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Nutritional Evaluation of Fermented Potato (*Solanumtuberosum*) and Green Bean (*Phaseolus vulgaris*) Vines in Growing Rabbit Diets

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THE aim of this study is to investigate the influence of using fermented potato (*Solanumtuberosum*) and green bean (*Phaseolus vulgaris*) vines on a growing rabbits. A 75 NZW weaned unsexed rabbits at 6 weeks of age 614.62±1.95g as average body weight were assigned randomly, into 5 treatments of 15 rabbits each. Five pelleted diets were: control and other diets of 15 or 30% fermented Potato and green bean vines. The growth trial lasted 8 weeks. Results indicated fermentation treatments improved final body weight, body weight gain and feed conversion, and performance index values (%) were significantly improved with 15 or 30% fermented potato and green bean vines. Total feed intake did not significantly affect by dietary treatments. Digestibility's of CP, CF, NFE, TDN and DE were significantly increased with feed a 15 or 30% fermented Potato and green bean vines compared with the control diet. On the other hand, nutritive values of DCP were significantly affected with 15 or 30% 15 or 30% fermented potato and green bean vines compared to the control diet. However, final body weight, body weight gain and feed conversion, Carcass (weight and percentage), dressing percentages, total protein, albumin, globulin, AST, ALT, total cholesterol, creatinine, urea and. moisture, CP, ash, EE of meat were no affected between different treatments. Net revenue (LE) for diets and economic efficiency increase with the fermentation of different treatments and the best values for them were recorded with 15% Potato and green bean vines diets compared to the other treatments.

Keywords: Growing rabbit, Using fermented potato, Green bean, Blood parameters.

Introduction

Feed is the major input cost in animal production, about 65-70% of the total cost [1].Vegetable residuals are very good choice to be include in animal diets. They produced numerous amounts and could be environmental pollutants, for example, the total waste produced from tomatoes was approximately 3.70 million tons/year in the world [2].

Moreover, vegetable by-products have potential nutritive value for animal feeding. Several types of research determined the nutritive value of several kinds of vegetable residuals as this disposal as animal feed value [3, 4, 5]**.** Vegetable vines are the cheapest contents of essential amino acids, vitamins and minerals. Potato, tomato and carrots vines can help to reduce feeding costs in rabbits where ration could be used in fresh, dried or ensiled forms. Ensilaging had improved the fermentation of several varieties of crops. However, inoculation with lactic acid bacteria to forage is needed to ensure consistent improvement in fermentation and decreased anti-intuitional factors [6]. Also, Fazaeli and Mahdavi [7],found that the effects of rice straw, molasses, ground barley and salt improvement for berseem clover silage. Silage supplementation can be used to adjust moisture, nutrient composition, silage value, palatability, develop rapid fermentation decrease storage losses, and limit the extent of fermentation declining fermentation losses [8]. Lin *et al*. [9] investigated the fermentation quality, digestibility and preferences of total mixed ration with fermented food by-products (tofu cake or green tea waste).The dry matter intake recorded the highest value with tofu cake by-product than the control group. Therefore this study aimed to investigate the effect of using fermented Potato *(Solanumtuberosum)* and green bean (*Phaseolus vulgaris*) vines on the productive performance of growing rabbits.

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Material and Methods

The present study was carried out at Sakha Experimental Station, Animal Production Research Institute, Ministry of Agriculture, Egypt. The experimental farm work lasted 8 weeks. Animals in the 1st group (control group, T1) were fed a concentrated feed mixture (CFM), while animals in T2 and T3 were fed 85 or 70% CFM pals 15 or 30% fermented Potato vines, respectively and animals in T4 or T5 were fed 85 or 70% CFM pals 15 or 30% green bean vines, respectively. Table (1) showed the formulation and chemical analysis of the experimental diets fed to rabbits.

TABLE 1. Chemical composition of feedstuff of rabbit growth during experimental.

Feed stuff	DM%	OM	CP	CF	EE	NFE	Ash
Concentrate mixture	92.12	95.59	17.10	12.74	1.99	63.76	4.41
Fermented Potato (P)	33.5	97.56	11.11	20.55	1.15	64.75	2.41
Green bean (B)	34.8	96.61	13.75	18.12	1.12	63.62	3.39
Chemical composition calculated							
T1: 100% CFM (control)	92.12	95.59	16.10	13.74	1.99	63.76	4.41
T2: 85% CFM+15% P	92.33	95.88	16.21	13.61	1.86	63.91	4.12
T3: 70% CFM+30% P	74.54	96.17	15.25	15.08	1.73	64.05	3.83
T4: 85% CFM+15% B	92.52	95.74	16.60	13.55	1.86	63.74	4.26
T5: 70% CFM+30% B	74.92	95.89	16.03	14.36	1.73	63.72	4.11

Animals

NZW weaned unsexed rabbits (75) at five weeks of age were randomly divided into five experimental groups of 15 rabbits each with approximately similar initial body weights (614.62 ±1.95 g). Rabbits were fed the experimental diet to meet their nutrient requirements during the growing period according to Agriculture Ministry Decree [10] recommendations. Any health problems or death were recorded during the experimental period. Rabbits were housed in wire floor batteries and diets were offered in pelleted form with drinking water *ad-libtum* all over the experimental period (8 weeks**).**

Fermentation treatment of crop residues

Potato and green bean vines were chopped into 3-5 cm and strained until the moisture level reached 65-70% then ensiled layer in order and left 30 days in a moderate temperature (28-30°C). The control diet without fermented potato and green bean vines while the other four diets were of fermented potato and green bean vines as shown in Table 1. Chemical analyses of fermented potato and green bean vines are presented in Table 2. The digestible energy (DE kcal /kg) of fermented potato and green bean vines was calculated according to the equation of Cheek [11].

TABLE 2. Chemical analysis of fermented potato and green bean vines (on DM basis)

Items	Fermented Potato vines	Fermented bean vines
DM%	28.87	32.37
Chemical analysis% (on DM basis)		
OM%	97.56	96.61
Crude protein (CP%)	11.11	13.75
Crude fiber (CF%)	20.55	18.12
EE%	1.15	1.12
Nitrogen free extract (NFE%)	64.75	63.62
Ash%	2.44	3.39
DE (kcal/kg)	**2276.69**	**2355.25**
Cell wall constituents		
NDF	42.43	40.83
ADF	28.17	25.96
ADL	6.22	6.03
Hemicellulose	14.26	14. 87
Cellulose	21.95	19.93

Growth performance traits

Live body weight and feed intake were recorded weekly; also weight gain and feed conversion ratio were calculated according by North [12].

Digestibility trial

Four rabbits were used for each treatment in a digestibility trial that was conducted at the end of the experimental period (at 14 weeks of age). Daily collections of faeces were made, weighted, dried at 60 to 70 o C for 24 hours, powdered finely, and preserved for chemical analysis. To determine the nutrients digestion coefficients and nutritional values of dietary treatments, data on amounts and chemical analyses of feed and faeces were collected as described by Cheeke *et al*. [13]. The technique was determining the amounts of detergent lignin (ADL), acid detergent fiber (ADF), and neutral detergent fiber (NDF) by Van Socest [14]. The samples were chemical analysis according to A.O.A.C. [15].

Traits of carcass

Three rabbits were slaughtered and carcass traits were measured in each group at the end of the experimental period. The relative weight of giblets percentages (heart, liver and kidney) and dressing percentages were calculated by Abu El-Hamd *et al.* [16]. Boneless meat and faeces were chemical analysis according to AOAC [15].

Blood parameters

Blood samples were collected by vacuum pump into dry clean tubes using heparin as an anticoagulant at the end of the experimental period (at 14 weeks of age). The collected samples were centrifuged at 3000 rpm for 15 min and then separate blood plasma, and stored at -20°C for subsequent analysis. Blood plasma was utilized to determine the following biomarkers using calorimetric methods: total protein, albumin, globulin, A/G ratio, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), urea, creatinine, total cholesterol, LDL and HDL.

Activity of caecum

Caecum contents samples from identically slaughtered rabbits in each treatment were collected and utilised right away to determine the caecum pH, total volatile fatty acids, ammonia nitrogen concentration and microbiological analysis. A digital pH meter was used to rapidly determine the pH of the caecum's contents.Ammonia nitrogen concentration was determined by Conway [17]. The total volatile fatty acids were determined by Eadie *et al*. [18].

Microbiological analysis

Cecum microflora (bacteria) Aerobic total count, Fecal coliforms, *Escherichia coil* count, *Bacillus cereus*, Enterobacter, Clostridium sp., Enterococcus, yeasts, Salmonella and Shigella. The microbial contents were studied in their selective media, as described by Postage [19] for Aerobic total bacterial counts and Difco [20] for Fecal coliforms and *E. coli*, while, the methods described by Baired Parker [21] and Kim and Goepfert [22] were used for Enterococcus and Bacillus cereus, respectively and Difco [20] for Enterobacter and Clostridium sp.; while the method described by Lodder [23] was used for yeasts determination. Salmonella and Shigella were enumerated according to the methods described by AOAC [24]. Colony forming unit (CFU) technology was used. The incubation period lasted 2–7 days at 30 ^{o}C.

Statistical analysis

Using the SAS [25] computer software, data were statistically analyzed using the following fixed model: Yij= μ +Ti + eij

Where: Yij = An observation, μ = Overall Mean, Ti = Treatment Effects and eij = Assumed Normally Distributed Random Error Component. To find significant variations between means, Duncan's multiple range tests were run [26].

Results and Discussion

Chemical composition of fermented Potato and green bean vines

Data in Table 2 show that, fermented Potato and green bean vines contained 2276.69 and 2355.25, respectively digestible energy (DE). Also, it contains crude protein (CP) values of 11.11, and 13.75, respectively, but, it contains higher crude fiber values (CF) of 20.55, and 18.12, respectively. Nitrogen free extract (NFE) content values were 64.75, and 63.62, respectively. Moreover, NDF values were 42.43, 40.83respectively. Values of ADF were 28.17, and 25.96, respectively. ADL values were 6.22, and 6.03, respectively. Hemi cellulose values were 14.26, 14.87 respectively. However, values of cellulose were 21.95, and 19.93 respectively. Ash content was 2.44 and 3.39 respectively. Ensilaging had improved fermentation and nutritional value and increased of many by-products because they have significant levels of carbohydrates. While, the contents of crude fiber were decreased because microorganisms depend on this material as a carbon source for microbial protein formation and growth [27]. Moreover, findings for both potato and green vines values are close [28-30]. Also, values are comparable to those reported by Gupta *et al*. [31] who concluded that cull bean waste had potential used as livestock feed if processed suitably.

Growth performance traits

Results in Table 3 indicated that LBW in 10 weeks of age and final body weight in tested groups significantly increased for 15 or 30% fermented potato and green bean vines compared to the control diet.–Whereas the highest value of the body weight (1490 g) was recorded for in rabbits received 30 % green bean while the lowest value was recorded in the control diet (1470.42 g). Also, the final weight value was measured the highest level (2312.92g) in rabbits received 15% fermented green bean vines followed by 30% fermented green bean vines which recorded (2305.42 g) compared with the control group (2246.67g). Moreover, feed conversion and BWG significantly improved in (6-10) and (6-14) weeks of age for fermented potato and green bean vines compared with the control group. Also, weight gain and feed conversion were significantly improved for fermented potato and green bean vines compared with the control group at (6-14) weeks of age. While, during 6-10 weeks of age period, there was no significant effect on BWG and feed conversion. However, the feed intake in (10-14) weeks and relative growth performance had a significant among different treatment groups. Also, performance index (%) values confirm the improvement in performance parameters significantly increased with 15 and 30% fermented potato and green bean vines compared with control. Improving LBW, BWG, feed conversion, performance index and relative growth rate with fermentation of fermented potato and green bean vines were higher contents of amino acids, exogenous enzymes and like vitamins as a result of microorganism activity [32]. These results were, also, confirmed by Salama and Abo El-Azayem [33] who reported that rabbits feeding on 25% biologically treated palm fronds with EM1 improved final LBW and WG.

TABLE 3. Rabbits performance values as affected by the experimental diets

Items	Control Diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
Initial body weight(g)	614.42	614.75	614.58	614.42	614.92	1.95
Body weight 10 weeks of age	1470.42^{c}	1473.33^{c}	1476.25^{abc}	1487.92^{ab}	1490.00^{a}	5.22
Final body weight (g)	2246.67^{c}	2263.33^{bc}	2276.67^{b}	2312.92^{a}	2305.42^{a}	9.05
***Body weight gain* (g)**						
6-10 weeks of age	856.00	858.58	861.67	873.50	875.08	5.86
10-14 weeks of age	776.25^{c}	790.00^{bc}	800.42^{abc}	825.00^{a}	815.42^{ab}	9.89
6-14 weeks of age	1632.25^{c}	1648.58^{bc}	1662.08^{b}	1698.50^{a}	1690.50^{a}	9.15
***Feed intake(*g)**						
6-10 weeks of age	2095.00	2047.83	1990.08	2092.67	2068.50	63.98
10-14 weeks of age	3392.0^{a}	2812.0^{b}	326.33^{a}	3092.3^{ab}	3073.5^{ab}	108.3
6-14 weeks of age	5487.0^{a}	4859.8^{b}	5250.4^{ab}	5185.0^{ab}	5142.0^{ab}	148.7
Feed conversion ratio						
6-10 weeks of age	2.48	2.41	2.32	2.42	2.40	0.08
10-14 weeks of age	4.50^{a}	3.63^{b}	4.09^{ab}	3.76^{b}	3.87^{b}	0.16
6-14 weeks of age	4.10^{a}	3.39^{b}	3.74^{ab}	3.49^{b}	3.58^{b}	0.13
Relative growth rate (%)	114.09^{c}	114.56^{c}	114.97^{bc}	116.04^{a}	115.75^{ab}	0.33
Performance index (%)	55.15^{b}	69.49^{a}	61.97^{ab}	66.99^{a}	65.28^{a}	2.74

A and b: Different superscripted means within the same row are substantially different ($P< 0.05$).

Digestibility coefficients and nutritive values

Results in Table 4 revealed that all digestibility coefficients and nutritive values were significantly increased with feeding 15 or 30% fermented potato and green bean vines, respectively compared with the control diet. Abd–El Ghany *et al*. [34] found that digestion coefficients significantly increased CP, CF, EE and nutritive values when replacing berseem hay with 15 or 30% conocarpus treated with EM1 in diets compared with control in rabbit diets. Additionally, Salama and Abo El-Azayem [33] discovered that there was no discernible impact on the apparent digestibility of DM, OM, and NFE. In contrast, when rabbits were fed diets made up of 50% untreated discarded palm fronds and 50% bio-treated biologically (EM1) discarded palm fronds; the digestibilities of CP and CF were considerably the best.

TABLE 4. Digestibility coefficients of nutrients and nutritive values% as affected of growing rabbits by experimental diets.

Items	Control Diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
DM	72.65^{c}	73.97^{bc}	74.97^{ab}	76.48^{a}	76.30^{a}	0.47
OM	61.70^{c}	63.82^{b}	65.31^{ab}	66.45^{a}	66.37^{a}	0.51
CP	74.22^{c}	75.84^{b}	76.23^{ab}	76.76^{ab}	77.29^{a}	0.36
CF	29.34^{c}	32.41^{b}	35.00^{a}	36.06^{a}	36.26^{a}	0.41
EE	70.67^{c}	72.39^{b}	72.50^{b}	74.27^{a}	74.20^{a}	0.26
NFE	75.89^{c}	76.18^{bc}	76.81^{ab}	77.28^{a}	77.07^{a}	0.20
DCP	12.91^{b}	13.13^{b}	13.19^{b}	13.42^{a}	13.44^{a}	0.07
TDN	62.87^{c}	63.65^{b}	64.68^{a}	64.76^{a}	64.77^{a}	0.24
*DE kcal/kg	2785.14^{c}	2819.85^{b}	2865.32^{a}	2868.72^{a}	2869.16^{a}	10.62

a and b: Different superscripted means within the same row are substantially different (P< 0.05).
*DE = TDN × 44.3 (Schneider and Flatt, 1975).

That's progressing high water holding capacity, easy gel formation, increased luminal viscosity, and simple microflora degradation in the large bowel are all characteristics of soluble fibre. On the other hand, insoluble fibre increases faecal mass, reduces transit time, and only partially degrades by microflora. It also has a low capacity to store water [35]. For diets including fermented by products, improvements in chemical composition, nutritional values, and digestibility of nutrients account for the improvement in performance. Digestibility coefficients (DCF) of the diets, except crude fat, were no significant. The lack of significance may be partially explained by the high variability of the DCFs with the diet of maize silage [36]. The improvement of CP and CF digestibility may be, also due to stimulated absorption in treated tissues and increased intestinal nutrients absorption [37, 38].

The results in Table 5 indicate that carcass, edible giblets, liver, kidneys, lungs, spleen%, heart% and dressing percentage were not significantly affected by different treatments. While, carcass weights**,** carcass and dressing percentages were significantly affected. The highest value (58.81%) of dressing percentage was noticed in rabbits fed 30% fermented potato vine compared with the rabbits fed the control diet which recorded 52.65%. The improvement of carcass traits with feeding 30% fermented potato may be related to the enhancement of body weight gain. In opposite, the results which recorded by Salama and Abo El-Azayem [33**]** who found that carcass weight and dressing percentages were not significant improved with those fed on treated biologically (EM_1) discarded palm fronds diets as compared to rabbits fed the control diet. In this respect, there were insignificantly affected by different treatments in edible giblets rabbits fed 15 or 30% berseem hay replaced by conocarpus treated with EM_1 [34].

TABLE 5. Carcass traits of growing rabbits fed different diets

Items	Control Diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
Carcass wt	1115.0^{b}	1224.7^{ab}	1256.3^{ab}	1238.3^{ab}	1345.0^{a}	57.2
Carcass %	48.05^{b}	49.55^{ab}	54.57^{a}	52.96^{ab}	51.46^{ab}	1.73
Edible giblets,%	4.60	4.29	4.24	4.20	4.54	0.41
Liver, %	3.44	3.13	3.15	3.12	3.45	0.34
Heart, %	0.37	0.38	0.34	0.34	0.33	0.06
Kidneys ,%	0.79	0.78	0.75	073	0.76	0.06
Spleen, %	0.05	0.04	0.05	0.05	0.05	0.012
Lungs%	0.60	0.59	0.59	0.61	0.62	0.07
Dressing, %	52.65^{b}	53.84^{b}	58.81^{a}	57.16^{a}	56.00^{a}	1.62

a and b: Different superscripted means within the same row are substantially different (P< 0.05).Dressing % = Empty carcass %. (Without head) + Edible giblets %t.

Blood parameters

The all blood plasma concentration were insignificantly differences. Whereas the concentrations of total protein, albumin, globulin, AST, total cholesterol, LDL, HDL, creatinine and urea of plasma for rabbits fed 15 or 30% % fermented potato and green bean vines diets were fluctuated between the different treatments and with the control treatment (Table 6). Result is agree with Salama and Abo El-Azayem [33] who revealed that total protein, albumin, AST, creatinine and urea concentrations were not affected by different treatments. In the same trend, the present results were contradiction with Abd–El Ghany *et al.* [34], who discovered that when rabbits were fed physiologically conocarpus with EM1 at levels of 15 or 30 present compared to untreated ones, cholesterol was significantly (P<0.05) lower. Low cholesterol levels may be related to both a reduction in cholesterol biosynthesis in the liver and a high level of bile acid degradation by Lactobacillus species, according to Mousa *et al.* [39] who reported that administration of EM1 in rat diet produced a significant decrease in cholesterol, triglycerides, and levels of alloxan-induced diabetic rats. They also reported that administration of EM1 in chicken diet produced a similar result Cenesiz *et al.* [40].

TABLE 6. Blood parameters of growing rabbits fed on different experimental diets.

Items	Control Diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
Total protein (g/dl)	7.10	7.23	7.20	7.30	7.27	0.08
Albumin (g/dl)	3.98	4.14	4.18	4.10	4.06	0.10
Glublmn (g/dl)	3.12	3.09	3.02	3.20	3.21	0.10
ALT(U/L)	34.67	32.00	32.00	32.33	34.66	2.05
AST(U/L)	48.33	44.67	41.00	47.00	46.66	1.79
Total cholesterol(mg/ dl)	30.00	27.67	31.00	29.67	30.00	1.28
LDL(mg/ dl)	9.47	10.07	9.80	9.00	9.20	0.53
HDL(mg/ dl)	6.00	5.33	7.00	6.33	5.67	0.73
Creatinine (mg/ dl)	1.10	1.10	1.03	1.09	1.08	0.04
Urea-N (mg/ dl)	34.00	34.33	32.33	34.33	32.67	1.76

A and b: Different superscripted means within the same row are substantially different (P< 0.05).

Chemical composition of meat

Chemical composition of meat may be seen insignificantly differences in moisture**,** EE and ash of rabbits meat with different experimental diets. However, the CP% was significantly affected with tested groups. Whereas the highest value of CP (25.08) was limited in rabbits received 30% of fermented green bean vines while the control diet was recorded about 24.26 (Table 7). These results agreed with Abd–El Ghany *et al.* [34] who found that moisture of rabbit meat were not affected by fed conocarpus treated with EM_1 compared to control.

TABLE 7. Meat chemical composition of growing rabbits fed on experimental diets

Items	Control Diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
Moisture%	72.90	73.15	72.64	72.90	72.78	0.24
ASH%	1.57	1.22	1.32	1.29	1.04	0.13
CP%	24.26^{b}	24.49^{b}	25.01^{a}	$24.66a^{b}$	25.08^{a}	0.16
EE%	1.27	1.15	1.03	1.14	1.09	0.03

A and b: Different superscripted means within the same row are substantially different (P< 0.05).

Caecum traits and microbiological assay

Caecum content of pH, TVFA and ammonia concentration of the study are found in Table (8). Analysis of variance revealed that feeding on fermented potato and green bean vines didn't have any significant effect on caecum weight (g) and TVFA. However, it had a significantly effect on TVFA and ammonia**.** Whereas, the highest value of TVFA (4.28 mg/100ml) was recorded for15% fermented green bean vines while the control diet was recorded the lowest level about 3.95 mg/100ml. However, the highest value of ammonia (10.16 mg/100ml) was recorded in the control diet. These results agreed with obtained by Abd–El Ghany *et al.* [34] who reported that production of TVFA significantly higher while, the ammonia concentration of caecum was significantly decreased (P≤ 0.05) in rabbits fed on diets containing 15% and 30% conocarpus treated with EM1 diets.

TABLE 8. Caecum traits of growing rabbits fed on experimental diets

Items	Control Diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
Caecum weight (g)	124.07	133.60	129.73	143.13	142.23	9.87
pH caecum	6.20	6.21	6.40	6.22	6.33	0.13
TVFA (mg/100ml)	3.95^{a}	4.11^{ab}	4.24^{a}	4.28^{a}	4.26^{a}	0.05
Ammonia(mg/100ml)	10.16^{a}	9.87^{b}	9.65^{c}	9.62^{c}	9.59^{c}	0.06

A and b: Different superscripted means within the same row are substantially different (P< 0.05).

For microbiological assay results shown in Table 9 revealed that the significant effect was on the aerobic total count, *Enterococcus* and yeasts. The highest values of their values were for the control diet. These results may be related to the useful effect of fermentation microbes in fermented potato and green bean vines on caecum activity ([32, 34]. Also, feeding on 25 or 50% biologically treated (EM1) discarded palm fronds diets no significant effect on pH values [33].

TABLE 9. Microbial counts (x 10^8 CFU/ml) as affected by the experimental diets

Cecum microbes (CFU/ml)[1]	Control diet	Fermented potato vines		Fermented green bean vines		SEM
		15%	30%	15%	30%	
Aerobic total count	7.57^{a}	7.60^{a}	6.47^{b}	7.13^{ab}	7.0^{ab}	0.30
Fecal coliforms	5.64	5.73	5.58	5.57	5.73	0.23
E.Coli	1.57	1.63	1.37	1.30	1.20	0.18
Bacillus cereus	3.23	3.20	3.00	2.77	2.90	0.22
Enterobacter	2.50	2.50	2.23	2.40	2.97	0.23
Clostridium sp	1.12	1.13	1.10	1.10	1.09	0.07
Enterococcus	2.57^{a}	2.60^{a}	1.47^{c}	2.13^{ab}	1.97^{bc}	0.18
Yeasts	3.13^{b}	3.15^{b}	3.14^{b}	3.23^{ab}	3.26^{a}	0.03
Salmonella &Shigella	ND	ND	ND	ND	ND	-

Each value is an average of 3 observations. ND =Not detected [1]CFU =Colony forming unite. Number of bacterial cells per gram of cecum content (log10-1 CFU/ml).

Economic efficiency

Results presented in Table 10 reported that the economic efficiency increase with fermentations, that the best values for them were recorded with 15% of fermented potato vines diet, which was recorded about 123.18 followed by 15% of Fermented green bean diet, which recorded 116.81, compared with the control diet which recorded 100. Total feed cost reduced in both 15 or 30 % fermented potato and green bean vines diets as a result to reducing of feed intake than control diet. Also, the selling price was increased in 15 or 30% fermented potato and green bean vines diets this increase may be due to an high in AWG (kg) at levels 15 or 30% than the control. The use of untraditional feedstuffs such as the agricultural by-products in the diets may helps in solving the problem of feed shortage and decreases the cost of feeding [41]. Moreover, Abdel-Monein [42] showed that the use of green beans processing by-products in the broilers diet led to improve the economic point of view by decreasing the total cost of the diet and thus increasing the profitability. Also, dried GBV can be successfully used as a suitable ingredient in pelleted complete feed for growing rabbits and being more economically than the control diet under Egyptian conditions dried green bean vines can be successfully used as a suitable ingredient in pelleted complete feed for growing rabbits and being more economically than control diet under Egyptian condition [38].

TABLE 10. Economic efficiency of growing rabbits fed experimental diets

Items	Control Diet	Fermented potato vines		Fermented green bean vines	
		15%	30%	15%	30%
Total weight gain (kg)	1.63	1.65	1.66	1.70	1.69
Price of 1kg body weight	45	45	45	45	45
Selling price/rabbit (LE) (A)	73.35	74.25	74.70	76.50	76.05
Total feed intake (kg)	5.49	4.86	5.25	5.19	5.14
Price/kg feed(LE)	4.17	4.12	4.11	4.13	4.12
Total feed cost/rabbit (LE)(B)	22.89	20.02	21.58	21.43	21.18
Net revenue(LE)[1]	50.46	54.23	53.12	55.07	54.87
Economic efficiency[2]	2.20	2.71	2.46	2.57	2.51
Relative economic efficiency	100	123.18	111.81	116.81	114.09

(1) Net revenue = A – B.
(2) Economic efficiency = (A-B/B x 100).

Conclusions

In conclusion, fermented potato (*Solanumtuberosum*) and green bean (*Phaseolus vulgaris*) vines could be used in feeding of growing rabbits up to 30% in their diets was useful the effect on productive performance, carcass traits, physiological functions and economic efficiency and therefore may help in solving the problem of animal feeding gap and decrease the cost of feeds.

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The authors declare that the present study has no financial issues to disclose.

Conflict of interest

None

Authors contributions

All authors contributed to the study's conception, and design. Data collection, examination and experimental study were performed by FTA, MMA and MAA. All biochemical analysis and data analysis were performed by FTA and MMA. All authors drafted and corrected the manuscript; MAA revised the manuscript. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

References

1. FAO. *Production year book*, vol.46. Food and agricultural Organization of the United (2000).
2. FAO. *Production Year Book*, Vol. 44. Food and agricultural Organization of the United (1991).
3. Bordowski, I. and Geisman, J.R. Protein content and amino acid composition of protein of seeds from tomatoes at various stages of ripeness. *Journal of Food Science*, **45**, 228-235 (1998).
4. Sayed, A.B.N. and Abdel-azeem, A.M. Evaluation of dried tomato pomace as feed stuff in the diets of growing rabbits. *International Journal of for Agro Veterinary and medical Science*, **3**, 12-18 (2009).
5. Karkoodi, K and Ghaffari, S.A. Ensiling fruit and vegetable residues as ruminants feed. *Research Opinions in Animal and Veterinary Science*, **2**(6),397-401 (2012).
6. Huisden, I. N. and McAllister, T.A. Effects of inoculants on whole-barley silage fermentation and dry matter disappearance in situ. *Journal of Animal Science*, **80**,510-516 (2009).
7. Fazaeli, H. and Mahdavi, R. Effect of rice straw, molasses, oatmeal and salt on silage 2941 .*Advances in Environmental Biology,* **6**(11), 2937-2941 (1996).
8. McDonald, P., Henderson, A.R. and Heron, S. *The biochemistry of silage*. Kingston, Kent: Chalcombe Publications., pp: 340 (1991).
9. Lin, D.Y., Lee, S.S., Choi, N.J., Lee, S.Y., Sung, H.G., Ko, J.Y., Yun, S.G. and Ha, J.K. Effects of feeding system on rumen fermentation parameters and nutrient digestibility in Holstein steers. *Asian-Australasian Journal of Animal Science*, **16**,1482-1486(2008).
10. Agriculture, Ministry Decree. The standard properties for ingredients, feed additives and feed manufactured for animal and poultry. El-Wakaee El-Masria, No. 192 (1997) P 95 Amirria Press Cairo, Egypt (1996).
11. Cheek, P.P. *Rabbit Feeding and Nutrition*. Orlando: Academic Press, Inc. Harcourt, Brace, Jovanovich, Publishers (1987).
12. North, M.O. *Commercial Chicken Production*. Annual. 2nd ed., Production 6th ed., Interstate Printers and Publishers. INC., USA (1981).

13. Cheeke, P.R., Patton, N. and Templton, G.S. *Rabbit Production*.5th Edition. The Intersate Printers and Publishers Danville II (1982).
14. Van Socest, P.J. *Nutritional ecology of ruminant O and B Books*. Inc., Corvallis, Oredon. **112**, 126-127 (1982).
15. A.O.A.C. *Official Methods of Analysis*. 15th ed. Association of Official Analytical Chemists. Washington, DC., USA (2000).
16. Abu El-Hamd, M.A., Abdelmeseh, I.L.I., Salama, A.M.A., Khalifa, E.A.S. and Enas Elsedfy, R.M. Veal production using two types of raising Friesian calves. *Egyptian Journal of Animal Production* **48**, 1-10 (2011).
17. Conway, E.J. *Micro-diffusion analysis and volumetric error*. (4th Ed.) The McMillan Co., New York (1958).
18. Eadie, J.M., Hobson, P.N. and Mann, S.O. A note on somecomparisons between the rumen content of barley fed steers and that of young calves also fed on high concentrate rations. *Journal of Animal Production*, **9**, 247 (1967).
19. Postage, J.R. Viable counts and viability. In: *Methods in Microbiology*. Norris, J. R., Robbens, D.W. (Ed.), vol. 1. Academic Press, London, N.Y.: 611-628 (1969).
20. Difco, M. Difco Manual of Dehydrated Culture Media and Reagents for Microbiological and Clinical Laboratory. Procedures Ninth Edition. Butterworth, Washington, D.C. (1989).
21. Baired Parker, A.C. The occurrence and enumeration of micrococci and staphylococci in becon and on human and pig skin. *Journal of Applied Microbiology,* **25 (5)**, 352-361 (1962).
22. Kim, H.U. and Goepfert, J.M. Enumeration and identification of Bacillus cereus in foods, 1, 24- hours presumptive test edium. *Applied Microbiology,* 22: 581-587 (1971).
23. Lodder, J., 1952. The yeasts.1st Ed. Pup. Inc., N.Y.
24. A.O.A.C. Association of Official Analytical Chemists, Official methods of analysis.15th Edition, Published by the AOAC, Washington, D. C., USA (1998).
25. SAS. SAS User's guide: Statistics, Version 9th Ed. SAS Institute Inc., Cary N.C., USA (2001).
26. Duncan, D.B. *Multiple range and multiple F tests*. *Biometrics*, **1**, 1-42 (1955).
27. Villas-Boas, S.G. Esposito, E. and Mitchell, D.A. Microbial conversion of lignocellulosic residues for production of animal feeds. *Animal Feed Science and Technology*, **98**,1-2 (2002).
28. Tag El-Din, T.H., El-Sherif, Kh., El-Samra, H.A. and Hassan, H.A. Effect of using graded levels of Phaseolus vulgaris straw in growing rabbits diet. *3rd Science Congr. Rabbit Production in Hot Climates*, **8-** (11), 643-659 (2002).
29. Hussien, F.A.H. Nutritional evaluation of some vegetable crop wastes used in rabbits feeding. Ph.D. Thesis, Fac. of Agric., Cairo Univ., Egypt (2009).
30. Elgohary Fatma, A. and Hayam Abo EL-Maaty, M.A. Phaseolus vulgaris straw as a substitute for clover hay in rabbit diets with prebiotic supplementation and feed restriction interaction: influence on nutrient utilization, caecal activity, carcass yield and blood plasma constituents. *Global Veterinaria*, **13**(6), 1010-1021 (2014).
31. Gupta, R., Chauhau, T.R. and Lall, D. Nutritional potential of vegetables waste products for ruminants. *Bioresource Technology*, 263-265 (1993).
32. Belewu, M.A. and Popoola, M.A. Performance characteristics of West African dwarf goat fed rhizopus treated sawdust. *Scientific Research and Essay*, **2** (9),496 (2007).
33. Salama, W.A. and AboEl-Azayem, E.H. Partial replacement of clover hay by discarded palm fronds on performance of growing rabbits. *Egyptian Journal of Rabbit Science*, **28** (1), 173 -193 (2018).
34. Abd–El Ghany, F.T.F., Ali, W.A.H., Mahmoud, M.A. and Lamiaa Abdel-Mawla, F. Effect of partial replacement of berseem hay by biologically treated conocarpus on productive performance and physiological response of growing rabbits.9th International Poultry Conference of Egyptian Poultry Science Association. Hurgada, Red Sea. Egypt, pp 351-373 (2016).
35. Swanson, J., Deutsch, C., Cantwell, D., Posner, M., Kennedy, J., Barr, C., Moyzis, R., Schuck, S., Flodman, P. and Spence, A. Genes and attention-deficit hyperactivity disorder. *Clinical Neuroscience Research*, **1**, 207–216 (2001).
36. Guermah, H., Maertens, L. and Berchiche, M. Nutritive value of brewers' grain and maize silage for fattening rabbits. *World Rabbit Science*, **24**, 183-189 (2016).
37. Abely, M., Dallet, P., Biosset, M. and Desjeux, J.F. Effect of cholera toxin on glutamine metabolism and transport in rabbit ileum. *American Journal of Physiology Gastrointestinal and Liver Physiology*, **278**(5), 789-796 (2000).
38. Khayyal, A. Amany, Morsy, W.A. and Amira El-Deghadi, S. Effect of feeding diets containing dried green bean (Phaseolus vulgaris L.) vines on performance of growing Apri-rabbits. Egyptian *Journal of Nutrition and Feeds*, **21**(2), 427-441 (2018).
39. Mousa J.M., Salh, M.R., Waleed, M.S. and Wadah, J.M. Effect of effective microorganisms (EM) in blood sugar contrition and some biochemical parameters in normal and alloxan induced diabetic male rats. *Al Rafidain Science Journal*, **22** (2),1-15 (2011).

40. Cenesiz, S., Yaman H., Ozcan, A., Kart, A. and Karademir, G. Effects of kefir as a probiotic on serum cholesterol, total lipid, aspartate amino transferase and alanineamino-transferase activities in broiler chicks. *Medycyna Wet.*, **64**, 2 (2008).
41. Mutetikka, D.B., Carles, A.B. and Wanyoike, M. The effect of level of supplementation to diets of Rhodes grass (Chlorisgayana) hay, maize (Zea mays) leaves and sweet potato (Ipomeabatatas) vines on performance of grower rabbits. *Journal of Applied Rabbit Research*, **13**, 179-183 (1990).
42. Abdel-Monein, M.A. Effect of using green beans processing by-products with and without enzyme supplementation on broilers performance and blood parameters. *Journal of Agrobiology*, **30**(1), 43-54 (2013).

التقييم الغذائي لنباتات البطاطس المتخمرة والفاصوليا الخضراء في عليقة الأرانب النامية

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الهدف من هذه الدراسة هو دراسة تأثير استخدام كروم البطاطس المخمرة (*Solanum tuberosum*) والفاصوليا الخضراء (*Phaseolus vulgaris*) على نمو الأرانب. تم تخصيص 75 أرنبًا مفطومًا غير مجنس بعمر 6 أسابيع بوزن 614.62 ± 1.95 جم كمتوسط لوزن الجسم ووزعت بشكل عشوائي، إلى 5 مجموعات لكل منها 15 أرنبًا. وكانت خمس علائق هي: العليقة الاساسية والعلا ئق الأخرى التي تحتوي على 15 أو 30% من البطاطس المتخمرة (المجموعة الثانية والثالثة على التوالى) والفاصوليا الخضراء. (المجموعة الرابعة والخامسة على التوالى) واستمرت التجربة لمدة تجربة النمو 8 أسابيع. حيث أشارت النتائج إلى تحسن ملحوظ في معاملتى تخمر البطاطس ، حيث تحسن وزن الجسم النهائي ومعدل زيادة وزن الجسم ومعدل تحويل الأعلاف وقيم مؤشر الأداء مع 15 أو 30٪ من البطاطس المخمرة وكذلك معاملتى الفاصوليا الخضراء. كما لم يتاثر يؤثر إجمالي تناول العلف بشكل معنوي على المعاملات الغذائية. اختلفت قابليات معدلات هضم CP، وCF، وNFE، وTDN، وDE بشكل ملحوظ مع البطاطس المتخمرة والفاصوليا الخضراء المتخمرة سواء المضافة بنسبة 15 أو 30٪. من ناحية أخرى، تأثرت القيم الغذائية للـDCP معنوياً عند استخدام 15 أو 30% من البطاطس المتخمرة وكرمة الفاصوليا الخضراء بنسبة 15 أو 30% مقارنة بالكنترول. أما وزن الذبيحة (الوزن والنسبة المئوية)، نسب التصافي، ومكونات الدم سواء البروتين الكلي، الألبومين، الجلوبيولين، AST، ALT، الكولسترول الكلي، الكرياتينين، اليوريا لم تتأثر وكذلك الرطوبة، CP، الرماد، وEE للحوم بين المعاملات المختلفة. بينما ارتفع صافي العائد (LE) للعلائق والكفاءة الاقتصادية مع معاملة التخمير، وسجلت أفضل القيم لها في عليقة البطاطس والفاصوليا الخضراء بنسبة 15% مقارنة بعليقة الكنترول السيطرة.

الكلمات الدالة: الارانب النامية والبطاطس المخمرة والفاصوليا الخضراء وصفات الدم.