

## **SOME NUTRITIONAL AND REPRODUCTIVE ASPECTS IN RABBIT FED ON DIETS PARTIALLY SUBSTITUTED WITH POTATO PROCESSING WASTE**

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### **ABSTRACT**

This study aimed to evaluate the effect of partial substitution of commercial rabbit pelleted concentrate diet with potato processing waste (PPW) on some productive and reproductive parameters in rabbits.

The experiment was carried out on 18 growing female New Zealand white rabbits divided into three equal groups. Rabbits were *ad.libitum* fed on commercial diet (Control group) or diets contained 20% (Group 2) and 40% (Group3) PPW. Daily feed intake; body gain and feed conversion rate were weekly estimated in growing rabbits from 12<sup>th</sup> to 20<sup>th</sup> weeks. Rabbits were observed for the occurrence of puberty, allowed to be copulated and conception rates and kidding data were recorded. Samples were taken from PPW as well as from formulated diets for nutritive evaluation. Blood samples were collected once weekly from pubertal does and assayed for progesterone and some blood metabolites.

Results indicated that PPW contained relatively high contents of nitrogen free extract, potassium and amino acids; aspartic, glutamic and proline. Substitution of commercial diets with PPW increased the energy/protein ratio (14.96, 16.90 and 19.62 in groups 1,2 and 3 respectively) in the daily feed intake with no significant changes in feed conversion rate among the three groups. Puberty occurred earlier and at lighter weight in experimental groups as compared with the control group. Conception rates were 40.00, 33.33 and 50.00% at the first mating in groups 1,2 and 3 respectively. The first litter size was 3.66, 3.00 and 6.60. Kids daily gain averaged 7.67, 8.71 and 11.26 g in-groups 1,2 and 3 respectively. The incidence of does copulated from kidding to day 7 was 100.00, 00.00 and 100.00%, however, pregnancy rate was 00.00, 00.00 and 33.33% in groups 1, 2 and 3 respectively. Blood analysis in pubertal does revealed non-significant changes in proteins, lipids or glucose values due to inclusion of PPW in the diet.

### **INTRODUCTION**

Nowadays, governments encourage small private projects. Many peoples started to invest their money in rabbit's production. As this source of meat and good production rates animal gradually gaining the acceptance of consumers as an important.

The future production of rabbits will largely depend on the availability of non-expensive sources of energy and protein, which are not consumed directly by human. As other herbivora, rabbits eat both concentrates and roughages. It is expensive and unsuitable to feed rabbits on full concentrate rations for meat production (Kamar *et al.*, 1995), therefore, more attention should be paid to formulate economic diets using agriculture byproducts which is much less questioned by consumer. In rabbits, there was a close relationship between voluntary dry matter intake, digestible and metabolizable energy contents of the ration (Dehalle, 1981).

Many food industries such as potato processing for human consumption are greatly increased in the present time. Approximately 20-35% of the total crop is discarded as waste during processing (Ahmed *et al.*, 1994). These unusable byproducts may cause environmental hazards if they were not probably dealt with. The present study aimed to investigate the effects of partial substitution of rabbit diet with potato processing waste on some productive and reproductive parameters.

## **MATERIALS AND METHODS**

The present experiment was carried out at the animal house of the National Research Center.

### **Experimental Rabbits:**

A total number of 18 immature New Zealand White (NZW) female rabbits (Does) were purchased from a commercial local farm. Live body weight of rabbits ranged from 2.00 to 2.50 kg and their age varied between 12 to 14 weeks. Rabbits were reared in automatic metal battery system under the prevailing Egyptian natural environmental conditions. Four proven mature bucks were used for mating. Animals were vaccinated against hemorrhagic septicemia and monthly injected with Ivomec for combating of parasitic diseases.

### **Potato processing Waste (PPW):**

This material was obtained during the processing of potato for human consumption (Chebsy factory) and was taken after peeling and slicing of potato and soaking it in cold and hot water for washing and blanching respectively. The PPW were sun-dried until the moisture content reached about 10%.

### **Experimental design:**

According to weight and age, rabbits were randomly divided into 3 comparable groups. The three experimental groups were fed *ad libitum* on 3 types of diets:

- **Group I:** Fed on pelleted commercial concentrate diet and served as a control group.
- **Group II:** Fed on pelleted commercial concentrates diet from which 20% was replaced by PPW.
- **Group III:** Fed on pelleted commercial concentrate diet from which 40% were replaced by PPW.

Constituents of PPW (Table, 1) and experimental diets (Table, 2) were analyzed (A.O.A.C., 1990) and the estimated daily intake of rabbits were recorded (Table, 2).

During the prepubertal period (whereas does refused bucks and progesterone level was < 1ng/ml), individual body weight and feed consumption were weekly recorded.

Feed conversion rate was estimated as feed intake (g) / body gain (g). Rabbits were frequently observed for the changes of vaginal mucous membranes and acceptance of males. The occurrence of puberty was confirmed by weekly assaying of progesterone level (>1ng/ml) in blood samples. The number of does reached puberty, interval from feeding until

puberty and weight at puberty were recorded. Does showing hyperemia of vaginal mucous membrane were allowed to be copulated and conception rate after the first service as well as gestation period and data of kids were recorded (Table, 3).

**Table(1): Chemical analysis and amino acids contents of potato processing waste (PPW)\*.**

Chemical analysis	(%)	Amino acids content	(%)
Moisture content	15.760	Lucine	0.370
Crude protein	8.580	Valine	0.318
Lipid	1.970	Lysine	0.268
Nitrogen free extract	75.850	Thionine	0.267
Gross energy	4.136	Phenyl alanine	0.229
Crude fiber	9.260	Tyrosione	0.156
ASH	4.410	Methionine	0.154
Calcium	0.100	Arginine	0.209
Phosphorus	0.304	Aspartic acid	1.074
Magnesium	0.122	Glutamic acid	0.772
Potassium	2.062	Glycine	0.247
Sodium	0.170	Alanine	0.284
Iron	0.245	Proline	0.363
		Total contents	5.261

\* on dry matter basis

**Table (2): Effect of partial replacement of commercial pelleted diet with Potato processing waste on its chemical composition and average daily intake of rabbits..**

Parameters	Commercial pelleted diet	Diet contains 20% PPW	Diet contains 40% PPW
<b>Chemical composition(%):</b>			
Moisture content	10.13	10.28	10.75
Crude protein	18.00	16.10	14.12
Crude fiber	13.16	12.00	11.41
Ether extract	2.50	2.10	2.10
Metabolizable energy(K Cal)	2700	2740	2780
<b>Daily intake</b>			
Average quantity(g/day)*	67.0± 14.60	76.33± 3.48	65.00± 1.70
Crude protein (g)	12.06	12.29	9.18
Metabolizable energy (Cal/day)	181.00	209.10	180.70
Energy/protein ratio	14.96	16.90	19.62

• Mean ±S.E

**Table (3): Effect of partial replacement of commercial pelleted diet with potato processing waste on some productive and reproductive parameters in rabbits (Mean  $\pm$  S.E.).**

Parameters	Commercial pelleted diet	Diet contains 20% PPW	Diet contains 40% PPW
<b>Pubertal period:</b>			
Daily feed intake(g)	116.33 $\pm$ 2.91	100.83 $\pm$ 4.58	105.67 $\pm$ 6.89
Daily gain (g)	12.30 $\pm$ 3.47	10.24 $\pm$ 1.53	12.93 $\pm$ 4.83
Feed conversion rate	5.70 $\pm$ 0.88	5.63 $\pm$ 0.65	6.78 $\pm$ 0.25
<b>On set of puberty:</b>			
Days after feeding	56.00 $\pm$ 3.50a	49.17 $\pm$ 2.14 b	50.20 $\pm$ 3.88b
Weight(Kg)	3.05 $\pm$ 0.14a	2.63 $\pm$ 0.07b	2.69 $\pm$ 0.30b
Conception rate after the 1 <sup>st</sup> service	40.00 (2/5)	33.33 (2/ 6)	50.00 (3/6)
Gestation length(days)	30.33 $\pm$ 3.66	29.25 $\pm$ 3.45	30.20 $\pm$ 0.74
<b>Kidding data:</b>			
The first litter size	3.66 $\pm$ 1.52a	3.00 $\pm$ 1.40a	6.60 $\pm$ 1.20b
Kid weight on day 7 (g)	117.30 $\pm$ 1.39c	142.80 $\pm$ 21.81d	94.83 $\pm$ 8.62c
Kid weaning weight(g)	278.32 $\pm$ 4.41c	325.52 $\pm$ 19.33d	331.33 $\pm$ 20.30d
Kid daily gain (g)	7.67 $\pm$ 1.83a	8.71 $\pm$ 0.89	11.26 $\pm$ 1.37b
Incidence of does copulated on day 7 post kidding(%)	100.00	00.00	100.00
Incidence of pregnancy(%)	00.00	00.00	33.33

Means with different alphabetic were significantly differ at  $P < 0.05$  for a& b and at  $P < 0.01$  for c& d.

#### Samples:

##### Potato processing waste (PPW):

An amount of 200kg PPW was taken from different batches and mixed separately before taking representative samples for chemical analysis, wet samples were sun dried until the moisture content reached about 10%. PPW were analyzed for calcium and potassium using flame photometer. Phosphorus, iron and magnesium were coloremometrically analyzed (A.O.A.C., 1990). Samples were hydrolyzed for 24 hours with 6 N HCl and analyzed for amino acid contents (A.O.A.C., 1990) using high performance amino acid analyzer, mode 7300, Beckman

##### Blood:

Blood samples were withdrawn from ear veins in to heparinized tubes once weekly and plasma samples were kept at  $-20^{\circ}\text{C}$ . Progesterone was assayed (RIA) according to Abraham (1981) using kits from Diagnostic Product Corporation (Los Angeles, USA). Assay had a sensitivity of 0.02 ng/ml with intra assay CV of 4.65%. Total protein, albumin, glucose, total lipids, triglyceride and total cholesterol were coloremometrically analyzed using available commercial chemical kits.

##### Statistical analysis:

Data were computed and analyzed (SAS, 1986) by one way analysis of variance using liner model as outlined by Snedecor and Cochran (1980).

## RESULTS

##### Nutritional value of potato processing waste (PPW):

The nutritional analysis of PPW including amino acid contents was recorded in table (1). PPW is rich in nitrogen free extract, potassium and amino acids especially aspartic, glutamic, proline, lucine and valine

**Effect of partial replacement of commercial diet with PPW:**

**1-Chemical composition of formulated diets and daily intake of rabbits:**

The effect of partial replacement of a part of complete pelleted concentrate diet with PPW on its chemical composition is shown in table (2). It is evident that the partial decrease in the crude protein and fibers of replaced diets was substituted by an increased energy/protein ratio in the daily intake of rabbits (Table 2). Moreover, such diets were accepted by rabbits and induced no observable digestive disturbances.

**2- Some nutritional and reproductive aspects:**

In growing female rabbits (Does), the feed conversion rates revealed no significant differences among the three studied groups. Does firstly accepted bucks indicating puberty (confirmed by progesterone levels >1ng/ml later on) after significantly ( $P<0.05$ ) shorter time from the start of feeding PPW and at lighter weights when compared with the control group. Also, conception rates were higher in PPW groups compared to the control one (Table, 3). The first litter size and daily gain ( $P<0.05$ ) as well as kids weaning weight ( $P<0.01$ ) were significantly high in 40% PPW group, while, kids weight on day 7 post kidding were high in 20% PPW group. All does in control and 40% PPW groups were copulated from the day of kidding until day 7 post kidding, however, pregnancy rates were 00.00, 00.00 and 33.33 % in the three groups respectively.

**3- Blood analysis during puberty:**

Analysis of blood samples from does during weeks where progesterone levels were > 1ng/ml (indicating puberty) was recorded in table (4). No significant changes were recorded in protein, lipids or glucose values among the 3 groups. However, lipids and glucose values tended to be somewhat lower in experimental groups when compared to the control group.

**Table( 4): Effect of partial replacement of commercial pelleted diet with Potato processing waste on some plasma biochemical values in rabbits at puberty( Mean  $\pm$  S.E)**

Values	Commercial pelleted diet	Diet contains 20%PPW	Diet contains 40%PPW
Total proteins (g/dl)	6.72 $\pm$ 0.01	5.91 $\pm$ 0.16	5.87 $\pm$ 0.66
Albumin (g/dl)	4.10 $\pm$ 0.25	3.48 $\pm$ 0.13	3.23 $\pm$ 0.17
Globulin(g/dl)	2.61 $\pm$ 0.27	2.43 $\pm$ 0.14	2.64 $\pm$ 0.18
Urea(mg/dl)	56.46 $\pm$ 2.36	53.73 $\pm$ 1.46	55.67 $\pm$ 1.32
Total lipids (mg/dl)	344.70 $\pm$ 22.10	322.16 $\pm$ 49.97	318.19 $\pm$ 45.90
Triglyceride (mg/dl)	85.80 $\pm$ 5.26	83.11 $\pm$ 17.84	84.77 $\pm$ 17.02
Cholesterol (mg/dl)	78.70 $\pm$ 11.08	69.53 $\pm$ 16.87	71.87 $\pm$ 14.63
Glucose (mg/dl)	120.93 $\pm$ 4.06	108.25 $\pm$ 9.96	111.43 $\pm$ 8.30

**DISCUSSION**

Modern commercial animal production, like other industrial enterprises prerequisites the dimensioning of expensive costs of input especially that of food which represents 70 % of the cost of production (Ahmed *et al.*, 1994). In Egypt, there is a great shortage in feed stuffs, which are suitable for animal and poultry feeding. Therefore, there is increasing trends for feeding on byproducts and wastes of crops, both to use more safe nutrients and to prevent environmental pollution (McClure, 1994). Potato processing waste (PPW) is one of these products and it was previously evaluated by Ahmed *et*

*al.*(1994) with emphasis on compositional analysis and nutrient digestibility. In the present work PPW was utilized for formulating diets for rabbits and was evaluated from nutritional and reproductive points of view. The chemical analysis of PPW revealed high nitrogen free extract and potassium contents. In this respect, McDonal *et al.* (1990) reported that potato in general contain 70% starch, 0.5% sugar, 4% fat, 11% crude protein and 0.3% crude fibers on dry matter basis. Replacement of 20 or 40 % of commercial concentrate pelleted diet by PPW induced no harmful effects on the experimental rabbits as no digestive disturbances were recorded. This condition was mainly related to the low fiber content in the replaced diets (Barreto and De Blas, 1993). PPW also, provided the requirement of rabbits from energy and protein during the different phases of the reproductive cycle as outlined by Samy ( 1991) and promote rabbits to achieve their productive potentials manifested by non significant changes in the pubertal daily gain in comparison to the control group. Also, PPW had beneficial effects on the occurrence of early puberty after feeding treatment application (49.17 and 50.20 days in 20 and 40 % PPW groups respectively versus 56.0 day in the control group), conception rate (50.00 and 66.67 versus 30.00%), litter size (3.00 and 6.60 versus 3.66), kid weight on 7 day post- kidding (142.80 and 94.80 versus 117.30 g) and preweaning kid daily gain (8.71 and 11.26 versus 7.67 g). These favorable effects of PPW could be attributed to the relative increased daily energy intake with no significant changes in feed conversion (Barreto and De Blas, 1993; Xiccato *et al.*, 1995 and Ezzo *et al.*, 1998) as energy is regarded as the most significant dietary component with respect to determination of ovarian activity and conception (Rhind, 1992), as well as regulation of ovarian steroidogenesis and production of insulin growth factor-1 (William, 1996). Also, it was reported that the high content of amino acids might play a role as an alternative energy source (Downing and Scaramuzzi, 1991 and McClure, 1994). The actual mechanism whereby energy balance influence reproductive activity is unclear, however, Rhind *et al.* (1991) found putatively greater GnRH pulse frequently and consequently LH level following increased energy content in the ration of sheep, while, Downing *et al.* (1995) attributed the condition to increased biological availability of glucose consumption rate in ovarian tissue. Moreover, it was reported that the high energy diet changes hypothalamic sensitivity to estradiol and inhibin as well as it changes circulating insulin and growth hormone levels (Boukhling *et al.*, 1996). The improved kids production especially in 40% PPW group was in agreement with the finding of Barreto and De Blas (1993), Castellini and Battaglini (1993) and Ezzo *et al.* (1998). They found that increasing energy contents in rations of breeding rabbits improved the daily gain and weaning weights of their pups due to the increased milk production. On the other hand, the litter size in this experiment was generally small. This condition may be attributed to the use of local commercial breed of NZW rabbits as well as this was the first litter of production. Similar litter size was given by Ezzo *et al.* (1998).

PPW induced no significant changes in the studied blood metabolites (Table, 4) after replacement of a part of the diet. These results were in line with the results of Tawfeek *et al.*(1994) and Ezzo *et al.*(1998) who reported

no significant changes in protein, lipids and glucose values in the blood of rabbits following increased daily energy intake, however, slight decreases in total lipids, cholesterol, triglyceride and glucose values were observed in experimental does and may be related to stimulation of the thyroid activity following the increased energy contents of the diet (Daghash *et al.*, 1999) and consequently increased rate of catabolism of cholesterol through increased activity of lipogenic enzymes in the liver and adipose tissue (El-Bedawy *et al.*, 1996) while, the decrease in glucose may be related to increased biological availability and/or insulin secretion (Rhind, 1992).

In conclusion, potato-processing waste could be used to replace part of the concentrate mixture in rabbit rations without inducing harmful effects on productive or reproductive performance.

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## **بعض النواحي الغذائية والتناسلية في إناث الأرانب المغذاة على علائق تم استبدال أجزاء منها بمخلفات تصنيع البطاطس**

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**قسم التكاثر الحيواني والتلقيح الصناعي وقسم تغذية الحيوان\* -المركز القومي للبحوث**

تمت در اسه بعض المؤشرات الغذائية والتناسلية لعدد ١٨ أنثى أرانب نيوزيلندي بعد تقسيمها آلي ثلاثة مجموعات تجريبية ,المجموعة الأولى تمت تغذيتها على عليقه أرانب مركزه على هيئه مكعبات , المجموعة الثانية(٢٠%) و المجموعة الثالثة (٤٠%) تم تغذيتهم على علائق تم استبدال أجزاء منها بمخلفات صناعه البطاطس وتم حساب كميته المأكول اليومي, زيادة الوزن اليومية ومعدل التحويل الغذائي قبل حدوث البلوغ الجنسي وتم ملاحظة الأرانب أخذت عينات دم لتحديد عمر ووزن البلوغ الجنسي وتم تلقيح الأرانب وحساب معدلات الحمل والبيانات الحاصه بالمواليد أخذت عينات من مخلفات البطاطس وكذلك العلائق التي تم تكوينها وتحليلها غذائيا . وأثبتت النتائج أن مخلفات البطاطس بها محتوى عالي من المستخلص الخالي من النتروجين ( NFE ) وكذلك البوتاسيوم وبعض الأحماض الأمينية وان إحلال جزء من العليقة بهذه المخلفات لا يؤثر معنويا على معدل التحويل الغذائي بل يزيد محتوى الطاقة في العليقة اليومية أما كوله وان البلوغ الجنسي يحدث مبكرا في الأرانب المغذاة على هذه المخلفات مقارنة بالمجموعة الضابطة ولا يؤثر معنويا على مكونات الدم الكيميائية وأيضا كانت نسبة العشار في المجموعة التجريبية أعلى من المجموعة الضابطة وكذلك تم تسجيل أعداد وأوزان المواليد في المجموعات الثلاثة .وخلص الباحثون آلي إمكانية استخدام مخلفات صناعه البطاطس في علائق الأرانب حيث أن ليس لها اثر ضار على إنتاجيه وتناسل الأرانب مقارنة بالمجموعة الضابطة