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EFFECTS OF DIETARY STARCH LEVEL ON PERFORMANCE OF GROWING NEW ZEALAND WHITE RABBITS

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***Abstract**: Ninety weanling New Zealand White (NZW) rabbits aging about 5 wks with an average initial weight 656±18.4 g, were used to study the influence of different levels of starch on growth performance, digestion, caecotrophy, carcass and economic efficiency. Three diets [low (L), moderate (M) or high (H)] were formulated to provide 12.4, 18.3 or 24.2% starch, respectively. Live body weight and feed intake were weekly recorded individually up to 13 weeks of age.*

The results showed that daily gain, growth rate and performance index were significantly increased by 3.9, 7.2 and 25.7 point, while feed intake decreased (P<0.01) from 115 to 98 g/d as the level of starch increased from 12 to 24%. Feed conversion rate was significantly improved by increasing the starch level (3.02 vs. 4.04; p<0.001). Mortality rate increased from 13.3% in the L diet to 20% in the H diet. Digestibility coefficients of DM, CP, EE and GE were increased (P<0.001) by 5.1, 5.9, 5.8 and 4.9 points, respectively, but CF digestibility was decreased (P<0.001) by 6.2 points as level of starch increased from 12 to 24%. The H diet caused a significant decrease in DM intake (94 vs. 106 g DM/ d; P<0.001), while the L diet caused a significant increase in soft faeces excretion (24.6 vs. 16.7 g DM/d). Dressing % was increased (P<0.01) by 4.6 points due to a decrease (P<0.001) by 4.1 points in gastrointestinal tract (GIT) in the H diet as compared with L diet. Plasma total protein, glucose, cholesterol and total lipids were significantly increased with increasing dietary starch. The highest value of economic efficiency (%) was obtained in the H diet, followed by M diet, while the poorest value was found in the L diet.

It could be concluded that the high starch diet (24%) recorded the best growth performance, nutrient utilization and economic efficiency, in spite of high level of mortality.

INTRODUCTION

The carbohydrate fraction (starch and fiber) is very important in the young rabbit diets, mainly due to its effects on digestive transit and on substrate available for microbial activity in the hindgut. Both factors affect stability of the microbial ecosystem and gut health **(Gidenne et al., 2005)**. Starch is the main source of energy in rabbit nutrition. Also, it is used in diets to provide the high energy requirement of animals in the intensive system of rabbit production. Young rabbits begin to eat solid diet at about 20 days of age **(Scapinello et al., 1999). Maertens, (1992)** reported that a low dietary starch level is recommended around the weaning, as well as in the post-weaning period. Digestive problems linked to incomplete development of enzymatic system in young rabbits and their inability to digest starch completely were reported by **Debray et al., (2003)**. Moreover, dietary starch is incompletely hydrolyzed in the small intestine of weanling rabbits, reaching the caecum, which leads to increase mortality during post-weaning period **(Blas and Gidenne, 1998)**.

Barley is the cereal most commonly used in rabbit diets and is preferred than yellow corn because of its lower frequency of mycotoxin contamination and higher starch digestibility **(Xiccato et al., 2002)**. In the last years several commercial diets contained higher proportion of corn because it is more cheaper than barley. This means that higher amount of starch reached the caecum and provoked enteritis.

Therefore, the aim of the present study was to evaluate the effects of different levels of starch on growth performance, digestibility, caecotrophy, some blood parameters, carcass traits and economic efficiency.

MATERIAL AND METHODS

The present study was carried out in the Rabbitary Farm of Poultry Production Department, Faculty of Agriculture, Kafr El-Sheikh University, during winter 2005.

Three experimental diets were formulated to meet or exceed the nutrient requirement for growing rabbits according to **De Blas and Mateos, (1998)**. The three diets [low (L), moderate (M) or high (H)] were formulated to contain 12.4, 18.3 and 24.2% starch, respectively. All diets were nearly iso-nitrogenous energy and contained similar levels of micro-elements. Table 1 shows the ingredients and chemical composition of these experimental diets.

Ninety unsexed weanling NZW rabbits of 5 weeks old were individually housed and assigned at random to 3 groups of 30 rabbits each. Feed and water were offered *ad libitum* throughout the experimental period from 5 to 13 weeks of age. Live body weight, feed intake and number of dead rabbits were recorded. Daily weight gain, feed conversion rate and mortality rate were calculated. Performance index was calculated according to **North (1981)** and economic efficiency was calculated according to **Raya et al., (1991)**.

Digestibility trial was carried out, at the end of the growth experiment using 6 males per diet to determine the nutrient digestibility coefficients and nutritive values of experimental diets. Rabbits were housed individually in metabolic cages, which allowed separation of faeces and urine. Faeces were collected individually during 5 consecutive days according to the European reference method for rabbits digestion trials **(Perez et al., 1995)**.

Simultaneously, caecotrophy trial was carried out using 6 males per diet to determine the excretion and chemical composition of soft faeces. Plastic collars were used to prevent caecotrophy. Soft faeces were collected according the methods of **Carabaño et al., (1989)**.

Chemical analysis was carried out for diets, soft and hard faeces, caecal content and meat samples according to methods of **AOAC (1995)** for ash, DM, CP, CF and EE. Gross energy was determined in an adiabatic bomb calorimeter. Digestibility coefficients and nutritive values of nutrients in terms of total digestible nutrient (TDN), digestible crude protein (DCP) and digestible energy (DE) were calculated as described by **Perez *et al.*, (1995)**. Relative contribution of soft faeces to dry matter and crude protein intake were calculated according to **Fraga *et al.*, (1991)** as follows:

Relative contribution of soft faeces to DM intake

= (Soft faeces excretion, g DM/day) / (feed intake, g DM/day + soft faeces excretion, g DM/day) X 100

Relative contribution of soft faeces to CP intake

= (CP excreted in soft faeces, g /day) / (CP ingested in feed, g /day + CP excreted in soft faeces, g /day) X 100

Caecal turnover rate was calculated according to **Garcia et al., (1995)** as follows:

[Soft faeces production (g DM/ d)/ caecal content (g DM)] X 100

At 13 weeks of age, 6 rabbits from each treatment were randomly taken, fasted for 12 hours, weighed and slaughtered to estimate some of carcass traits according to **Blasco et al., (1993)**. Carcass parts were estimated as a percent of live body weight. Caecal contents were dried at 60 ^{o}C for 2 days and ground for chemical analysis. Blood samples were taken from 6 rabbits of each treatment to determine some blood constituents.

Data of the growth performance, digestibility, caecotrophy, blood and carcass traits were statistically analyzed using the General linear Model Program of **SAS (1990)**. Duncan's multiple range test was performed **(Duncan, 1955)** to detect significant differences among means.

RESULTS AND DISCUSSION

Growth Performance:

The level of starch had a significant effect on the growth performance of growing NZW rabbits from 5 to 13 weeks of age as shown in Table 2. The daily weight gain, growth rate and performance index were significantly higher by 3.9, 7.2 and 25.7 points as the level of starch increased from 12.4 to 24.2% in the diets. This increase in the growth performance of high starch diet may be due to stimulating the weight gain **(Xiccato et al., 2002)**. These results are in agreement with those obtained by **Cossu et al., (2004)** who reported that high corn diet (35%) had a higher ($P<0.05$) final body weight and, weight gain than that in low corn diet (15%) during fattening period.

On the contrary, feed intake was decreased ($P<0.01$) from 115 to 98 g/ d as the starch level increased from 12.4 to 24.2% in the diets. Feed conversion rate (FCR) was significantly improved by increasing the dietary starch and showed the best value of FCR in the H diet (3.02) followed by M diet (3.43), while the worst value was found in the L diet (4.04). The decrease in feed intake with increasing starch levels may be due not only to high DE content, but also to a reduction of fiber level, which leads to an increase of retention time in the whole digestive tract **(Gidenne et al., 2004a)**.

It is important to note that mortality rate records with high and low starch diets were three and two times, respectively, more than moderate starch diet (Table 2). This increase in mortality may be due to severe diarrhea as a result to lower digestibility of corn starch than barley starch **(Xiccato et al., 2002)**, which resulted in an excessive starch flow entering the caecum and increasing the digestive disorders (diarrhea). These results

are in agreement with those of **Perez et al., (2000)**, who found that the mortality of high starch diet was significantly higher than that in low starch diet. Also, **Gidenne et al., (2005)** observed that mortality with rabbits fed diet containing wheat was three points lower than those fed diet with maize.

Digestibility and Nutritive Values:

Starch and fiber contents accounted for the main differences in chemical composition among three diets as a result of the substitution of berseem hay with cereals (Table 1). Digestibility coefficients of DM, CP, EE and GE were significantly increased by 5.1, 5.9, 5.8 and 4.9 points, respectively, but the CF digestibility was decreased ($P<0.001$) by 6.2 points as the level of starch increased from 12.4 to 24.2% in the diets (Table 3). This increase in the digestion of nutrients could be attributed to decrease CF level in the H diet, which led to increase the caecal microbial activity by reducing the rate of passage and increasing the retention time **(Gidenne et al., 2004a)**. The decrease in CF digestibility may be due to high quantities of starch entering the caecum, which could be unfavorable to the fibrolytic flora **(Perez et al., 2000)**.

Digestion of energy and CP were significantly increased in rabbits fed H diet as a result to their high EE and CP digestion and decreased the CF level in this diet. These results are in agreement with those of **Xiccato et al., (2002)**, who found that DM, OM, CP, EE and GE digestibility were higher ($P<0.001$) in the high starch diets (20.6%) than those in moderate starch diet (17%).

Caecotrophy Trials:

Table 4 shows that the H diet caused a significant decrease in the DM intake (94 *vs.* 106 g/d), while L diet caused a significant increase in soft faeces (SF) excretion (24.6 *vs.* 16.7 g DM/d) and also in caecal contents (33.5 *vs.* 25.6 g DM) as the level of starch increased from 12 to 24% in the diets. This increase in SF excretion and caecal content may be due to increase the dietary fiber level, which leads to an improvement of fibrolytic bacterial activity **(Gidenne et al., 1998)**. However, the rich starch diet resulted in an excessive starch flow entering the caecum, which could be unfavorable to fibrolytic flora **(Perez et al., 2000)**.

The DM% and CP% of the SF and caecal content were decreased ($P<0.001$) by increasing the starch level in the diets. This decrease may be due to the change in the caecal microbial activity of rabbits, which caused a reduction of the bacterial biomass **(Jehl and Gidenne, 1996)**. The starch level had a significant effect ($P<0.001$) on DM and CP contribution of the

SF to total DM and CP intake, due to differences in the DM intake, SF excreted and CP% of the SF among the experimental diets.

The highest (P<0.001) value of caecal turnover rate (CTR) was recorded by L diet (73.4%), followed by M diet (68.5%). While, the lowest value was obtained by H diet (65.2%). This increase in the CTR means that caecal content of rabbits fed L diet (rich fiber level) tended to remain shorter time in the caecum. This could be explained by the increased SF production in this diet. This is in accordance with **Gidenne et al., (2004b)**, who found that the decrease CF level leads to an increase of retention time and a reduction of both SF production and CTR by decreasing the bacterial fibrolytic activity.

Carcass Traits and Some Blood Parameters:

The results presented in the Table 5, showed that dressing % was increased (P<0.01) by 4.6 points due to a decrease (P<0.001) by 4.1 points in the gastrointestinal tract (GIT) percentage in the rabbits fed H diet as compared with those fed L diet. This is in accordance with **Xiccato et al., (2002)**, who observed that dressing percentage was higher (P<0.05) in rabbits fed high starch diet, due to lower gut incidence. Also, the same trend was obtained in the abdominal fat, which was significantly increased with increasing the dietary starch level. This was reported by **Abdel-Azeem et al., (2000)**, who found that rabbits fed high starch diets (20 or 28%) were significantly higher in the total non-carcass fat % than those fed high fiber diets (14 or 17%). Caecal content and pH were lower (P<0.01 & P<0.05) by 2.13 and 0.24 points, respectively, in rabbits fed H diet than in those fed L diet. This reduction may be due to lower fiber level in this diet, which leads to decrease in both the caecal weight and volatile fatty acids concentration **(Gutiérrez et al., 2002; Gidenne et al., 2004a and Tao and Li, 2006)**.

The meat content of DM, EE and ash% were significantly decreased as the level of starch increased in diets, while CP% was significantly increased. Similarly **Cossu et al., (2004)** found that the meat content of heavier rabbits, fed diets with high corn, had more energy content, but were slightly fatter with a higher proportion of saturated fatty acid.

The blood parameters of rabbits fed the experimental diets are shown in Table 5. Plasma total protein and glucose were significantly increased in the rabbits fed H diet. This increase may be due to higher activity of proteolitic and amylolitic microflora in the caecum, which led to better CP and starch digestibility **(Padhila et al., 1995 and Xiccato et al., 2002)**. The same trend was found in total lipids and cholesterol, which were

significantly increased with increasing the dietary starch level. On the contrary, **Abdel- Azeem et al., (2000)** reported that dietary starch level did not reveal any significant differences in total protein and glucose, while total lipids was significantly increased as the starch level increased.

Economic Efficiency:

The results of performance (weight gain and feed intake) were subjected to economic study (Table 6). Mortality rate was taken into consideration to calculate the total meat yield. The results showed lower total feed cost in the rabbits fed H diet. This reduction was mainly due to lower average feed intake and also to lower number of survival rabbits. Although, total meat yield and net revenue were higher in the rabbits fed M diet, due to higher number of survival rabbits. The highest value of economic efficiency (%) was obtained in rabbits fed H diet, followed by those received M diet, while the poorest value was found in the rabbits fed L diet. These results are in agreement with those of **Abdel-Azeem et al., (2000),** who found an improvement in the economic efficiency (%) for rabbits fed diet with 28% starch as compared with other diets containing 14 or 20% starch (258.3 *vs.* 239.7 or 208.5%, respectively).

It could be concluded that the nutritive value of diets for growing rabbits can be increased by the inclusion of 24.2% starch, as barley and corn, providing good growth performance and improving feed efficiency and economic efficiency, in spite of high level of mortality.

Table 1: Formulation and chemical composition of experimental diets.

Ingredient	Dietary starch level		
	L	M	H
Berseem hay	45.2	38.2	30.3
Yellow corn	12.5	18.0	24.0
Barley	3.5	10.0	18.0
Soybean meal 44%	19.5	21.0	24.5
Wheat bran	17	10.1	-
Bone meal	1.5	1.9	2.4
Salt	0.3	0.3	0.3
Premix (1)	0.3	0.3	0.3
DL-methionine	0.2	0.2	0.2
Total	100	100	100
Chemical analysis (% as DM):			
Ash	9.1	9.6	10.7
Crude protein (CP)	17.6	17.5	17.7
Crude fiber (CF)	14.5	12.6	10.5
Digestible energy (Kcal/kg) DE	2321	2438	2629
Ether extract (EE)	2.59	2.49	2.36
N-Free extract (NFE)	56.21	57.81	58.74
Starch (2)	12.4	18.3	24.2
Calcium (2)	1.09	1.09	1.10
Phosphorus (2)	0.65	0.65	0.65
Lysine (2)	0.92	0.92	0.96
Methionine (2)	0.47	0.47	0.48

(1) Each 3 Kg vitamin and mineral mixture provides : Vitamin A 12000000 IU, Vit.D3 2200000 IU, Vit. E 10000 mg, Vit.K,2000 mg, Vit.$B_1$1000mg, Vit.$B_2$4000mg, Vit.$B_6$1500mg, Vit.B_{12}10mg, Pantothenic Acid 10000mg, Niacin 20000mg, Biotin 50 mg, Folic Acid 1000mg, Choline chloride 500gm, Selenium 100mg, Manganese 55000mg, Zinc 50000mg, Iodine 1000 mg and carrier CaCo3, to 3000 gm.

(2) Calculated according to De Blas and Mateos (1998)

Table 2: Effect of dietary starch level on growth performance of growing NZW rabbits from 5 to 13 weeks of age.

Item	Experimental diets			SEM	Sig.
	L	M	H		
Initial body weight (g)	661	658	649	18.4	NS
Final body weight (g)	2258^{c}	2372^{b}	2464^{a}	26.6	**
Daily weight gain (g)	28.5^{c}	30.6^{b}	32.4^{a}	0.36	***
Feed intake (g/ d)	115^{a}	105^{b}	98^{c}	1.16	**
Feed /Gain (g/ g)	4.04^{a}	3.43^{b}	3.02^{c}	0.051	***
Growth rate (%)	109.4^{c}	113.1^{b}	116.6^{a}	1.75	**
Performance index (%)	55.9^{c}	69.2^{b}	81.6^{a}	1.23	***
Number of dead rabbits	4	2	6	-	-
Mortality rate (%)	13.30	6.65	20.00	-	-

^{a,b,c} Means in the same raw with different superscripts are significantly different ($p<0.05$).

L: low starch level, M: moderate starch level, H: high starch level, Sig.= Significant, NS= non significant, ** = P<0.01, *** = P<0.001, SEM= standard error of mean.

Table 3: Effect of dietary starch level on apparent digestibility coefficients and nutritive values of growing NZW rabbits.

Item	Experimental diets			SEM	Sig.
	L	M	H		
Digestibility coefficients (%):					
DM	65.3[c]	67.6[b]	70.4[a]	0.54	***
OM	64.2[c]	65.7[b]	69.9[a]	0.62	***
CP	73.7[c]	76.8[b]	79.6[a]	0.48	***
CF	27.9[a]	25.4[b]	21.7[c]	1.22	**
EE	78.5[c]	80.9[b]	84.3[a]	0.82	***
GE	63.9[c]	65.4[b]	68.8[a]	0.77	***
Nutritive values (%):					
TDN	58.9[c]	59.6[b]	60.3[a]	0.65	*
Digestible crude protein (DCP)	12.97[c]	13.44[b]	14.09[a]	0.05	***
Digestible energy (kcal /g DM)	2.321[c]	2.438[b]	2.629[a]	0.04	***

[a,b,c] Means in the same raw with different superscripts are significantly different ($p<0.05$).
L: low starch level, M: moderate starch level, H: high starch level, Sig.= Significant,
* = P<0.05, ** = P<0.01, *** = P<0.001, SEM= standard error of mean.

Table 4: Effect of dietary starch level on soft faeces excretion and caecal content of growing NZW rabbits.

Item	Experimental diets			SEM	Sig.
	L	M	H		
Dry matter intake (g /d)	106[a]	98[b]	94[c]	2.19	***
Soft faeces excretion (g DM /d)	24.6[a]	20.7[b]	16.7[c]	0.58	***
Chemical composition of soft faeces:					
DM%	33.2[a]	29.5[b]	27.7[c]	0.43	***
CP% DM	32.6[a]	30.2[b]	25.8[c]	0.69	***
Relative contribution of soft faeces to:					
Dry matter intake	18.8[a]	17.4[b]	15.1[c]	0.28	***
Crude protein intake	28.4[a]	25.4[b]	19.9[c]	0.44	***
Caecal content (g DM)	33.5[a]	30.2[b]	25.6[c]	0.32	***
Chemical composition of caecal content:					
DM%	36.4[a]	32.9[b]	30.5[c]	0.49	***
CP% DM	30.8[a]	28.3[b]	24.6[c]	0.53	***
Caecal turnover rate (%)	73.4[a]	68.5[b]	65.2[c]	1.28	***

[a,b,c] Means in the same raw with different superscripts are significantly different ($p<0.05$).
L: low starch level, M: moderate starch level, H: high starch level, Sig.= Significant, NS= non significant, *** = P<0.001, SEM= standard error of mean.

Table 5: Effect of dietary starch level on carcass traits and some blood parameters of growing NZW rabbits.

Item	Experimental diets			SEM	Sig.
	L	M	H		
Dressing (%)	56.6[c]	59.4[b]	61.2[a]	0.92	**
GIT (%) BW	25.6[a]	23.4[b]	21.5[c]	0.67	***
Abdominal fat (%) BW	2.62[c]	3.12[b]	3.78[a]	0.11	***
Caecal content (%) BW	6.06[a]	5.83[b]	5.42[c]	0.07	***
PH	6.33[a]	6.21[b]	6.09[c]	0.04	***
Meat composition (%):					
DM	26.9[a]	24.5[b]	23.3[c]	0.46	**
CP [(1)]	67.3[c]	69.2[b]	70.9[a]	0.67	**
EE [(1)]	23.6[a]	22.2[b]	19.7[c]	0.36	***
Ash [(1)]	3.69[a]	3.12[b]	2.23[c]	0.55	*
Blood parameters:					
Total protein (g /dI)	5.09[c]	5.62[b]	6.14[a]	0.056	***
Glucose (mg /dI)	75.3[c]	85.9[b]	92.5[a]	3.92	**
Total lipids (g /dI)	4.63[c]	5.24[b]	6.86[a]	0.12	***
Cholesterol (mg /dI)	77.6[c]	86.4[b]	93.2[a]	6.52	*

[a,b,c] Means in the same raw with different superscripts are significantly different ($p<0.05$).

L: low starch level, M: moderate starch level, H: high starch level, Sig.= Significant, NS= non significant, * = P<0.05, ** = P<0.01, *** = P<0.001, SEM= standard error of mean.

(1) On dry matter.

Table 6: Effect of dietary starch level on economical efficiency of growing NZW rabbits at 13 weeks of age.

Item	Experimental diets		
	L	M	H
Number of survival rabbits	26	28	24
Average feed intake (kg /rabbit)	6.440	5.880	5.488
Total feed intake (kg)	167.4	164.6	131.7
Price /kg diet (L.E.)	1.02	1.14	1.21
Total feed cost (L.E.)	170.7	187.6	159.4
Average weight gain (kg /rabbit)	1.596	1.714	1.814
Total meat yield (kg)	41.5	48.0	43.5
Selling price (L.E.)*	498	576	522
Net revenue (L.E.)**	327.3	388.4	362.6
Economic efficiency (%)***	191.7	207.0	227.5

* Selling price = 1 kg L.B.W. was 12 L.E. X total meat yield.

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

*** Economic efficiency (%) = (Net revenue / total feed cost) X 100

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الملخص العربى
تأثير مستوى النشا فى عليقة الأرانب النيوزيلندى الأبيض النامية على الأداء الإنتاجي

خيرى على عمبر

قسم إنتاج الدواجن- كلية الزراعة- جامعة كفر الشيخ

أجريت هذه الدراسة على 90 أرنب نيوزيلندى أبيض مفطوم عمر 5 أسابيع بمتوسط وزن 656±18.4 جرام ، لدراسة تأثير المستويات المختلفة من النشا على الأداء الإنتاجي والهضم و عملية الاجترار الكاذب وصفات الذبيحة والكفاءة الاقتصادية ، وتم عمل ثلاث علائق منخفضة ومتوسطة ومرتفعة فى النشا تحتوى 12%، 18%، 24%نشا على الترتيب ، وتم تسجيل وزن الجسم الحى والعلف المستهلك أسبوعيا وبشكل فردى حتى عمر 13 أسبوع.

أوضحت النتائج زيادة كلا من الزيادة اليومية فى وزن الجسم ومعدل النمو ودليل الأداء معنويا بمقدار 3.9 ، 7.2 ، 25.7 نقطة على التوالى ، بينما انخفض العلف المستهلك معنويا من 115 جرام /اليوم الى 98 جرام /اليوم بزيادة مستوى النشا فى العليقة من 12% إلى 24% ، كما أظهرت النتائج تحسن معنوى فى معدل الكفاءة الغذائية بزيادة مستوى النشا فى العليقة (3.02 مقابل 4.04) ، كما لوحظ ارتفع نسبة النفوق من 13.3% للعليقة المنخفضة فى النشا إلى 20% للعليقة المرتفعة فى النشا وارتفع معامل هضم المادة الجافة والبروتين الخام والدهن والطاقة الكلية بمعدل 5.1 ، 5.9 ، 5.8 ، 4.9 نقطة على التوالى بينما انخفض معامل هضم الألياف الخام بمعدل 6.2 نقطة بزيادة مستوى النشا فى العليقة من 12% الى 24% ، العليقة المرتفعة فى النشا تسببت فى زيادة المادة الجافة المستهلكة (94 مقابل 106 جرام مادة جافة/يوم) بينما العليقة المنخفضة فى النشا أدت إلى زيادة معنوية فى إنتاج الروث الطرى (24.6 مقابل 16.7 جرام مادة جافة/يوم) ، ارتفعت نسبة التصافى معنويا بمقدار 4.6 نقطة وهذا ربما يرجع لانخفاض القناة الهضمية بمقدار 4.1 نقطة فى العليقة المرتفعة فى محتواها من النشا عند مقارنتها بالمنخفضة فى النشا ، كما لوحظ ارتفاع محتوى بلازما الدم من البروتين الكلى والجلوكوز والكوليستيرول واللبيدات الكلية بزيادة مستوى النشا فى العليقة ، حققت العليقة المرتفعة فى النشا أعلى قيمة للكفاءة الاقتصادية النسبية يليها العليقة المتوسطة فى النشا بينما المنخفضة فى النشا كانت أقلهم.

مما سبق عرضه يتضح أن العليقة المرتفعة فى النشا (24%) حققت أفضل كفاءة للأداء الإنتاجي واستفادة من العناصر الغذائية وكذلك أفضل كفاءة اقتصادية على الرغم من ارتفاع نسبة النفوق.