.70, wheat bran = 0.75, yellow corn = 1.45, Barley = 1.35, Soya bean meal = 1.70, Sugar cane molasses = 0.80, Limestone = 0.10, Sodium chloride = 0.25, Calcium diphosphate = 2.25, Minerals and vitamin mixture = 7.00.

Statistical analysis:

The Statistical analysis was performed using the least squares method described by Likelihood program of SAS(1994). The obtained data for nutrient digestibility, nutritive value, blood parameters, average body weight and average daily gain were subjected to one way analysis of variance according to the following model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where;Y = Observation of the tested factor, μ = Overall mean, T_i = Treatment effect and e_{ij} = Random error.

The differentiations among means were carried out according to Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Table 2 shows the chemical analysis of the experimental rations. The results for CP ranged from 19.55 to 19.64%, CF 12.96 to 15.92%, EE 2.59 to 2.89%, NFE 51.06 to 54.27%, NDF 33.00 to 38.73%, ADF 17.71 to 21.26%, hemicellulose 15.29 to 17.46% and cellulose 12.79 to 16.06%. The chemical composition of the rations met the nutrient requirements, for growing rabbits as recommended by NRC (1977) and Lebas (1989). The non fiber carbohydrates (NFC) were ranged from 28.25 to 34.23% in the presented experimental rations. Wheeler (2003) reported that the NFC levels in the total ration dry matter should not bellow 20 to 25% nor go above 40 to 45%. Rations formulated for 35 to 37% NFC (DM basis) should avoid metabolic disturbances related to feeding high levels of starches in grains. The NFE and NFC% were decreased as the proportion of SBP increased in the rations, while the NDF, ADF, hemicellulose, cellulose and lignin % were increased with increasing SBP in the rations. There were no changes in the DM, OM, CP, and EE % among the different rations. Poor *et al.* (1993) investigated the effect of the ratio of starch to forage NDF. These workers reported that a starch : NDF ratio of at least 1 will allow acceptable performance.

Effect of feeding experimental rations on digestion coefficients, dry matter intake and feeding values:

The dry matter intake (DMI) ranged from 85.71 to 93.91 g/day (Table 3). These differences in DM intake among groups were not significant ($P<0.05$). As shown in Table 3, the apparent digestibility of all tested nutrients and feeding values were not differed significantly ($P<0.05$) for the 5 experimental rations. The obtained results indicated that, dietary inclusion of sugar beet pulp (SBP) up to 20 % instead of the barley did not affect digestibility coefficients and feeding values of the rations. Garcia *et al.* (1992[a]) concluded that, the substitution of barley grain by SBP in growing rabbits diet caused a decrease in DM and OM and increase of CF and NDF digestibility. The feeding value of the experimental ration expressed as ME, TDN or DCP did not differ among rabbit groups.

Table 2. Chemical composition of the experimental rations (% DM basis).

Items	The experiential rations				
	R1	R2	R3	R4	R5
DM	91.95	91.89	91.83	91.80	91.90
Composition:					
OM	89.70	89.59	89.49	89.31	89.13
CP	19.58	19.62	19.64	19.55	19.56
CF	12.96	13.91	14.62	15.22	15.92
EE	2.89	2.83	2.78	2.66	2.59
NFE	54.27	53.23	52.44	51.88	51.06
Ash	10.30	10.41	10.51	10.69	10.87
Fiber fractions:					
NDF	33.00	34.50	36.10	37.46	38.73
ADF	17.71	19.16	19.72	20.33	21.26
Hemicellulose	15.29	15.33	16.38	17.14	17.46
Cellulose	12.79	14.22	14.66	15.27	16.06
ADL	4.92	4.94	5.06	5.05	5.20
NFC*	34.23	32.64	30.97	29.64	28.25
NFC/NDF	1.03	0.94	0.86	0.79	0.72
Cell./ADF	0.72	0.74	0.74	0.75	0.75
Cell./NDF	0.38	0.41	0.40	0.40	0.41
NFC/hemi.	2.20	2.10	1.90	1.70	1.60

* Non fiberous carbohydrates%= OM% - (CP%+NDF%+EE%), Calsamiglia *et al*.. 1995.

Table 3. Effect of feeding experimental rations on digestion coefficients, dry matter intake and feeding values of the growing rabbits.

Items	Experimental rations				
	R1	R2	R3	R4	R5
Nutrient digestibility (%):					
DM	74.46 ± 0.80	73.41 ± 1.50	72.94 ± 1.86	73.29 ± 0.39	73.14 ± 0.34
OM	77.47 ± 0.57	76.55 ± 1.32	76.20 ± 1.71	76.49 ± 0.25	76.30 ± 0.33
CP	74.84 ± 1.40	74.43 ± 1.55	74.04 ± 2.03	74.05 ± 0.55	73.13 ± 0.43
EE	81.83 ± 0.35	80.50 ± 1.12	79.90 ± 1.04	78.95 ± 0.84	78.49 ± 0.55
CF	25.16 ± 0.66	25.39 ± 1.05	25.19 ± 4.28	26.99 ± 0.36	26.34 ± 1.15
NFE	90.68 ± 0.57	90.49 ± 1.32	91.04 ± 0.94	91.81 ± 0.35	92.97 ± 0.28
NDF	36.73 ± 2.73	36.74 ± 6.31	38.43 ± 3.42	37.12 ± 1.85	36.25 ± 1.78
ADF	32.44 ± 2.82	33.66 ± 6.64	31.31 ± 7.90	32.45 ± 0.64	32.01 ± 1.25
Hemicell.	41.70 ± 2.81	40.60 ± 5.90	47.01 ± 2.58	42.66 ± 4.74	41.40 ± 2.46
Cellulose	41.44 ± 2.94	42.51 ± 9.07	39.18 ± 10.2	40.48± 1.41	39.41 ± 2.01
ADL	9.00 ± 2.53	8.17 ± 0.38	8.51 ± 1.50	8.19 ± 2.59	9.17 ± 1.09
Dry matter intake and feeding values as DM (%):					
DM intake (g/d)	92.13 ± 4.97	93.91 ± 0.85	87.18 ± 0.49	88.56 ± 4.99	85.71 ± 1.24
TDN	71.85 ± 0.52	70.84 ± 1.49	70.40 ± 1. 6	70.41 ± 0.23	69.75 ± 0.28
TDN intake (g/h/day)	66.20 ± 4.44	66.53 ± 1.54	61.37± 1.47	62.36 ± 10.8	59.78 ± 2.80
DCP	14.85 ± 0.27	14.60± 0.36	14.54 ± 0.40	14.47 ± 0.11	14.03± 0.08
TDN : DCP	4.83 ± 0.17	4.85± 0.02	4.84 ± 0.04	4.87 ± 0.18	4.97 ± 0.20
CP intake (g/d)	18.04 ± 0.97	18.43 ± 0.17	17.13 ± 0.10	17.32 ± 0.97	16.77 ± 0.24
ME (Mcal/kg)*	2.56 ± 0.02	2.52 ± 0.04	2.50 ± 0.06	2.51 ± 0.01	2.48 ± 0.01
ME intake (Mcal/d)	0.24 ± 0.00	0.24 ± 0.00	0.22 ± 0.01	0.22 ± 0.01	0.21 ± 0.00
CP intake (g/d) / ME intake (Mcal/d)	75.16 ± 5.64	76.79 ± 1.30	77.86 ± 1.67	78.72 ± 0.26	79.85 ± 0.31

* ME (Mcal/kg) = TDN% × 3.56 (McDonald *et al.*, 1973).

Effect of feeding the experimental rations on some blood serum parameters:

Table 4 shows the effect of feeding the experimental rations on some blood serum parameters. Blood serum glucose concentrations were ranged from 154.47 to 224.61 mg/100ml with different treatments. The glucose concentration trended to be lower (P<0.05) with increasing the level of SBP in the ration, being lowest with those fed the rations R_4 and R_5. In this respect, Oliveira *et al.* (1995) and Fouad *et al*, (2002) Showed that the decrease in serum glucose may be attributed to the decrease of carbohydrate metabolism and decrease in the rate of intestinal glucose absorption.

Blood serum protein concentrations tended to be significantly lower ($P \leq 0.05$) when level of SBP was higher than 10 % in the ration. The globulin concentrations have the same trend as protein concentration in the experimental groups. Melby and Altman (1974), found that normal range of total protein was from 4.9 to 7.2 (g/100 ml), albumin from 3.3 to 5.1 (g/100 ml) and globulin from 1.85 to 3.6 (g/100 ml). Farouk (1995) found that, the AL/GL ratio of New Zealand White rabbits was 2.03 ± 0.08. Blood serum urea-N concentrations was elevated (P<0.05) with increasing the level of SBP in the ration. However, these concentrations were within the normal physiological level as recorded by Fararato and Zaha (1990). The creatinine concentrations have the same trend of urea-N and uric acid, being significantly higher (P<0.05) in those rabbits fed either ration R_4 or R_5. The AST and ALT activities were decreased when feeding on SBP rations compared with the control. The concentrations of cholesterol and triglycerides were increased (P<0.05) with increasing SBP level in the ration. The level of cholesterol ranged from 54.64 to 124.72 mg/100ml, while the triglycerides levels ranged from 81.75 to 156.41 mg/100ml. The total lipids, also increased (P<0.05) with increasing SBP levels and ranged from 82.44 to 183.99 mg/100ml. High plasma cholesterol concentrations in the absence of excess dietary energy intake are considered to reflect the capacity of the animal to mobilize body fat reserves (Ruegg *et al.*, 1992). High density lipoprotein (HDL), low density lipoprotein (LDL) and alkaline phosphates levels were higher (P<0.05) with increasing SBP levels. The values for HDL concentrations ranged from 27.73 to 45.19 mg/100ml. The LDL concentrations were ranged from 13.56 to 48.25 mg/100ml. The alkaline phosphates also was increased with increasing the level of SBP in the ration. The values ranged from 88.00 to 130.58 IU/L. Ahmed (1997) found that rabbits given 25% beet pulp ration recorded the highest value of alkaline phosphatase. The pH values were about 7 for all blood samples of rabbits fed the experimental rations.

Table 4. The effect of experimental rations on some blood serum parameters .

Items	R1	R2	R3	R4	R5
Glucose (mg/100ml)	224.61[a] ± 8.31	175.51[b] ± 2.38	171.30[bc] ± 5.56	157.26[cd] ± 3.77	154.47[d] ± 1.24
Total protein (g/100ml)	9.45[ab] ± 0.20	10.35[a] ± 0.19	9.23[b] ± 0.06	7.92[c] ± 0.41	7.36[c] ± 0.49
Albumin (g/100ml)	3.29 ± 0.04	3.50 ± 0.34	3.48 ± 0.31	3.17 ± 0.34	3.45 ± 0.55
Globulin (g/100ml)	6.16[ab] ± 0.20	6.85[a] ± 0.39	5.75[abc] ± 0.28	4.75[bc] ± 0.57	3.91[c] ± 1.04
AL/GL	0.536 ± 0.02	0.520 ± 0.08	0.612 ± 0.08	0.703 ± 0.16	1.151 ± 0.05
Urea-N (mg/100ml)	19.55[d] ± 0.12	25.43[c] ± 1.97	29.86[b] ± 1.34	35.38[a] ± 0.26	38.77[a] ± 0.41
Uric acid (mg/100ml)	0.70[c] ± 0.03	0.74[c] ± 0.09	1.25[b] ± 0.09	1.38[b] ± 0.01	1.70[a] ± 0.02
Creatinine (mg/100ml)	2.06[bc] ± 0.07	1.87[c] ± 0.05	2.20[b] ± 0.03	2.43[a] ± 0.10	2.53[a] ± 0.07
AST (%)	100	95.08	90.65	87.33	80.32
ALT (%)	100	91.97	87.88	84.85	77.73
Cholesterol (mg/100ml)	54.64[c] ± 5.20	58.72[c] ± 2.37	65.58[c] ± 1.57	103.03[b] ± 9.91	124.72[a] ± 6.67
Triglycerides (mg/100ml)	81.75[d] ± 6.91	93.79[dc] ± 2.53	111.30[bc] ± 6.04	136.09[ab] ± 4.02	156.41[a] ± 14.52
HDL (mg/100ml) *	27.73[c] ± 2.32	33.36[bc] ± 1.57	35.59[abc] ± 2.19	40.02[ab] ± 3.72	45.19[a] ± 5.29
LDL (mg/100ml) **	13.56[b] ± 0.61	6.60[b] ± 0.35	7.73[b] ± 0.26	35.80[a] ± 5.87	48.25[a] ± 4.22
Alkaline phosphatase (IU/l)	88.00[c] ± 1.40	94.18[c] ± 4.02	96.80[c] ± 1.72	121.79[b] ± 2.67	130.58[a] ± 2.80
pH	7.05 ± 0.02	7.08 ± 0.01	7.14 ± 0.06	7.06 ± 0.03	7.05 ± 0.09

a, b, c, d: Means within the same raw with different superscripts are significantly different ($P<0.05$).

*HDL : high density lipoproteins

**LDL : low density lipoproteins.

Growth performance parameters:

As shown in Table 5, the final live body weight (LBW) at 13 week of age for rabbits received R_1, R_2, R_3, R_4 and R_5 were 2093, 1988, 2094, 2068 and 2037g, respectively. These differences in LBW among groups were not significant. The average daily body gain of rabbits had the same trend of live body weight, where the differences among rabbit groups were not significant. The obtained results are in agreement with those given by Frank and Seroux (1980) and Jensen (1992) who reported that, there were no significant differences in daily live weights gain between control ration and experimental rations containing different levels of dried beet pulp.

Table 5. The effect of feeding experimental rations on body weight, average daily gain, average dry matter intake and feed conversion of growing rabbits.

Items	Dietary groups				
	R1	R2	R3	R4	R5
Number of rabbits	9	9	9	9	9
Initial live body weight (g)	747 ± 0.06	778 ± 0.08	761 ± 0.06	747 ± 0.08	750 ± 0.07
Final live body weight (13 weeks)	2093 ± 0.14	1988 ± 0.09	2094 ± 0.10	2068 ± 0.10	2037 ± 0.53
Daily body weight gain (g/d)	27.47 ± 0.09	24.68 ± 0.10	27.19 ± 0.09	26.95 ± 0.40	26.26 ± 0.09
Daily feed intake (g/d)	88.93	89.34	89.96	90.11	90.14
Feed conversion (g feed / g gain)	3.59 ± 0.07	4.17 ± 0.10	3.46 ± 0.38	3.68 ± 0.13	3.70 ± 0.06
Viability (%)	100	116.16	96.38	102.51	103.06

The difference of average DMI (g/day) between rabbit groups was not significant, it recorded 88.93, 89.34, 89.96, 90.11 and 90.14 g/day, for those fed experimental ration R_1,R_2, R_3, R_4 and R_5, respectively. The average of feed conversion rate (dry matter intake g/g daily gain) as shown in Table (5) was not differed between rabbit groups fed the experimental rations from 6 to 13 weeks of age. The obtained results indicate that inclusion of sugar beet pulp up to 20 % in the rabbit ration instead of the barley grains had no adverse effect in growth performance parameters of rabbits.

Garcia *et al.* (1992[b]) concluded that, inclusion of SBP significantly impaired live body weight, length of fattening period, total dry matter intake and feed conversion rate. The differences being greater when proportion of SBP increased from 15 to 30% than 0.0 to 15%. Inclusion of 15% SBP had no significant effects on growth performance, digestible energy and digestible CP efficiencies.

Slaughter traits:

Table 6 showed carcass characteristics. There were no significant differences among of dietary treatments on all carcass characteristics and dressing percentage. Yet, the slaughter weight was the highest (2178g) when rabbits fed on R_4 and the lowest (1968g) with feeding on R_5. The head and viscera weights were lowest (115 and 255g, respectively) with feeding on R_5 than the other rations. The hot carcass weight was 1249, 1326, 1178. 1347 and 1176 g for R_1, R_2, R_3, R_4 and R_5, respectively. Reyntens *et al.* (1970) reported that, the slaughter yield improved with age. For a given carcass weight, animal with a high growth rate, receiving more balanced feed, generally have a better carcass yield.

Economic efficiency:

Data of the economic evaluations are summarized in Table (7). The costs for each kg of feed mixture were 1.122, 1.093, 1.056, 1.028 and 1.001 LE for the experimental rations R_1, R_2, R_3, R_4 and R_5, respectively. These results showed that the average price of kg fresh feed decreased gradually as a result of increasing the level of SBP in the ration.

The economic efficiency (%) were found to be 303.7, 272.6, 322.3, 331.0 and 333.0 for rabbit groups fed the experimental rations R_1, R_2, R_3, R_4 and R_5, respectively. The obtained result indicate high economic efficiency when SBP included in the ration at level of 15 or 20 %.

Table 6. Effect of the experimental rations on carcass characteristics of growing rabbits.

Items	R1		R2		R3		R4		R5	
Live body weight	2140 ± 0.03		2212 ± 0.06		2058 ± 0.11		2235 ± 0.14		2027 ± 0.11	
Dressing %*	64.78 ± 0.76		66.39 ± 0.32		63.86 ± 0.71		66.41 ± 1.20		64.33 ± 1.28	
	Weight (g)	(%) of LBW	Weight (g)	(%) of LBW	Weight (g)	(%) of LBW	Weight (g)	(%) of LBW	Weight (g)	(%) of LBW
Head	123.33 ± 0.12	5.76	128.33 ± 0.12	5.80	120 ± 0.12	5.83	123.33± 0.12	5.52	115 ± 0.11	5.67
Liver	50.67 ± 3.18	2.37	49.67 ± 0.33	2.25	49 ± 2.08	2.38	48.67 ± 2.40	2.18	49.67 ± 2.33	2.45
Heart	8.67 ± 1.33	0.41	8.33 ± 0.33	0.38	8.67 ± 0.88	0.42	8.33 ± 0.88	0.37	8.67 ± 0.33	0.43
Kidneys	13.67 ± 0.67	0.64	13.33 ± 1.45	0.60	13.67 ± 3.28	0.66	13 ± 1.53	0.58	13.67 ± 1.45	0.67
Giblets weight**	73.00	3.42	71.33	3.23	71.33	3.46	70.00	3.13	72.00	3.55
Hot carcass	1190 ± 0.03	55.61	1269 ± 0.04	57.37	1123 ± 0.05	54.57	1291 ± 0.10	57.76	1117 ± 0.05	55.11

* Dressing percentage (D.P.) = Carcass weight + Head weight + Giblets weight**/ Live body weight × 100

** Giblets weight including the weight of liver, heart and kidneys.

Table 7. Economic efficiency of growing rabbits fed the experimental rations.

Items	Experimental rations				
	R1	R2	R3	R4	R5
Price (LE)/ kg fresh of feed	1.122	1.093	1.056	1.028	1.001
Feed intake /g/h/d	96.72	97.18	97.67	98.16	98.08
Total feed cost (LE) / day	0.109	0.106	0.103	0.100	0.097
Average daily gain (g)	27.47	24.68	27.19	26.95	26.26
Price of daily gain (LE)	0.440	0.395	0.435	0.431	0.420
Profit (LE)	0.331	0.289	0.332	0.331	0.323
Economic efficiency %	303.7	272.6	322.3	331.0	333.0
*Relative economic efficiency	100	89.8	106.1	109.0	109.6

Market price (LE) kg fresh of ingredients : CH = 0.55; BS = 0.12; SBP = 0.70; WB = 0.75; C = 1.45; B = 1.35 ; SBM = 1.70; SCM = 0.80; limestone = 0.10; Sodium chloride = 0.25; calcium diphosphate = 2.25; vitamin-minerals mixture = 7.00;kg body weight gain = 16.00.

- Assuming that the relative economic efficiency of control ration equal 100.

Conclusively, agro-industrial by-products such as dried sugar beet pulp could be used as new alternative source of energy in the growing rabbits rations. Dried sugar beet pulp can be used up to 20 % of the total balanced ration of growing rabbits to replace 100 % of barley grains without any adverse effects on growth performance and feed utilization of rabbits.

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تأثير إحلال تفل بنجر السكر محل حبوب الشعير فى علائق الأرانب النامية

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تم اختيار ٤٥ أرنبا نيوزيلندي ابيض عمر ستة أسابيع بمتوسط وزن ٧٥٧ جم وتم توزيعهم عشوائيا في خمس مجاميع متساوية في العدد والعمر وتغذيتها على خمس علائق تجريبية على النحو التالي: عليقه المقارنة تحتوى على ١٤% دريس برسيم + ٨% تبن فول + ٢٠% نخالة قمح + ١٠% أذرة صفراء + ٢٠% شعير + ٢٢% كسب فول صويا + ٣% مولاس + ١,٢% حجر جيري + ٠,٥% ملح + ١% داي كالسيوم فوسفات + ٠,٣% مخلوط فيتامينات وأملاح معدنية . وتم إحلال تفل بنجر السكر محل الشعير بنسب صفر، ٢٥، ٥٠، ٧٥، ١٠٠% في الخمس علائق على التوالي. وكانت جميع العلائق على شكل مكعبات ومتساوية في الطاقة والبروتين تقريبا وطبقا للاحتياجات المطلوبة لتغذية الأرانب النامية حيث تراوحت نسبة البروتين بين ١٩,٥-١٩,٦% والألياف بين ١٢,٩٦-١٥,٩٢% بالعلائق المختبرة (على أساس الوزن الجاف تماما).

استمرت التجارب سبعة أسابيع وتم إجراء تجارب هضم واخذ عينات دم وكذالك ذبح ثلاث حيوانات من كل مجموعه لدراسة تأثير المعاملات المختلفة على صفات الذبيحة وخصائصها ألمختلفة فضلا عن إجراء دارسه اقتصاديه للعلائق المختبرة وكانت أهم النتائج المتحصل عليها هي كما يلي:

أولا: تجارب الهضم:

- لم تظهر فروق معنوية في معاملات الهضم للمركبات الغذائية نتيجة للتغذية على العلائق المختبرة.
- لم تظهر أيضا فروق معنوية على القيم الغذائية للعلائق التجريبية معبرا عنها في صورة مركبات مهضومة كليا (TDN) وطاقة ممثلة (ME) وبروتين خام مهضوم (DCP).

ثانيا: اختبارات الدم:

- مع زيادة مستويات تفل بنجر السكر في العلائق انخفضت تركيزات الجلوكوز والبروتين الكلى والجوبيولين وكذلك نشاط أنزيمات نقل الأمين في سيرم الدم، بينما ارتفعت تركيزات نيتروجين اليوريا وحامض اليوريك والكرياتنين والكليستيرول والجليسريدات الثلاثية والليبوبروتين عالي الكثافة ومنخفض الكثافة وإنزيم الفوسفاتيز الكلى.

ثالثا: الإنتاج والكفاءة الإنتاجية:

- لم تظهر فروق معنوية بالنسبة لوزن الجسم ومتوسط الزيادة اليومية في وزن الحيوانات أثناء التجارب المزرعية بين العلائق المختبرة حيث بلغ الوزن النهائي عند عمر ١٣ أسبوع ٢٠٩٣ ، ١٩٨٨ ، ٢٠٩٤ ، ٢٠٦٨ ، ٢٠٣٧ جم عند التغذية على العليقه الأولى، الثانية، الثالثة، الرابعة والخامسة على التوالي.
- كانت نسبة وزن الذبيحة الصافي والأعضاء المأكولة (الكبد، القلب، الكلى) بالنسبة لوزن الجسم الحي (Dressing%) هي: ٦٤,٧٨، ٦٦,٣٩، ٦٣,٨٦، ٦٦,٤١ و٦٤,٣٣% عند التغذية على العلائق المختبرة الأولى، الثانية، الثالثة، الرابعة والخامسة على التوالي بفروق غير معنوية.
- أظهرت النتائج أن الكفاءة الاقتصادية للعلائق هي: ٣٦٤,٤، ٣٢٥,٩، ٣٧٨,٣، ٣٨٦,٣ و ٣٨٧,٦ % عند التغذية على العلانق المختبرة الأولى، الثانية، الثالثة، الرابعة والخامسة على التوالي.

الخلاصة: تشير نتائج البحث أنه من الممكن تغذيه الأرانب النامية بعد الفطام (من عمر ٦-١٣ أسبوعا) على علائق تحتوى على تفل بنجر السكر حتى نسبة ٢٠% من العليقه الكلية ليستبدل ١٠٠% من حبوب الشعير دون أن يؤثر ذلك سلبا على معدلات نمو الأرانب أو استفادتها الغذائية. ومن الناحية الاقتصادية كانت العلائق التي تحتوى على ١٠، ١٥ و ٢٠ % تفل بنجر السكر أفضل من المقارنة وكانت العليقه التي تحتوى على ٢٠% تفل بنجر السكر ألأفضل بصفه عامه. وان إدخال تلك المخلفات ألعرضيه في برامج تغذية الحيوان تسهم في الحد من التلوث البيئي وتساعد في تخفيض كميات الحبوب ألمستخدمه في تغذية الحيوان.