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# EFFECT OF SUGAR BEET PULP ON GROWING RABBIT PERFORMANCE

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## SUMMARY

This work was carried out to study the effect of grain diet (yellow corn and barley) replacement by sugar beet pulp (SBP) on performance of growing rabbits.

Twenty male and forty female growing rabbits about 6 weeks old and nearly similar initial body wight (900 ± 20 g) were randomly assigned to four experimental treatments (5 male + 10 female) in each. The rabbits in the first group, fed diet without SBP (control) and the other groups (2 – 4) fed diets contained SBP e.g. replacement of grains diet at levels of 25, 50 and 75 % respectively.

Results showed that feeding different levels of SBP (25, 50 and 75%) instead of grains (corn and barley) led to increase feed intake and water consumption of rabbits. Digestibility of dry matter (DM) and organic matter (OM) increased ($P<0.05$) with level of 25% replacement in comparison with the control one. On other hand, 75% replacement decreased DM and OM digestibility. However, introducing SBP did not affect on nutritive values as TDN and DCP and the daily body weight gain of total period (12 weeks). Inclusion of SBP decreased feed conversion and did not affect on mortality rate. The economical efficiency indicated that the best replacement level of grains in the growing rabbit diets by SBP was 25% of grains.

It could be concluded that, replacement of 25% grains diet by SBP in growing rabbit diet had no adverse effect on its performance and the economical efficiency.

*Keywords: sugar beet pulp, growing rabbit, feed intake, digestibility, performance*

## INTRODUCTION

Sugar beet pulp (SBP) mainly used as an energy source for rabbits, because of its high digestible fiber, pectins and sugars. It has a low starch concentration (De Blas and Carabano, 1996). Replacing starch with SBP leads to an increase of the fermentative activity in the hindgut where 40 % of the dry matter content of SBP is digested in the caecum (Merino and Carabano, 1992) . When the diet contain greater than 30 % SBP , a

correction factor should be envisaged to take an account the increase of energy losses associated to caecal digestion (De blas and Carabano, 1996). Many attempts were carried out to improve utilization of high levels of SBP like addition of inulin sugar in rabbit diets (Volek *et al*., 2004 ) or molasses for horses (Karlsson *et al*., 2002)

In the recent years, cultivation of sugar beet in Egypt increased because its water requirement is less than sugar cane. Therefore, the quantity of sugar beet pulp also increased now and in the future. Agriculture Economics, (2000) reported that the quantity of SBP in Egypt was 173326 ton, could supply 155993 ton of dry matter, 113150 ton of TDN and 6708 tons of DCP .

This work was carried out to study the effect of replacement of 25, 50 and 75 % of grains diet (yellow corn and barley) by SBP on performance of growing rabbits

## MATERIALS AND METHODS

This work was carried out in private farm in Menia El-Kameh, Sharkia Governorate and Department of Aminl Production, Faculty of Agriculture, Zagazig University, Egypt during 2008 – 2009.

Twenty male and forty female growing rabbits about 6 weeks old and nearly similar initial body weight (900 ± 20 g) were randomly assigned to four experiment treatments (5 male + 10 females) in each. The rabbits in the first group fed diet without SBP (control) and the other groups (2 – 4) fed diets contained SBP e.g. replacement of grains diet (25, 50 and 75 % respectively) the chemical composition of the experimental diets showed no siginificant differance (Table 1). This trial lasted 12 weeks. Animals were housed four/cage (60 x 50 x 40 cm) for 6 weeks, then two/ cage until experiment finished (12 weeks). Same managerial, hygienic and environmental conditions were allowed allover the experimental period. Daily fresh water was available all time. Animal fed the tested diets *ad libitum*. Water intake was recorded daily and the average daily intake was calculated weekly. Individual live body weight of animals were recorded weekly. The growth rate and feed conversion were calculated. In the last week, feed and faeces of 4 male rabbits of each treatment were determined and digestibility of all nutrients were determined. The mortality rate and economical efficiency were determined. Proximate chemical analysis of feed and faeces was carried out according to A.O.A.C (1990). Data was statistically analyzed using the General Linear Model Program of SAS (1996). Duncan's new multiple range test (Duncan, 1955) was used to determine the significant differences among treatments.

## RESULTS AND DISCUSSION

### *1-Effect of diets on feed intake:*

Feeding different levels of SBP (0.0, 25, 50 and 75%) instead of grains diet (corn and barley) led to in significant plight increase in feed intake of rabbits allover the experimental period (Table 2). These results agreed with those reported by Shehata and Bahgat (2006)

who reported that SBP increased feed intake of growing rabbits when 25% of basal diet was replaced by SBP. On the other hand, Blenguer *et al.* ( 2004 ) and Volek *et al.* (2004) found that SBP reduced feed intake of rabbits when compared with alfalfa hay and wheat bran. The differences between results may be due to type of basal diet and the levels of inclusion used (DE Blas and Carabano, 1996).

**Table (1): Formulation and chemical composition of the experimental diets (DM basis)**

| Items | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Ingredients (%): | | | | |
| Yellow corn | 20 | 15 | 10 | 5 |
| Barley | 20 | 15 | 10 | 5 |
| Soybean meal | 25 | 25 | 20 | 20 |
| Wheat bran | 10 | 15 | 25 | 30 |
| Wheat straw | 24.40 | 19.4 | 14.4 | 9.4 |
| Sugar beet pulp* | 0.0 | 10 | 20 | 30 |
| Vitamin and minerals premix | 0.3 | 0.3 | 0.3 | 0.3 |
| Dicalcium phosphate | 0.3 | 0.3 | 0.3 | 0.3 |
| Total | 100 | 100 | 100 | 100 |
| Chemical composition (%): | | | | |
| Dry matter | 89.63 | 89.64 | 89.64 | 89.98 |
| Organic matter | 90.98 | 89.77 | 89.12 | 90.18 |
| Crude protein | 18.45 | 17.40 | 17.85 | 17.34 |
| Crude fiber | 16.21 | 16.06 | 16.09 | 16.75 |
| Ether extract | 2.40 | 2.27 | 2.40 | 2.47 |
| Nitrogen free extract | 53.92 | 54.04 | 52.78 | 53.62 |
| Ash | 9.02 | 10.23 | 10.88 | 9.82 |

Sugar beet pulp* (SBP) contain 91.17 , 10.88 , 1.31 , 22.75 and 56.23 % of OM, CP , EE , CF and NFE , respectively .

**Table (2): Effect of inclusion different levels of sugar beet pulp on daily feed intake (g)**

| Weeks | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 71.43 | 84.29 | 78.57 | 81.54 |
| 2 | 71.43 | 84.29 | 78.57 | 81.54 |
| 3 | 71.43 | 71.43 | 62.86 | 61.54 |
| 4 | 60.00 | 72.86 | 67.14 | 66.15 |
| 5 | 57.14 | 65.76 | 65.17 | 69.23 |
| 6 | 68.57 | 68.57 | 58.57 | 61.54 |
| Average | 66.67 | 74.53 | 68.48 | 70.26 |
| 7 | 54.29 | 62.86 | 64.29 | 63.08 |
| 8 | 84.62 | 75.71 | 70.00 | 66.15 |
| 9 | 75.38 | 85.71 | 70.00 | 75.38 |
| 10 | 74.85 | 74.29 | 74.79 | 77.46 |
| 11 | 83.66 | 85.72 | 83.66 | 76.44 |
| 12 | 73.85 | 91.43 | 98.57 | 81.54 |
| Average | 74.44 | 79.29 | 76.89 | 73.34 |
| Total Average | 70.56 | 76.91 | 72.69 | 71.80 |

*2- Effect of diets on water consumption:*

Sugar beet pulp increased water consumption of rabbits in the total experimental period (Table 3). The increase in water consumption was expected correlated with increasing SBP levels. These results may be due to its higher content of NDF (50%) which increase its water holding capacity, small proportion of long particles and indigestible fiber, low rate of passage, and high caecal retention time in rabbits (De blas and Carbano, 1998).

*3- Effect of diets on digestion cofficient and nutritive values:*

Digestibility of dry matter (DM) and organic matter (OM) were increased ($P<0.05$) with 25% SBP replacement level in comparison with the control one. Inclusion of 50% SBP instead of grains diet had no effect on DM and OM digestibilities. On the other hand, 75% replacement caused significantly ($P<0.05$) decreased DM and insignificantly decreased OM digestibilities comparied with the control (Table 4). The digestibility of

**Table (3): Effect of inclusion different levels of sugar beet pulp on daily water consumption (ml)**

| Weeks | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 212 | 236 | 293 | 527 |
| 2 | 245 | 283 | 352 | 475 |
| 3 | 286 | 314 | 337 | 346 |
| 4 | 288 | 265 | 315 | 393 |
| 5 | 303 | 260 | 378 | 415 |
| 6 | 292 | 319 | 405 | 396 |
| Average | 271.00 | 279.50 | 331.63 | 425.3 |
| 7 | 267 | 371 | 392 | 396 |
| 8 | 250 | 409 | 413 | 409 |
| 9 | 268 | 385 | 407 | 415 |
| 10 | 322 | 338 | 408 | 418 |
| 11 | 366 | 346 | 442 | 409 |
| 12 | 354 | 341 | 400 | 403 |
| Average | 304.50 | 365.00 | 400.33 | 408.33 |
| Total Average | 287.75 | 322.25 | 365.98 | 416.82 |

ether extract (EE) significantly ($P < 0.05$) decreased as a result of SBP replacement. These results agreed with those obtained by Shehata and Bahgat, (2006) who reported that substitution of 25% of basal rabbit diet by SBP did not affect on DM, OM, CP, CF, EE, and NFE digestibilities. Also, Gomez *et al.* (2004) reported that protein digestibility was not affected by SBP addition. Moreover , Karlesson *et al.* (2002) reported that molasses SBP can replace oats in a hay basal diet of horses without impairing nutrient utilization and metabolic response in horses. On the other hand, inclusion of 15% SBP e.g. replacement of barley in rabbit diet decreased CP digestibility (Garcia *et al.*, 1993). Substitution of a basal pig diet by 33% SBP reduced the digestibilities of CP and fat (Graham *et al.*, 1986). Horses fed on molasses SBP showed lower apparent digestibility (Karlsson *et al.*, 2002).

Inclusion of SBP did not affected on nutritive values as TDN and DCP (Table 4). These results agreed with those reported by Shehata and Bahgat. (2006) who found that substitution of 25% of basal rabbit diet by SBP did not effect on TDN % value. Also , Gomez *et al.* (2004) reported that SBP increased gross energy digestibility in rabbits.

**Table (4): Effect of inclusion different levels of sugar beet pulp on digestibility and nutritive values.**

| Items | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Digestibility (%) | | | | |
| DM | 70.34±1.8 [b] | 75.88±0.77 [a] | 68.69±0.93 [b] | 62.63±0.38 [c] |
| OM | 72.94±1.58 [b] | 79.54±0.26 [a] | 73.34±0.32 [b] | 69.28±0.27 [b] |
| CP | 66.82±0.59 | 68.25±0.89 | 64.85±1.26 | 65.58 ±0.49 |
| CF | 34.78±1.21 [b] | 42.07±0.69 [a] | 41.19±2.59 [a] | 32.83±1.02 [b] |
| EE | 93.74±0.37 [a] | 90.18±0.67 [ab] | 84.98±0.58 [c] | 80.55±0.496 [c] |
| NFE | 77.67±1.42 | 75.19±0.68 | 73.74±0.35 | 73.95±0.42 |
| Nutritive values (%) | | | | |
| TDN | 64.90±1.43 | 63.88±0.09 | 63.72±0.17 | 62.02±0.38 |
| DCP | 12.33±0.14 | 11.88±0.15 | 11.58±0.12 | 11.37±0.08 |

a, b,c... Means in the same row bearing different letters differ significantly (P<0.05).

***4- Effect of diets on daily body weight gain :***

Inclusion of 25 and50% SBP instead of grains diet did not significantly affect body weight gain of rabbits allover experimental period (Table 5). Replacement 75% of grains diet by SBP led to significantly (P<0.05) decreasing in daily body weight gain than that of control one (Table 5). These results agreed with those 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. Similar results were reported by Volek *et al.* (2004) who reported that inclusion of 20 % SBP substitute of wheat bran with or without 4% inulin sugar in diets of early weaned rabbits did not affect the average body weight gain. Garcia *et al.* (1993) reported that inclusion of 15% SBP institution of barely grains did not effect on growth performance, empty body compositions, digested energy and crude protein efficiencies for rabbit growth. Higher levels of SBP (35 and 50%) led to decrease of growth rate. Inclusion of 10% SBP in feed of pigs did not affect on daily gain KO *et al.* (2004).

***5- Effect of diets on feed conversion ratio (feed / gain ) :***

Inclusion of SBP decreased feed conversion ratio (Table 6), which was positive correlated with increasing the SBP level. The values of feed conversion were 4.11, 4.36,

**Table (5) : Effect of inclusion different levels of SBP on daily body weight gain(g).**

| Weeks | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 18.81± 1.33 $^{a}$ | 22.02±1.61 $^{a}$ | 13.33±1.27 $^{b}$ | 19.71±0.79 $^{a}$ |
| 2 | 22.92 ± 1.56 | 26.31±1.29 | 23.57±1.19 | 24.57±1.47 |
| 3 | 17.56 ± 1.72 $^{b}$ | 22.86±1.39 $^{a}$ | 15.66±1.39 $^{b}$ | 15.93±1.57 $^{b}$ |
| 4 | 13.63 ± 0.85 $^{ab}$ | 14.82±1.39 $^{a}$ | 10.77±1.32 $^{b}$ | 10.07±1.26 $^{b}$ |
| 5 | 17.14 ± 1.17 | 18.57±1.29 | 16.19±1.33 | 16.00±0.87 |
| 6 | 15.62 ± 1.04 | 14.29±1.26 | 17.44±1.6 | 15.43±1.36 |
| Average | 17.61±0.42 $^{b}$ | 19.81±0.53 $^{a}$ | 16.16 ± 0.51 $^{b}$ | 16.95±0.36 $^{b}$ |
| 7 | 14.76±1.12 $^{a}$ | 13.20±0.89 $^{a}$ | 11.90±1.14 $^{ab}$ | 9.71±1.41 $^{b}$ |
| 8 | 15.24±1.49 | 14.98±0.62 | 16.43±1.09 | 13.43±0.96 |
| 9 | 23.93±1.87 $^{ab}$ | 25.24±1.78 $^{a}$ | 23.33±2.28 $^{ab}$ | 18.00±2.06 $^{b}$ |
| 10 | 20.48±1.29 $^{ab}$ | 16.91±1.28 $^{b}$ | 21.55±1.38 $^{a}$ | 21.00±2.06 $^{ab}$ |
| 11 | 15.81±0.79 | 15.28±1.21 | 15.11±1.18 | 17.86±1.35 |
| 12 | 13.81±1.19 $^{a}$ | 14.05±1.46 $^{a}$ | 9.52±1.24 $^{b}$ | 12.00±1.14 $^{b}$ |
| Average | 17.34±0.38 $^{a}$ | 16.61±0.48 $^{ab}$ | 16.81±0.49 $^{ab}$ | 15.33±0.89 $^{b}$ |
| Total average | 17.48±0.20 $^{a}$ | 18.21±0.26 $^{a}$ | 16.49±0.20 $^{b}$ | 16.14±0.30 $^{b}$ |

a, b,c... Means in the same row bearing different letters differ significantly (P<0.05).

4.53 and 4.61 for control, 25, 50 and 75% SBP replacement level, respectively. These results agreed with those obtained by (Shehata and Bahgat., 2006) who found that feeding rabbits on SBP with or without molasses decreased feed conversion, the obtained values were 3.99, 4.39 and 4.56 for groups fed the diets of control, SBP without or with molasses, respectively. Garcia *et al.* (1993) reported that substitution of 0.0 , 30, 70 and 100% barley grains (50% of diet ingredients) by SBP reduced feed efficiency (g body weight gain /g dry matter intake) which were 100, 96, 87.4 and 72 % respectively. The negative influence of dietary SBP inclusion on feed efficiency might be related to an increase of the energy losses associated to increase on the fermentative activity in the hindgut which 40% of the dry matter content of SBP is digested in the caecum (Marino and Carabano., 1992). Microbial fermentation might imply higher energy losses than enzymatic digestion in the small intestine, as it occurs in pigs (ZHU *et al.*, 1990). Furthermore, the end products of microbial digestion (volatile fatty acid) might be metabolized less efficiently than the glucose arising from starch digestion in rabbits (Low, 1985). On the other hand, inclusion

of SBP increased feed efficiency with respect to the rabbit diets with oat hulls (Gomez *et al.*, 2004).

**Table (6): Effect of inclusion different levels of sugar beet pulp on Feed conversion ratio (feed / gain).**

| Weeks | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 3.80 | 3.83 | 5.89 | 4.14 |
| 2 | 3.12 | 4.20 | 3.33 | 3.32 |
| 3 | 4.06 | 3.12 | 4.61 | 3.86 |
| 4 | 4.40 | 4.92 | 6.23 | 6.57 |
| 5 | 3.33 | 3.54 | 4.30 | 4.33 |
| 6 | 4.38 | 4.79 | 3.36 | 3.99 |
| Average | 3.78 | 3.76 | 4.24 | 4.15 |
| 7 | 3.68 | 4.76 | 5.40 | 6.49 |
| 8 | 5.55 | 5.05 | 4.26 | 4.93 |
| 9 | 3.15 | 3.39 | 3.00 | 4.19 |
| 10 | 3.65 | 4.39 | 3.47 | 3.69 |
| 11 | 5.29 | 5.61 | 5.54 | 4.28 |
| 12 | 5.35 | 6..51 | 7.87 | 6.80 |
| Average | 4.44 | 4.95 | 4.81 | 5.06 |
| Total average | 4.15 | 4.43 | 4.91 | 4.72 |

*6- Effect of diets on mortality rate (%) :*

The mortality rate of rabbits was decreased by 25 and 50% SBP which was 6.67% in comparison with 13.33% for control and 75% SBP. These results agreed with those reported Gomez *et al.* (2004) who found that SBP reduced the mortality rate in rabbits in comparison with oat hulls. Mortality rate was 25, 20 and 25 % for rabbits fed control, SBP and SBP with molasses diet, respectively (Shehata and Bahgat, 2006). These results similar to that obtained by Volek *et al.*, (2004) who reported that the mortality rate did not significantly differ between rabbits fed diet contained SBP and those fed control diet (contained wheat bran). Also, Garcia *et al* (1993) reported no significant effect on mortality of rabbits when SBP added at levels of 15, 35 and 50% instead of barley grains.

*7- Economical efficiency:*

The total average values of the tested parameters and the Economical efficiency (Table 7, 8) indicated that the best substitution level of SBP was 25% of grains diet.

It could be concluded that, replacement up to 50% of grains diet by SBP in growing rabbits diet did not had any adverse effect on its performance and the economical efficiency.

**Table (7): The total average values of the tested parameters**

| Items | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| dailyfeed intake | 70.56 | 76.91 | 72.69 | 71.80 |
| water consumption | 282.75 | 322.28 | 365.98 | 416.82 |
| weight gain | 17.48±0.20[a] | 18.21±0.26[a] | 16.49±0.20[b] | 16.14±0.30[b] |
| feed conversion | 4.15 | 4.43 | 4.41 | 4.72 |

**Table (8): Effect of inclusion different levels of sugar beet pulp on economical Efficiency of the experimental diets.**

| Items | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Total gain (g) | 1468.32 | 1529.64 | 1365.16 | 1355.76 |
| Total feed intake/gain (kg) | 5.93 | 6.45 | 6.11 | 6.03 |
| Total feed cost (LE)* | 11.56 | 12.26 | 10.88 | 10.43 |
| Selling price (LE)** | 22.02 | 22.94 | 20.48 | 20.34 |
| Net revenue (LE)*** | 10.46 | 10.68 | 9.60 | 9.91 |
| Relative revenue (%) | 100 | 102.10 | 91.78 | 94.74 |

* Price of 1 kg diet was 1.95 , 1.90 , 1.78 , and 1.73 LE for diets 1, 2, 3 and 4, respectively (cost of Kg SBP was 1.20 LE) .

** Selling price of 1 Kg = 15 LE .

*** Net revenue = selling price – total feed cost.

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# تأثير تقل بنجر السكر على أداء الأرانب النامية

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أجريت هذه الدراسة لدراسة تأثير إحلال حبوب العليقة ( الذرة الصفراء و الشعير) بتقل بنجر السكر على أداء الأرانب النامية. حيث تم استخدام ٢٠ذكر، ٤٠ أنثى أرنب نامي عمر ٦ أسابيع تقريبا ومتشابهة فى الوزن البداني(٩٠٠±٢٠ مم) وزعت عشوائيا على ٤معاملات تجريبية(٥ ذكر+١٠ أنثى) فى كل واحدة. غذيت الأرانب فى المجموعة الأولى على عليقة بدون تقل بنجر سكر( كنترول) بينما تغذت المجموعات الأخرى(٢-٤) علائق بها تقل بنجر السكر مكان حبوب العليقة بنسبة ٢٥ ،٥٠ ،٧٥% على التوالي.

أظهرت النتائج أن التغذية على مستويات مختلفة من تقل بنجر السكر (٢٥، ٥٠، ٧٥%) بدلا من الحبوب (الذرة، الشعير) أدى إلى زيادة الغذاء المأكول والماء المشروب للأرانب. زاد هضم المادة الجافة والمادة العضوية معنويا (على مستوى ٥%) عند مستوى الإحلال ٢٥% بالمقارنة بالكنترول، على الجانب الأخر أدى المستوى ٧٥ % أحلال إلى انخفاض هضم المادة الجافة والعضوية. وفى كل المعاملات فان استخدام تقل بنجر السكر لم يؤثر على القيم الغذائية كمجموع المركبات الغذائية المهضومة (TDN) والبروتين الخام المهضوم (DCP) ومعدل الزيادة اليومية فى وزن الجسم للفترة كلها (١٢ أسبوع).انخفضت كفاءة التحويل الغذائي بإضافة تقل بنجر السكر ولم يتأثر معدل النفوق. أشارت الكفاءة الاقتصادية إلى أن أفضل نسبة إحلال للحبوب بتقل بنجر السكر هى ٢٥% من الحبوب الكلية.

يستنتج من هذه الدراسة أن إحلال ٢٥% من حبوب العليقة بتقل بنجر السكر لم يكن له تأثير عكسي أداء الأرانب النامية وكذلك الكفاءة الاقتصادية.