Effect of Partial Replacement of wheat brain and Alfalfa hay by potato by-products in Diet On Nutrients digestibility coefficients and Nutritive values Of Growing Rabbit

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Effect of Partial Replacement of wheat brain and Alfalfa hay by potato by-products in Diet On Nutrients digestibility coefficients and Nutritive values Of Growing Rabbit

Abstract:

The experimental work of the present study was conducted at Rabbit Production Unit, Poultry Production Department, Faculty of Agriculture, Alexandria University, Egypt, The goal of the current experiment was direct toward the possibility of incorporating graded levels of Potato Peel (0, 5, 10, 15 and20%) as a source of dietary fiber into growing rabbit diets to evaluate their effect on productive performance, mortality, nutrient digestibility coefficients, carcass characteristics, some blood hematological, serum metabolites and economic efficiency throughout the entire studied experimental growth period. A total number of three hundred weaned rabbits, fifty-fifty between Alex. and V-lines, at 4 weeks of age having nearly equal live weights according to their guide line were used in this study. Rabbits of each line were individually weighted, randomly distributed into five equal groups (30 each treatment). Each group divided into ten replicates, each replicate contains 3 rabbits. All animals were kept under the same managerial, hygienic and environmental conditions throughout the experimental growth periods. A photoperiod of 14 to 16 hours of day light was also provided throughout the experimental periods. Feed and clean fresh water were offered ad libitum. the feeding period was extended for 10 weeks of age. Graded levels of the ground potato peel meal (0, 5, 10, 15 and 20%) were incorporated into experimental diets. So, five experimental diets were formulated and pelleted to cover the nutrient requirements of rabbits.

Results obtained could be summarized as follows:

1- Results of the proximate analysis of potato peels meal shows that it contains a slightly lower crude protein being 14% than

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that of wheat bran and Alfalfa which being 15 and 15.5%, respectively. While, values of crude fiber and nitrogen free extract determined for the tested material fall in range of wheat bran and Alfalfa hay (15.6 vs.11.0 or 25 and 57.1 vs.64.0 or 49.5), respectively.

2- Both ether extract and ash content of potato peels were higher than those of other studied materials. Similar results were attained with values of gross energy and digestible energy which being 4296.85 vs.1300 or 3950 Kcal /kg DM and 2574.8 vs.2550 or 2175Kcal /kg DM, respectively.
3- Rabbits of Alex. line fed 10% level of the potato peels meal containing experimental diet gave the highest values in all nutrients digestibility coefficients over those of other dietary treatments compared with those of V. line. Meanwhile, Alex. Values of OM, EE and NFE were statistically similar with those of V- line fed 5% potato peel meal containing experimental diets. The opposite was true with increasing dietary potato peel up to 20% where the digestions of nutrients were decreased.
4- Dietary 5% potato peels meal had a beneficial effect on TDN, DCP and DE of V. rabbits, while, adding the same dietary treatment up to 5 or 10% to Alex. diets gave the best values in this respect compared with those of V-lines. The opposite was true with increasing inclusion dietary potato peel up to 15 or 20%. So, the dietary inclusion of 5% is recommended in formulating V. rabbits diets and that of 10% is suitable level in diet of Alex. rabbits.

From the results of this study, it could be concluded that potato peels meal can be used as a good alternative source of dietary fiber instead of wheat bran and alfalfa containing growing rabbits diets and no adverse effect was faced the digestibility coefficients of nutrient substances and their nutritive values. So, the dietary inclusion of 5% is recommended in

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formulating V. rabbits diets and that of 10% is suitable level in diet of Alex. rabbits.

Keywords: by-products, Potato Peels. alternative , Rabbits, ,digestibility.

Introduction:

It is commonly known that shortage in animal feed has been found to have a negative effect on the development of animal and poultry production. Therefore, more considerable attention was given to use unconventional ingredient such as agro-industrial by-products in formulating rabbit diets to achieve a suitable efficiency of the utilization and economic efficiency of production (Gaafar et al., 2014). Fortunately, rabbits have high ability to consume forge and agricultural by-products contained high levels of fiber (Cheeke,1986). Therefore, fiber is one of the main components of rabbit diets which usually contain 35 to 40% neutral detergent fiber (De Blas and Mateas,1998).However, fiber plays an important role in rabbit nutrition. In that, it helps to maintain high rate of passage, avoiding the accumulation of digest a in the caecum that reduce feed intake and impairs growth (De Blaset al., 1999). Also, fiber is a substrate for cercal microorganisms and its fermentation product mainly VFA which may reduce the incidence of digestive disorders and mortality (Gidenne et al., 2002).The digestibility of organic matter of feed is lower in rabbit than the other herbivorous animals, primarily due to lower digestion of crude fiber (Garcia et al.,2000).

The early studies reported that there are many fibrous feed stuffs which are usually included in rabbit diets. Inclusions of these materials are often severely limited because little information is available about their nutritive value. However, most of these materials are residues of agricultural or industrial processes (Mikhail et al., 2013 and Shamma et al., 2014). Vegetable peels are usually considered waste, so they are

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obviously cost-effective (Parmar and Kar,2009andHamendraet al., 2010). Researches on the use of vegetable and fruits peels are on the increase. Among these materials which may possess a considerable feeding value are the potato peels where, potato annual output is around 206 million tons which is the largest in Africa (FAO,2006) Potato peels contains an array of nutritionally and pharmacologically interesting components such as phenolic compounds, glycol alkaloids and cell wall polysaccharides which may be used as natural antioxidants, precursors of steroid hormones and dietary fiber. Since approximately 50% of potato peels (w\w) is dietary fiber (Camire et al.,1995). Studies of physical and chemical characteristics of potato peels indicated that it as being superior to wheat bran in its content of total dietary fiber, water holding capacity and low quantities of starchy components.

Thus, a large quantity of potato peels has been introduced as a non-conventional and non-competing ingredient from chips industries. The preliminary analysis of potato peels composition indicated that it is being superior to wheat bran in its content of total dietary fiber, water holding capacity and low quantities of starchy components.

Digestibility of crud fiber by rabbits was greater using diets contained high level of fiber (20%) than low level (Abdel-Rahman and Shehata, 1978). The same trend was reported by Fix et al. (1979) who indicated that crud fiber content had a negative effect on digestibility of organic matter and nitrogen free extract (NFE).As published by Pascual and Fernandez-Carmona (1980), the DM, OM and CF digestibility values tended to increase as the citrus pulp inclusion level increased up to 100%. In that, OM digestibility values ranged from 67% to 89 % for rations supplemented with 45-100% citrus pulp. Also, in experiment conducted by Zeweil (1992), rabbits fed diets supplemented with 25% pea by-product recorded the highest values of nutrients

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digestion coefficients which were 74.68, 75.1, 70.54, 19.02 and 81.85 for DM, CP, EE and NFE, respectively. Carabaño et al. (1997) noticed a linear increment for CP digestibility with increasing percentage of dietary sugar beet pulp up to 30%. The overall effect on nutrient digestion was an increase of dietary DE by 1.05, 1.51 and 1.46 MJ/Kg when 10, 20 or 30%of sugar beet pulp levels was added on the expense of Alfalfa hay inclusion. Genedy et al. (2000) showed the nutrients digestibility of CP, EE, CF, NFE and OM were significantly increased with 4, 8 and 12% inclusion level of dried watermelon by–product when compared to those of the control diet. Meanwhile, feeding values in terms of DCP, TDN,SV and DE of diet contained dried watermelon by-product were nearly similar to those of control, but without significant differences.

In an experiment by Abou-Zeid et al. (2001) who concluded that digestion coefficient of CP and EE was significantly higher in rabbits fed diets containing 12 or 14% Azolla hay than those fed 36%. Meanwhile, digestibility of NEF did not show any significant difference among the tested groups. The opposite was attained with digestion coefficient of CF which was significantly higher for 24% inclusion of tested material than those of the other studied levels. Generally, similar trend was observed for nutritive values of all studied experimental rations in terms of DCP, SV and DE Kcal/kg. Furthermore, Suliman (2006) replaced 25, 50, 75 and 100% Canola meal levels for soybean meal and found that the digestion coefficient of DM, OM, CP and NFE were significantly higher for rabbit fed 50%Canola meal diet than those of the other tested diets. Exception was seen with treatment of 25% which had a highest value of CF digestibility. Meanwhile, the highest nutritive value in terms of TDN, DCP and DE were recorded by rabbits fed 50% Canola meal diet. It is worth to note that potato waste is an excellent energy source values similar to corn and barley, while

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being low in protein, vitamin A and calcium (Lardy and Anderson, 2009). Potato peel, as waste of potato processing, is found to be a good source of dietary fiber and polyphenols (Singh et al., 2005), which is strongly anti-oxidant (Singh et al., 2008).

Because of the scarcity of information on the possibility of using potato peels as a source of fiber in growing rabbit diets. Therefore, the objective of this study was aimed to:

(1) Determine the proximate analysis of the potato peels meal (PPM) to evaluate its nutritive value.
(2) to investigate the possibility of substituting wheat bran and Alfalfa by potato peel meal as un-classical ingredient in formulated growing rabbit diets.
(3) Compare the digestibility traits of the experimental diets for the two studied lines of growing rabbits in this respect.

MaterialS and Methods:

The experimental work of the present study was conducted at Rabbit Production Unit, Poultry Production Department, Faculty of Agriculture, Alexandria University, Egypt.

The goal of the current experiment was direct toward the possibility of incorporating graded levels of Potato Peel(0, 5, 10, 15and20%) as a source of dietary fiber into growing rabbit diets to evaluate their effect on nutrient digestibility coefficients, throughout the entire studied experimental growth period.

Stock History:

The rabbits used in this study were Alexandria and V-Lines weaning rabbits. In that, rabbits of the V-line are a line that was founded in 1981, as a Spanish synthetic line, crossing animals that were progeny of four specialized maternal lines. After three generations without selection, the line has been selected (Estany et al., 1989)to increase litter size at weaning. A set of V-line rabbits was imported to the Poultry Research

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Center; Alexandria University at the end of 1998, as a gift provided from Valencia University, multiplied for five years and after that selection was continued under the same criteria. While those of the Alex Line were established and developed at the nucleus breeding rabbit unit of the Poultry Research Center, Faculty of Agriculture, Alexandria University (El-Raffa, 2007).

Preparation and Evaluation of Potato Peel Meal:

Fresh potato peel which obtained from a commercial potato chips making units, were washed with tap water and dried by using sunshine. The dried peel was ground in a multi mill to obtain fine powder. Then, the meal kept in plastic bags until the preparation of experimental diets. Sample of the prepared potato peel meal was taken for estimating its chemical composition.

Experimental Procedure:

.Rabbits Housing and Management:

A total number of three hundred weaned rabbits unisexual, fifty-fifty between Alexandria and V-lines, at 4 weeks of age having nearly equal live weights according to their guide line were used in this study. Rabbits of each line were individually weighted, randomly distributed into five equal groups (30 each treatment). Each group divided into ten replicates, each replicate contains 3 rabbits. Through the experimental period, animals were housed in an open, east-west oriented windowed farm, with one level design cages having galvanized wire (30cm length × 35cm width × 40cm height). Each cage was equipped with an automatic drinker stainless steel nipple and a manual feeder allowing recording individually feed intake for each rabbit. All animals were kept under the same managerial, hygienic and environmental conditions throughout the experimental growth periods. A photoperiod of 14 to 16 hours of day light was also provided throughout the experimental periods. feed and clean fresh water were offered ad libitum. the feeding period was extended for 10 weeks of age.

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Experimental Diets:

Five experimental diets were formulated and pelleted to cover the nutrient requirements of rabbits according to NRC, (1994) and De Blas and Mateos (1998) as shown in Table (1). In that, graded levels of the potato peel meal were incorporated into experimental diets which were classified as follow:

Diet (1) basal diet without replacement and served as control diet.

Diet (2) basal diet replaced PPM at level 5% of wheat bran and Alfalfa.

Diet (3) basal diet replaced PPM at level 10% of wheat bran and Alfalfa

Diet (4) basal diet replaced PPM at level 15% of wheat bran and Alfalfa

Diet (5) basal diet replaced PPM at level 20% of wheat bran and Alfalfa

All diets had nearly iso-nutritive value but differ in their components according to the purpose study.

Table (1): Composition and chemical analysis of experimental diets.

Ingredient, %	Potato peel meal replacement levels,%				
	0.0	**5**	**10**	**15**	**20**
Yellow corn	7.00	7.00	7.00	7.00	7.00
Wheat bran	20.00	17.50	15.00	12.50	10.00
Barely	18.30	18.20	18.00	17.90	17.80
Alfalfa	22.50	20.00	17.50	15.00	12.50
Soybean meal, 44%	18.20	18.40	18.50	18.60	18.70
Wheat Straw	8.00	8.00	8.00	8.00	8.00
Potato Peel	-	5.00	10.00	15.00	20.00
Di-calcium phosphate	1.9	1.7	1.7	1.7	1.7
Limestone	0.2	0.3	0.4	0.4	0.4
Methionine	0.15	0.15	0.15	0.15	0.15
Lysine	0.05	0.05	0.05	0.05	0.05
Salt	0.4	0.4	0.4	0.4	0.4
Premix*	0.3	0.3	0.3	0.3	0.3

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Molasses	3.00	3.00	3.00	3.00	3.00
Total	**100**	**100**	**100**	**100**	**100**
Determined analyses on DM basis:	17.50	17. 43	17.48	17.45	17.51
Crude protein %	13.40	13.30	13.30	13.20	13.10
Crude fiber%	2.10	2.20	2.30	2.20	2.20
Ether extract%					
Calculated values:	2545	2544	2543	2546	2547
Digestible	7.20	7.08	7.07	7.02	7.01
energy(kcal/kg)**	145.4	145.95	145.48	145.90	145.45
Ash %	2	0.91	0.92	0.94	0.93
DE/P	0.92	0.60	0.60	0.60	0.60
Calcium%	0.60	0.40	0.40	0.40	0.40
Phosphorus available %	0.40	0.91	0.91	0.91	0.91
Methionine %	0.91				
Lysine %					

* Vitamin-mineral premix provides per kg of diet vit. A. 13,340 iu; vit. D3. 2680. i.u; vit. E. 10. i.u; vit. K, 2.68 mg; Calcium pantothenate, 10.68 mg; vit. B12, 0.022 mg; folic acid, 0.668 mg; choline chloride, 400 mg; chlortetracycline, 26.68 mg; manganese, 133.34 mg; iron, 66.68 mg; zinc, 53.34 mg; copper, 3.2 mg; iodine, 1.86 mg; cobalt, 0.268 mg, selenium, 0.108 mg.

** Calculated DE (Kcal/kg) = TDN ×44.3 (**Schneider and Flatt, 1975**).

Measurements:

Chemical Composition of Potato Peel Meal:

Proximate chemical composition was determined according to methods of A.O.A.C. (2000).

Nutrient Digestibility and Nutritive Value of the Experimental Diets:

Total number of 30 animals, fifty–fifty between Alex. and V-Lines, at 10 weeks of age were used indigestibility trials to determine the nutrient digestibility coefficients and nutritive values of studied experimental diets over period of 12 days divided into the preparation period (8 days) and the collection

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period (4 days) according to Abd El-Ghany (2006).Three animals for each treatment approximately similar in live weight were individually housed in the metabolic cages to facilitate collection of feces. Actual daily feed intake was recorded during the collection period. Feces were daily quantitatively collected. feed intake of experimental diets and weight of feces were daily recorded representative samples of feces was dried at 60°C for 48 hrs, ground and stored for later chemical analysis.

Proximate analysis of experimental diets and feces samples on dry matter basis were carried out to determine the dry matter (DM), ether extract (EE), crude protein (CP), crude fiber (CF) and ash according to the Association of Official Analytical Chemists (A.O.A.C, 2000). The nitrogen free extract (NFE) and the organic matter (OM) were calculated as follow:

NFE% = 100 – (CP% + CF% + EE% + Ash(%)

OM% = (CP% + CF% + EE% +NFE(%)

The apparent digestion coefficient for DM, OM, CP, EE, CF, and NFE were calculated.The Nutritive value of the experimental diets were calculated and expressed as TDN, DE and DCP according to classic formula (Cheekeet al., 1982).In that:

Digestible crude protein (DCP)= Digestibility coefficient of crude protein ×crude protein% of the diet

TDN% = DCP% + DCF% + DEE% (2.25) + DNFE%

The digestible energy (DE) was calculated according to Schneider and Flatt (1975) by using the following equation:

DE (kcal / kg) = TDN × 44.3

Statistical Analysis:

Collected data were subjected to statistical analyses by using the international software program (SAS, 2003). The application of the least significant ranges among different treatment means was done according to Duncan (1955).Data in

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percentage values were transformed with the arcsine square-root procedure to normalize variance before analysis.

The following statistical model was used:

$Yijk = \mu + Li + Tj + LTij + eijk$

Where:

Yijk = The observation of the parameter measured,
μ = The overall mean,
Li = The effect of line,
Tj = The effect of dietary treatment, j = (1, 2,3,4,5).
LTij = Interaction between lines and treatment,
eijk = The experimental random error.

Results and Discussion:

Chemical Composition of Potato Peel Meal:

It is worthy to note that chemical constitutes of potato peel meal (PPM) as comparison with those of wheat bran and Alfalfa hay may vary according to climatic conditions, type of soil, Processing techniques and operators using the analytical techniques. Moreover, laboratories and samples should be considered. In addition, the potential value of the tested material in animal feeding depends on their nutritive characteristics as the fibrousness, the protein content and other components (Afshar and Naser, 2008).

Determined analysis on DM basis of studied materials as a dietary fiber is listed in Table (2). It is clearly shows that dry matter of potato peel meal had an intermediate score (89.9%) between that of wheat bran and Alfalfa hay which being 88 and 90%, respectively. However, dry matter of potato peel had a higher percentage compared with that of wheat bran. The opposite was true with organic matter,where the tested material had an approximately equal percentage 92% with that of Alfalfa hay and a lower value than that of wheat bran which being 94%.

Inspection in data, it is clearly shows that potato peel meal contained a slightly lower crude protein being 14% than that of

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wheat bran and Alfalfa which being 15 and 15.5%, respectively. While, values of crude fiber and nitrogen free extract determined for the tested material fall in range of wheat bran and Alfalfa hay (15.6 vs.11.0 or 25 and 57.1 vs.64.0 or 49.5), respectively. In connection, result of crude protein was within range obtained by Omer et al.(2011).

Concerning the ether extract and ash content of potato peel meal, it was higher than those of other studied materials. Similar results were attained with values of gross energy and digestible energy which being 4296.85 vs.1300 or 3950 Kcal /kg DM and 2574.8 vs.2550 or 2175Kcal /kg DM, respectively.

So it is of a great importance to note that nutrient substances of potato peel meal are of relatively suitable values to its rank as a dietary fiber for growing rabbits. Then, it is the preliminary indicator on the possibility using this agro-industrial by–production in feeding rabbits, but the final evaluation can be obtained through the biological evaluation.

Table (2): Chemical composition of Potato peel meal, Wheat bran, and Alfalfa hay as an ingredient in rabbits diets.

Item	Potato peel	Wheat bran*	Alfalfa hay*
Chemical analyses (%)			
Dry matter (DM)	89.90	88.00	90.00
Chemical analyses on DM basis:			
Organic matter (OM)	91.90	94.00	92.00
Crude protein (CP)	14.00	15.00	15.50
Crude fiber (CF)	15.60	11.00	25.00
Ether extract (EE)	5.20	4.00	2.00
Nitrogen free extract (NFE)	57.10	64.00	49.50
Ash	8.10	6.00	8.00
Gross energy (kcal/kg DM)	4296.85	1300.00	3950.00
Digestible energy(kcal/kg DM)	2574.80	2550.00	2175.00

*****Source: NRC(1994)

Digestion of Nutrient Substances:

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Digestion trial was carried out to compare nutrients digestibility coefficients expressed as DM, OM, CP, CF, EE and NFE as well as nutritive values of experimental diets contained different levels of dietary potato peel for two growing rabbit's lines at 10 weeks of age.

Nutrients Digestibility Coefficients:

Average digestion coefficients of DM, OM, CP, CF, EE and NFE for Alex. and V-lines rabbits as feeding different inclusion levels of potato peel meal are summarized in Tables (3 and 4) .The data revealed that rabbits of Alex. line recorded the highest values in all digestibility coefficients, irrespective of different inclusion levels of the tested material, compared with those of V. line. In that, the increment values were 2.18,1.70,4.47, 5.17, 1.83 and 3.16 for DM, OM, CP, CF, EE and NFE, respectively. This result may be due to the wide genetic variation in gut morphology between the two lines of rabbits as reported by El-Raffa (2007). However, the higher values can be attributed to more efficient nutrient utilization in the intestinal tract of Alex. rabbits.

Concerning the inclusion levels of potato peel meal and their effect on nutrients digestibility coefficients, irrespective of studied growing rabbit's lines differences, are also presented in table (3). It is clearly shown that incorporating the tested material up to 5 or 10% as a dietary fiber into experimental diets recorded un-significant differences in the apparent digestibility of DM, OM, CP, CF, EE and NFE compared with those of the control diet. This may confirm that inclusion dietary potato peel at level10% is safe and its content of anti-nutrition factors is tolerant to the growing rabbits. In connection, these results agreed with those reported by Sarhan (2005) who noticed that the digestibility of all nutrients was not significantly affected by the inclusion of pea vines hay or pea pod hulls at 15 or 30% in the rabbits diets, such increase in these value may be due to the

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effect of adaptation time on the concentration and pattern of short chain fatty acid formed in the cecum of rabbit given the tested material inclusion as noticed by Englyst et al. (1996) who reported that digestibility of starch in plant foods is highly variable and is dependent on a number of factors including the physical structure of both the starch and the food matrix. Also, potato starch had a higher Purina base concentration in middle colonic digesta (Martinez-puig et al., 2003).

With increasing inclusion levels of potato peel meal up to 15 and 20%, there is a tendency to decrease nutrients digestibility coefficients (DM, OM, CP, CF, EE and NFE) as feeding different studied experimental diets. This decrement was the highest with rabbits fed diet contained 20% dietary potato peel. However, lowing digestibility of nutrient substances with 15 and 20% replacement levels might have been as a result of increasing level of anti- nutritional factors contained tested dietary fiber. The previous studied in this regard have shown that as dietary fiber especially pectin level increased, the apparent digestibility coefficients of nutrients were declined (Gidenne, 2003).

Regarding the application of data in table (4), the interaction effect between rabbits lines difference by different inclusion levels of potato peel meal was highly significant in most nutrients digestibility coefficient. Meanwhile, rabbits of Alex. line fed 10% level of the tested ingredient containing experimental diet gave the highest values in this regard over those of other dietary treatments. Meanwhile, Alex. values of OM, EE and NFE were statistically similar with those of V- line fed 5% potato peel meal containing experimental diets. Meanwhile, nutrients digestibility coefficient was significantly decrease as increasing inclusion of potato peel meal from 15 to 20% for both the studied lines of rabbits under the same condition. It is meaning that the initial increase in nutrients

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digestion must have occurred when experimental rabbits fed on diets of 10% tested ingredient which trigged better movement in the tract and improved digestion. The opposite was true with increasing dietary potato peel up to 20% where, the digestion of nutrients was decreased. The earlier study in this respect by Agunbiade et al. (2002) and Bawa et al. (2008) who reported that such decrement in nutrients digestion may be due to anti-nutrition factors presented in potato peel meal. This confirms the report of earlier researcher who reported that nutrients digestion is dependent on a number of factors including the physical structure of tested ingredient and food matrix as reported by Englyst et al. (1996).

Along the same line, Cheeke (1986) cleared that difference in CF digestibility may be due to CF constituents among different source of dietary fiber. Moreover, the digestion coefficients of CF considerably depended on the type, source and fractions of dietary fiber (Santomaet al., 1989). So, it could be concluded that potato peel meal as a dietary fiber is of a great importance in improving values of nutrients digestibility when incorporated into growing rabbit's diets.

Nutritive Values of Experimental Diets:

The main effect of growing rabbits(V. and Alex. Lines) fed different inclusion levels of potato peel meal and their interaction on nutritive values of experimental diets in terms of total digestible nutrients (TDN), digestible crude protein (DCP) and digestible energy (DE) are tabulated in tables (5 and 6) . Irrespective of dietary potato peel levels containing experimental diets, rabbits of Alex line recorded the highest significant values of TDN, DCP and DE over those of V-line. The increment rate represented by 1.03, 1.07 and 1.03, respectively. It may be due to differences in digestion coefficients of nutrient substances containing diets for either of the two lines rabbits. In agreement with our results, Khamis (2014) indicated that Alex. rabbits

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recorded a slightly increase in values of TDN, DCP and DE but without significant.

Concerning the inclusion levels of potato peel meal, irrespective of rabbits lines differences, significant differences was seen among dietary treatment in values of TDN,DCP and DE. In that, dietary treatment of 5% recorded the significantly upper record than those of other treatment in TDN% and DE kcal /kg, whereas no significant differences among treatment of the control and that contained 10% tested ingredient in value of DCP%. With feeding experimental diets contained 15 or 20% tested ingredient, it is clearly shows that there is a tendency to decrease all nutritive values in terms of TDN,DCP and DE. Meanwhile, the least value was recorded with treatment level of 20%. In connection, the improvement in TDN(%) could be due to the increase in digestion coefficients of CP,EE and NFE as reported by Ease (2002). However, the high nutritive value may be an indication to good acceptability of diets and / or higher ceacal activity (Mehrez and Mousa,2011). In this respect, Sarhan(2005)found that the digestible crude protein of diet contained 30% peapods hulls was significantly ($P \leq 0.05$)higher than that of the control diet. Also, Tag El-Din et al.(1998) concluded that TDN of rabbits diets contained 10,20 or 30% turnip (Roots and leaves) was gradually improved as the level of dried turnip increased in diet. On the contrary, Ibrahim (2000) reported that substituting clover hay with peanut hay partially or completely in rabbits diets numerically increased DCP and TDN values.

Regarding the interaction effect between growing rabbit lines by dietary inclusion levels of potato peel, it is obvious that dietary 5% tested ingredient had a beneficial effect on TDN, DCP and DE of V. rabbits, while the opposite was true with increasing inclusion dietary potato peel up to 10, 15 or 20%. On the other hand, adding the same dietary treatment up to 5 or 10%

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to Alex. diets gave the best values in this respect compared with those of V-lines. However, this trend did not continue but it significantly decreased. Therefore, the dietary inclusion of 5% is recommended in formulating V. rabbits diets and that of 10% is suitable level in diet of Alex. rabbits.

Table(3):The main effect of two lines of growing rabbits fed different inclusion levels of potato peel meal on nutrients digestibility coefficients of the experimental diets at the end of the experiment.

Items	Nutrients digestibility coefficients, (%)					
	DM	OM	CP	CF	EE	NFE
Lines V.	67.83 ^{b}±1.27	89.88 ^{b}±2.10	63.13 ^{b}±1.08	44.01 ^{b}±1.21	47.21 ^{b}±1.09	55.14 ^{b}±2.34
Alex.	70.01 ^{a}±2.19	91.58 ^{a}±2.15	67.60 ^{a}±1.05	49.18 ^{a}±1.16	49.04 ^{a}±1.05	58.30 ^{a}±2.16
DietaryPotato Peel meal% 0.0	71.09 ^{a}±2.23	91.62 ^{a}±2.05	67.98 ^{a}±1.03	49.00 ^{a}±1.33	49.98 ^{a}±1.07	59.07 ^{a}±2.14
5	72.77 ^{a}±2.21	91.78 ^{a}±2.33	67.99 ^{a}±1.11	50.51 ^{a}±1.27	51.08 ^{a}±1.03	59.38 ^{a}±2.09
10	70.37 ^{a}±2.15	91.07 ^{a}±2.17	67.56 ^{a}±1.06	48.38 ^{a}±1.20	49.43 ^{a}±1.08	58.23 ^{a}±2.05
15	66.60 ^{b}±2.23	89.62 ^{b}±2.18	62.42 ^{b}±1.13	43.95 ^{b}±1.32	47.09 ^{b}±1.04	56.12 ^{b}±2.15
20	66.27 ^{b}±2.06	89.57 ^{b}±2.14	60.90 ^{b}±1.04	41.19 ^{b}±1.26	43.05 ^{c}±1.06	55.81 ^{b}±2.17
Significance Lines	**	*	**	***	*	**
Dietary Potato Peel meal	***	**	***	***	***	**

*=Significant at P≤ 0.05 **=Significant at P≤ 0.01

***=Significant at P≤ 0.001

Different letters (a, b, c) in the same column indicate significant differences P≤ 0.05for each effect.

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Table (4): The interaction effect between two lines of growing rabbits by different inclusion levels of potato peel meal on nutrients digestibility coefficients at the end of the experiment.

Items	Nutrients digestibility coefficients, (%)					
	DM	OM	CP	CF	EE	NFE
V-line × control	69.13 ^{b}±1.23	90.50 ^{b}±1.54	64.99 ^{b}±1.18	45.42 ^{c}±1.02	48.83 ^{b}±2.12	58.40 ^{a}±1.85
V-line × 5% Potato Peel	71.66 ^{b}±1.18	91.52 ^{a}±1.52	65.94 ^{b}±1.15	48.00 ^{b}±1.04	51.61 ^{a}±2.20	59.62 ^{a}±1.73
V-line × 10 % Potato Peel	66.47 ^{c}±1.21	89.25 ^{bc}±1.60	62.58 ^{c}±1.12	43.61 ^{b}±1.03	46.39 ^{c}±2.17	56.66 ^{b}±1.75
V-line × 15% Potato Peel	66.07 ^{c}±1.09	89.10 ^{c}±1.67	62.17 ^{c}±1.16	42.84 ^{b}±1.09	46.19 ^{c}±2.09	55.60 ^{b}±1.89
V-line × 20% Potato Peel	65.82 ^{c}±1.10	89.05 ^{c}±1.53	60.00 ^{b}±1.09	40.22 ^{e}±1.08	43.03 ^{b}±2.13	55.43 ^{b}±1.83
Alex-line×control	73.05 ^{a}±1.15	92.75 ^{a}±1.56	70.97 ^{a}±1.20	52.52 ^{a}±1.13	51.14 ^{a}±2.21	59.75 ^{a}±1.46
Alex-line×5 % Potato Peel	73.89 ^{a}±1.12	92.05 ^{a}±1.59	70.04 ^{a}±1.19	53.03 ^{a}±1.10	50.56 ^{a}±2.19	59.15 ^{a}±1.52
Alex-line×10% Potato Peel	74.27 ^{a}±1.06	92.90 ^{a}±1.32	72.54 ^{a}±1.23	53.15 ^{a}±1.07	52.48 ^{a}±2.23	59.80 ^{a}±1.48
Alex-line×15% Potato Peel	67.13 ^{c}±1.08	90.15 ^{b}±1.47	62.68 ^{c}±1.21	45.07 ^{c}±1.02	47.99 ^{c}±2.16	56.65 ^{b}±1.43
Alex-line×20% Potato Peel	66.73 ^{c}±1.03	90.09 ^{b}±1.58	61.81 ^{cd}±1.14	42.16 ^{b}±1.11	43.07 ^{b}±2.14	56.19 ^{b}±1.48
Significance	**	*	***	***	***	**

*=Significant at P≤ 0.05 **=Significant at P≤ 0.01

***=Significant at P≤ 0.001

Different letters (a, b, c) in the same column indicate significant differences P≤ 0.05for each effect.

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Table(5):The main effect of two lines of growing rabbits fed different inclusion levels of Potato Peel meal on nutritive value of the experimental diets at the end of the experiment.

Items	Nutritive value of experimental diet		
	TDN%	DCP%	DE(Kcal/kg)
V-line × control	59.24 [b] ±0.24	11.37 [b] ±0.12	2624.33 [c] ±6.23
V-line × 5% Potato Peel	62.80 [b] ±0.21	11.49 [b] ±0.06	2782.04 [b] ±6.77
V-line × 10 % Potato Peel	56.52 [c] ±0.25	10.93 [c] ±0.13	2503.83 [d] ±5.94
V-line × 15% Potato Peel	55.71 [c] ±0.23	10.84 [c] ±0.07	2467.95 [e] ±5.83
V-line × 20% Potato Peel	55.68 [c] ±0.27	10.50 [c] ±0.05	2466.62 [e] ±4.12
Alex-line×control	60.08 [b] ±0.28	12.41 [a] ±0.08	2661.54 [c] ±6.27
Alex-line×5 % Potato Peel	61.39 [b] ±0.30	12.20 [a] ±0.13	2719.57 [b] ±4.75
Alex-line×10% Potato Peel	64.38 [a] ±0.19	12.67 [a] ±0.17	2852.03 [a] ±6.17
Alex-line×15% Potato Peel	57.14 [c] ±0.20	10.94 [c] ±0.12	2531.30 [d] ±5.48
Alex-line×20% Potato Peel	56.22 [c] ±0.26	10.82 [c] ±0.09	2490.54 [e] ±6.33
Significance	***	*	***

*=Significant at P≤ 0.05 **=Significant at P≤ 0.01 ***
=Significant at P≤ 0.001

Different letters (a, b, c) in the same column indicate significant differences P≤ 0.05for each effect.

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Table (6): The interaction effect between two lines of growing rabbits by different inclusion levels of Potato Peel meal on nutritive value of the experimental diets at the end of the experiment.

Items	Nutritive values of experimental diets		
	TDN, %	DCP, %	DE (Kcal/kg)
Lines			
V.	58.09 ^{b} ±0.35	11.02 ^{b} ±0.33	2568.95 ^{b} ±9.17
Alex.	60.04 ^{a} ±0.31	11.80 ^{a} ±0.36	2650.99 ^{a} ±8.57
Dietary Potato Peel meal%			
0.0	59.66 ^{b} ±0.24	11.89 ^{a} ±0.32	2642.93 ^{b} ±8.91
5	62.09 ^{a} ±0.26	11.85 ^{a} ±0.31	2750.80 ^{a} ±7.82
10	60.45 ^{b} ±0.19	11.80 ^{a} ±0.29	2677.93 ^{b} ±9.13
15	56.42 ^{c} ±0.23	10.89 ^{b} ±0.34	2499.62 ^{c} ±8.47
20	55.95 ^{c} ±0.29	10.66 ^{b} ±0.37	2478.58 ^{c} ±9.11
Significance			
Lines	*	*	***
Dietary Potato Peel meal	**	**	***

*=Significant at P≤ 0.05 ***=Significant at P≤ 0.001

Different letters (a, b, c) in the same column indicate significant differences P≤ 0.05for each effect.

ISSN: 2537-0367 **eISSN : 2537-0375**

REFFRENCES

A.O.A.C.(2000). Official methods of analysis Association of Official Analytical Chemists Washington, DC, USA.

Abd El-Ghany, Fatma, T. F. (2006). Evaluation of using some agro-industrial by-products in growing rabbit nutrition. M. Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Abd El-Rahman, M.M. Shehata. O. (1978). Effect of high vs low fiber rations with and without non-protein sources on growth in Baladi rabbits and production of V F A and ammonia in the alimentary tract. India J. Anim.Sci.,84(7)529-533.

Abou-Zeid A. E., Mohamed F. F., Radwan M. S. M., (2001). Assessment of the nutritive value of dried azolla hay as a possible feed ingredient for growing NZW rabbits. Egyptian Journal of Rabbit Science 11:1-21.

Afshar Mirzaei-Aghsaghali and Naser Maheri-Sis. (2008). Nutritive Value of Some Agro-Industrial By-products for Ruminants - A Review, World Journal of Zoology 3 (2): 40-46, 2008

Agunbiade J.A, Bello R. A. and Adeyemi O.A (2002). Performance characteristics of weaner rabbits on cassava peel-based balanced diet. Nig. J. Anim. Prod. 29(2): 171-175.

Ahamefule FO, BE Obua, I A, Ukweni, MA Oguike and RA Amaka, (2008). Haematological and biochemical profile of weaner rabbits fed raw or processed pigeon pea seed meal based diets. Afr J Agric Res, 3: 315-319.

Bawa GS, Ajide SO,Adeyinka IA, Ajala MK. (2008).Effects of varying levels of groundnut haulms and cowpea shells on performance of weaner rabbits. AJAVA.;3:54-61.

Camire ME, Zhao J, Dougherty MP, Bushway RJ. (1995). In vitro binding of benzo[a]pyrene by extruded potato peels. Journal of Agricultural and Food Chemistry; 43: 970- 973.

Carabaño R., Motta-Ferreira W., De Blas C., Fraga M.J. (1997). Substitution of sugarbeet pulp for alfalfa hay in diets for growing rabbits. Anim. Feed Sci. Technol., 65, 249-256.

Cheeke, P. R. (1986). Potential of rabbit production in tropical and subtropical agricultural system. J. Anim. Sci., 63: 1581 –

ISSN: 2537-0367 **eISSN : 2537-0375**

1586.

Cheeke, P.R.; Patton, N.M. and Templeton, G.S. (1982). Rabbit Production. 5th Edition. Int Printer and Published, USA.

De Blas, J. C. and Mateos, G. G. (1998). Feed formulation. In: De Blas, J. C. and Wiseman, J. (Eds.), The nutrition of the rabbit. CABI Pub I., Wallingford, UK. Chapter 13: 241 – 253.

De Blas, J. C., J. Garcı´a, and R. Caraban˜ o. (1999). Role of fiber in rabbit diets: A review. Ann. Zootech. 48:113–119.

Duncan, D.B.(1955). Multiple range and Multiple F-test Biometrics 11:1-42.

Easa, Fadila M. H. (2002). The role of fiber in rabbit nutrition. M. Sc. Thesis, Faculty of Agriculture, Ain Shams University, Egypt

El-Raffa A.M. (2007). Formation of a rabbit synthetic line (Alexandria line) and primary analysis of its productive and reproductive performance. Egypt. Poult. Sci. 27: 321-334.

Englyst, H.N., Kingman SM., Hudson G.J., Cummings J.H., and Cambridge A., (1996).Measurement of resistant starch in vitro and in vivo.Br.J.Nutr.,75(5):749-755.

Estany, Y.; Baselga, M.; Blasco, A. and Camacho, J. (1989). Mixed model methodology for the estimation of genetic response to selection in litter size of rabbits. Livest. Prod. Sci., 45: 87 - 92.

FAO. (2006). World agriculture: towards 2030/2050 – Interim report. Rome.

(http://www.fao.org/fileadmin/user_upload/esag/docs/Interim_report_AT2050web.pdf).

Fix, H.P ., Legal,S. and Hoffmann (1979).Possibilities of predicting the digestibility of nutrients by adult growing sheep from the nutrient content the diet. Archive furtierernahrung 29(4):259.

Gaafar, H.M.A.; Abd El-Lateif A.I.A. and Salwa Abd El-Hady B.(2014). Effect of Partial Replacement of Berseem Hay

ISSN: 2537-0367 **eISSN : 2537-0375**

by Ensiled and Dried Sweet Potato Vines On Performance of Growing Rabbits. Rep Opinion ,6(8):60-66].

Garcia, J.; Carabaño R.; Pérez-Alba L.and De Blas C. (2000). Effect of fiber source on cecal fermentation and nitrogen recycled through cecotrophy in rabbits. J. Anim. Sci. 78, 638-646.

Gidenne T. (2003).Fibers in rabbit feeding for digestive troubles prevention: respective role of low-digested and digestible fiber. Livest. Prod. Sci. 81, 105-117.

Gidenne, T.; Jehl, N.; Segura, M. and Michalet-Doreau, B. (2002). Microbial activity in the caecum of the rabbit around weaning: impact of a dietary fiber deficiency and of intake level. Anim. Feed Sci. and Technol., 99: 107 – 118.

Hamendra, S. P., Yamini, D., and Anand Kar (2010). Fruit and vegetable peels: Paving the way towards the development of new generation therapeutics, Drug Discoveries & Therapeutics. 4(5):314-325.

Ibrahim, M., (2000). Efficiency of Using Peanut Hay and Carrot-tops Hay for Feeding Growing Rabbits. Egypt Journal of Rabbit Science, 10: 147-156.

Khamis, M. (2014). Impact of garlic (Allium Sativum) on growth traits for two lines of rabbits under hot climates condition.M. Sc. Thesis, Fac. Agro., AlexUniversity, Egypt.

Lardy, G. and V. Anderson (2009). Alternative feeds for ruminant NDSU. Permission @ ndsu.edu. North Dakota State University Agriculture and University Extension Dept. 7070, Morrill 7, P.O. Box 6050, fargo,ND 58108-605.

Martinez-Puig, D.,J.F. Perez, M. Castillo, A. Andaluz, M. Anguita, J. Morales and J. Gasa, (2003). Consumption of raw potato starch increases colon length and fecal excretion of purine bases in growing pigs.J.Nutr., 133(1):134-139.

Mehrez, A. and M. Mousa, (2011). Growth Performance of Rabbits Fed Olive Pulp in North Sinai. Asian Journal of Animal Science, 5: 317-329.

Mikhail W. Z.; Abd El-Samee M. O.; Shebl M. A. and Abo-Atia A. R. (2013). Using distillers dried grains with solubles

ISSN: 2537-0367 **eISSN : 2537-0375**

(DDG'S) supplemented with enzymes in quail diets. Egypt. Poult. Sci. 33:805-823.

National Research Council, (1994). Nutrient Requirements of Poultry. 9th Ed. National Academy Press, Washington, DC, USA.

Omer, H.A.A. F.A.F. Ali and Sh. A.M. Ibrahim (2011). Strawberry By-Products as a Partial Replacement of Clover Hay in Rabbit Diets, American-Eurasian J. Agric. & Environ. Sci., 11 (6): 815-823, 2011

Parmar, H.S., and Kar, A., (2009). Comparative analysis of free radical scavenging potential of several fruit peel extracts by in vitro methods. Drug Disc Ther. 3:49-5.

Pascual, M.J. and Fernandez-Carmona, J.(1980).Citrus pulp in diets for fattening rabbits.Anim. Feed Sci. and Technol.,5:23-31.

Santoma, G. J. C.; De Blas, J. C.; Carabaño, R. and Fraga, M. I. (1989). Nutrient of rabbits. 3rd Feed Manufactures Conference, Nottingham University, pp. 109 – 137.

Sarhan, M. A. (2005). Utilization of agro-industrial by-products of pea (Pisum Sativum) in growing rabbit diets. Egypt. J. rabbit Sci., 15 (2): 157 – 172.

SAS. (2003). SAS/STAT Users Guide: Version 8 for Windows. SAS Istitute Inc., Cary, NC., USA.

Schneider, B. H. and Flatt, W. P. (1975). The evaluation of feed through digestibility expermints. University of Georgia Press Athens, Georgia, USA. P. 423.and terminal cross rabbits. J. App. Rabbit Res., 4: 66.

Shamma, T., A.,Abdel-Azeem, F. Abdel-Azeem, and Said M. Ismail(2014).The effect of Incorporating treated jojoba meal in broiler diets on productive and physiological performance. Egypt. Poult. Sci. Vol (34) (I):(305-331)

Singh N, Kamath V, Narasimhamurthy K, Rajini P. S.(2008). Protective effect of potato peel extract against carbon tetrachloride-induced liver injury in rats. Environmental Toxicology and Pharmacology;26(2):241-246.

Singh, N., Kamath V.and RajiniP.S., (2005). Attenuation of hyperglycemia and associated biochemical parameters in

ISSN: 2537-0367 **eISSN : 2537-0375**

STZ-induced diabetic rats by dietary supplementation of potato peel powder. Clin. Chim. Acta., 353(1-2): 165-175.

Tag El-Din, T., F. Aggoor and M. El-Meligy, (1998). The Possibility of Using Turnip as Non-Conventional Feeding Source in Rabbit Feeding and its Effects on Growth Performance, Carcass Quality, Some Litter Traits and Nutrients Digestibility. Journal of Agriculture Science, Mansoura Univ., 23: 5911-5921.

Zeweil, H.S. (1992). Use of residue from pea (Pisium sativum) processing in feeding growing rabbits. Egypt. Poult. Sci., 12: 17-30.

ISSN: 2537-0367 **eISSN : 2537-0375**