EFFECT OF CARAWAY SEEDS SIEVING (*CARUM CARVI L.*) AS FEED ADDITIVES FOR REX RABBITS ON: 1. GROWTH PERFORMANCE, FEED DIGESTIBILITY, BLOOD PARAMETERS AND CAECUM ACTIVITY

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SUMMARY

This study aimed to investigate the effect of inclusion of caraway seeds sieving (CSS) as feed additives at different levels in rabbits' rations. The experiment was carried out at privet farm in Giza, Egypt. Thirty-six unsexed Rex rabbits breed aged 5-6 weeks with average weight of 687.25±2.75g were randomly assigned into four equal groups, (9 rabbits each) in 3 replicates and housed in galvanized wire cages (30 x 35 x 40 cm). The experimental rabbits' groups received one of the tested rations. The feeding period was extended for 56 days throughout the summer season of year 2018. The experimental rations were classified as the following: First group was fed the basal ration (R_1) served as a control group, meanwhile, the other three experimental groups were received rations supplemented with 2, 4 and 6% of CSS for (R_2, R_3, and R_4), respectively. The results showed that, chemical composition of the experimental rations was similar in their contents of CP that ranged from 20.35 to 21.40% and differed in their contents of gross energy that ranged from 4190 to 4308 kcal/ kg DM. Incorporation of CSS in the rations increasing ether extract content of tested rations comparing to control, meanwhile it decreased the contents of crude fiber and cell-wall constituents. Rabbits received 4% CSS containing ration recorded the highest (P>0.05) digestion coefficient values of (OM, CP, CF, NFE, NDF, ADF and cellulose) and nutritive values (TDN, DCP and DE). Dietary rations had no significant effect (P>0.05) on blood serum total protein; albumin; globulin; albumin: globulin ratio; total lipids; triglycerides, alkaline phosphatase, LDH and HDL. Also, serum Glutamic Oxaloacetic Transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) activities were not affected by CSS. Serum concentration of creatinine (mg/dl) was significantly higher than control. Means of pH, NH_3-N and TVFA's in caecum was no affected by levels of CSS. Rations of (CSS) significant increase of final live body weight (FLBW), total body weight gain (TBWG) and average daily gain (ADG) comparing to control. ADG ranged 19.32 to 31.27 gm, respectively among the four groups. The best value of ADG was recorded by rabbits received 4% CSS containing ration. Also, feed conversion that expressed as (g feed intake of DM, CP, DCP and TDN/ g gain) and digestible energy (kcal/ g. gain) was improved. Net revenue and relative economic efficiency were increased, meanwhile, feed cost/ kg live body weight gain was decreased. It could be mentioned that incorporation 4% caraway seeds sieving in rabbit rations realized the best results in terms of growth performance with a positive effect on digestion coefficients and occurred high net revenue.

Keywords: *Feed additives, caraway seeds sieving, rabbits, growth performance, nutrient digestibility coefficients, blood parameters and caecum activity.*

INTRODUCTION

There is an increase interesting in using the natural feed additives from whole or extracts of some herbs and edible plants as safe supplements instead of chemically produced compounds. Feed additives are important materials that can improve the efficiency of feed utilization and animal performance. Modern animal production requires the use of safe and effective additives to stimulate feed consumption and destroy harmful microorganisms of the diet. Attempt to use natural materials such as medicinal plants are widely accepted as feed additives (Aboul-Fotouh *et al.*, 2000).

Beneficial effects of herbal extracts or active substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, antiviral, antioxidant and antihelminthic actions. Isoprene derivatives, flavonoids, glucosinolates and other plant metabolites may affect the physiological and chemical function of the digestive tract (Rahimi *et al.,*2011) and had the highest stimulatory influence particularly on bile secretion and pancreatic enzymes activity (Platel *et al.,* 2002). Caraway (*Carum carvi*) seed has antibacterial and fungicidal properties and its important in pharmaceutical applications and in human and veterinary medicine (Sedlakova *et al.,* 2001). The pharmacological action of active plant substances or herbal extracts in humans is well known, but in animal nutrition the number of precise experiments is relatively low. Caraway (Hindi- Kala Jira/Arabic-Siyah Zeera) which is grown for its high content of essential oil which is mainly found in seeds (Sachan *et al.,* 2010 and Sedlakov *et al.,* 1978) it was used in folk medicine for the treatment of many complains. The major compounds occurring in caraway are carvacrol, carvone, α-pinene,limonene, γ-terpinene, linalool, carvenone, and p-cymene, whereas the major compounds occurring in cumin are cumin aldehyde, limonene, α- and β-pinene, 1,8-cineole, o- and p-cymene, α- and γ-terpinene, safranal and linalool. In aqueous and solvent derived seed extracts, diverse flavonoids, iso-flavonoids, flavonoid glycosides, monoterpenoid glucosides, lignin's and alkaloids and other phenolic compounds have been found (Khafagy *et al.,* 1978).

The ability of caraway oils to inhibit the growth of fungi and bacteria is attributed to carvone, limonene and linalool. The antibacterial activity of carvacrol (5-isopropyl-2-methylphenol) is amply documented in various experimental studies and is suggested to be in synergism with its precursor *p*-cymene. Antifungal activity of caraway oil is recorded against soil, food, animal and human pathogens, including dermatophytes, *Vibrio* spp., yeasts, aflatoxins and mycotoxin producers. Carvacrol (from caraway oil) proved most active against *Penicillium citrinum*. caraway seeds are reported to be estrogenic. Singh *et al.* (2002). Potential effects of caraway on hormone and reproductive parameters of female ovariectomized rats are demonstrated due possibly to the presence of estrogenic iso-flavonoids, luteolin and apigenin (Malini and Vanithakumari, 1987).

Therefore, the present study was conducted to investigate the effects of incorporation of caraway seed sieving at different levels on productive performance, nutrient digestibility coefficients and blood metabolites of growing Rex rabbits.

MATERIALS AND METHODS

Animals, diets and management:

The experiment was carried out at privet farm in Giza, Egypt. Thirty-six unsexed Rex rabbits breed aged 5-6 weeks and average weight of 687.25±2.75g were randomly assigned into four groups, 9 for each group in 3 replicates. The trail was done in the summer season throughout year (2018). The feeding period was extended for 56 days. The chemical composition of caraway seeds sieving (CSS) and berseem hay are shown in Table (1). The basal experimental diet was formulated and pelleted to cover the nutrient requirements of rabbits according to (NRC, 1977) as shown in Table (2).

Table (1): Chemical analysis of caraway seed sieving and berseem hay.

Item	Caraway seed sieving (CSS)	Berseem hay (BH)
Dry matter (DM) %	90.6	94.44
Organic matter (OM) %	85.54	88.15
Crude protein (CP) %	18.54	17.81
Crude fiber (CF) %	21.08	29.42
Ether extract (EE) %	5.74	2.27
Nitrogen free extract (NFE) %	40.18	38.65
Ash%	14.46	11.85

Table (2): Composition of the experimental ration.

Item	Experimental rations			
	R_1 Control (0% CSS)	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
Yellow Corn	33.00	33.00	33.00	31.50
Soybean seeds, meal	26.00	24.00	24.81	22.50
berseem hay	29.52	28.26	25.50	27.41
Sunflower oil, refined	2.30	2.05	2.00	1.90
Corn Gluten Meal	1.00	1.00	1.00	1.00
Caraway seed sieving (CSS)	0.00	2.00	4.00	6.00
Calcium phosphate, dibasic	1.50	1.50	1.5	1.50
Sugar Cane Molasses	3.00	3.00	3.00	3.00
Coarse Wheat bran	1.40	3.00	3.00	3.00
Salt	0.35	0.35	0.35	0.35
Limestone	1.15	1.15	1.15	1.15
Methionine	0.33	0.33	0.33	0.33
L-Lysine HCL 98%	0.15	0.15	0.15	0.15
Premix (Vit. & Min. mixture)	0.30	0.21	0.21	0.21
Total	100	100	100	100
Price of ton per Egyptian pound (LE)	5500	5490	5480	5497

*R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving. * Vit. & Min. mixture: Each kilogram of Vit. & Min. mixture contains: 2000.000 IU Vit. A, 150.000 IU Vita. D, 8.33 g Vit. E, 0.33 g Vit. K, 0.33 g Vit. B1, 1.0 g Vit. B2, 0.33g Vit. B6, 8.33 g Vit.B5, 1.7 mg Vit. B12, 3.33 g Pantothenic acid, 33 mg Biotin, 0.83g Folic acid, 200 g Choline chloride, 11.7 g Zn, 12.5 g Fe, 16.6 mg Se, 16.6 mg Co, 66.7 g Mg and 5 g M.*

The experimental groups were classified as the following: First group of rabbits was fed the basal diet (R_1) and served as control group, second group was fed ration contained 2% CSS, third group was fed ration contained 4% CSS and the fourth group was fed ration contained 6% CSS. Each three rabbits were housed together in galvanized wire cages (30 x 35 x 40 cm). Stainless steel nipples for drinking and feeders allowing recording individual feed intake for each rabbit were supplied for each cage (*ad libitum).* Rabbits of all groups were kept under the same managerial conditions.

Chemical analysis of caraway seed sieving, berseem hay, tested ration samples and feces were analyzed according to AOAC (2005). Meanwhile, cell wall constituents include {neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL)} were evaluated according to Van Soest *et al.* (1991). Hemicellulose content was calculated as the difference between NDF and ADF, while, cellulose content was calculated as the difference between ADF and ADL.

Digestion trial:

At the end of the experimental period, all rabbits were used in digestibility trials over period of 7 days to determine the nutrient digestibility and nutritive values of the tested rations. Feed intake of experimental rations and weight of feces were daily recorded. Representative samples of feces were dried at 60^{o}C for 27 hrs. and stored for later chemical analysis. Pellets diets and fresh water were available all times *ad lib*. during the experimental period that lasted 56 days. Live body weight of rabbits and feed consumption were weekly recorded, and feed conversion ratio was calculated as (g feed intake/ g gain).

Blood serum samples:

The blood was collected after slaughtering from each rabbit (3 rabbits per group) into labeled sterile sample bottles without anticoagulant and used to determine the biochemical components. The blood samples were centrifuged at 3000 rpm for 15 min. to obtain serum was free from cell debris for the biochemical components. Serum was kept frozen at–18°C for subsequent analysis. Various blood serum chemical parameters were calorimetrically determined using commercial kits, following the same steps as described by manufactures. Blood serum was analyzed for total protein was determined according to (Armstrong and Carr, 1964); albumin according to (Doumas *et al.,* 1971). Globulin (was calculated by subtracting the albumin value from total protein value). Serum Glutamic Oxaloacetic Transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) activities were determined as described by (Reitman

and Frankel, 1957), alkaline phosphatase (Belfield and Goldberg, 1971), triglycerides (Fossati and Principe, 1982), total cholesterol (Roeschlau *et al.,* 1974), urea (Patton and Crouch 1977), and Creatinine by (Bartles, 1972). Data of live body weight, body weight gain, and feed consumption were recorded weekly during the experimental period to calculate the rabbit's performance and feed conversion ratio (FCR), respectively.

Caecum activity:

After slaughtering, caecum was taken for all slaughtered rabbits and Ruminal pH was immediately determined using digital pH meter, ammonia nitrogen (NH_3-N mg/100gm) according to Conway (1958) and Total volatile fatty acids (TVFA's MEq/100gm) concentrations of caecum content according to Eadie (1967).

Statistical analysis:

The experiment was set in a completely randomized design. Data were analyzed by analysis of variance using the general liner model procedure Proc. GLM (SAS, 2002). Differences among means were determined using Duncan's test Duncan (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical analysis of caraway seeds sieving and the experimental rations:

Data in Table (1) showed that the caraway seeds sieving (CSS) a good source of OM, CP, CF and EE, While, it lower in their content of NFE compared with berseem hay. The CSS contained higher values of organic matter, crude protein, crude fiber and Ether extract (EE) were CSS (85.54,18.54, 21.08 and 5.74%), respectively, while it contained lower values of DM, ash and NFE (90.6, 14.64 and 40.18) compared with berseem hay. these results nearest data by Abo El-Nor *et al.* (2007) found chemical composition of caraway seed powder (as dry matter basis) of OM, CP and EE were 90.82, 18.32 and 22. 24% while DM, CF, Ash and NFE values were 93.80, 24.33, 9.18 and 25.93%, respectively. Also, Kaki *et al.* (2018) noted that chemical analysis of Crushed Caraway seed of DM, OM, CP, CF, EE, ash, NDF and ADF were 93.64, 83.84, 19.25, 28.70, 3.81, 11.69, 67.64 and 40.13 %, respectively. Table (2) illustrated the composition (%) of the experimental ration, meanwhile, Table (3) showed the approximate analysis of the experimental rations that formulated to have a similar CP (20.53, 21.4, 20.88 and 20.88%), for R1,R2,R3 and R4, respectively, digestible energy that ranged from 2090 to 2367 kcal/ kg DM for the tested rations. The inclusion of CSS lead to increase the ether extract, while, it decreased the crude fiber, NDF and cellulose content.

Digestibility coefficients, cell wall constituent digestibility and nutritive values:

Digestibility coefficients, cell wall constituents and nutritive values data were illustrated in (Table 4) showed that the best apparent digestibility's of DM, OM, CP, CF and NFE and cell wall constituent's digestibility were recorded with rabbits fed 4% CSS rations in comparison with the other tested rations and the control, the increased significantly ($P<0.05$) values were average by 13.48, 10.53, 14.18, 45.38 and 6.55%, respectively, but EE insignificantly ($P>0.05$) increased average by 5.24 %, respectively compared with control. This results agreement with (Hassan and Abdel-Raheem, 2013) who found that the apparent digestibility's were higher significant of DM, OM, CP and CF in buffalo calves fed diets supplemented with caraway seed (CS) powder were 59.58, 62.48, 71.97and 48.89% than the control , respectively, however, the % of digestible NFE was significantly higher in buffalo calves fed the control diet. But the present results were increased compared with found by Abo El-Nor *et al. (*2007) found digestibility coefficients of caraway seed (added 50g/kg feed buffalo) in DMD, OMD, CPD, CFD, EED and NFED values were increased values from 60.51, 62.4,63.54, 53.07, 70.06 and 71.05% , respectively in control ration to 63.29, 65.19, 69.77, 55.11,72.71 and 71.33%, respectively. Beneficial effects of medicinal plants or active substances in animal nutrition may include the improvement of endogenous digestive enzyme secretion, stimulation of appetite and therefore increase feed consumption, activation of immune response and antibacterial, antiviral, antioxidant actions which may affect the physiological and chemical function of the digestive tract (Rahimi *et al.,* 2011).

Table (3): Chemical analysis and cell wall constituents of the experimental rations.

Item	Experimental ration			
	R_1 Control (0% CSS)	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
Dry matter (DM)	93.38	91.59	93.85	93.86
Chemical analysis % on DM basis:				
Organic matter (OM)	88.60	88.77	88.91	86.89
Crude protein (CP)	20.35	21.40	20.88	20.88
Crude fiber (CF)	10.42	9.27	8.73	8.28
Ether extract (EE)	4.71	5.78	5.38	5.15
Nitrogen-free extract (NFE)	53.12	52.32	53.92	52.58
Ash	11.4	11.23	11.09	13.11
Gross energy (Kcal/kg DM)[1]	4229	4308	4285	4190
Digestible energy (Kcal/kg DM)[2]	2267	2329	2367	2090
Non fibrous carbohydrates (NFC)[3]	46.12	45.49	49.17	46.02
Cell wall constituents (%):				
Neutral detergent fiber (NDF)	17.42	16.1	13.48	14.84
Acid detergent fiber (ADF)	12.55	11.77	10.78	10.29
Acid detergent lignin (ADL)	3.44	3.2	2.96	3.00
Hemicellulose	4.87	4.32	2.69	4.55
Cellulose	9.11	8.57	7.82	7.82

R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving. [1]Gross energy (Kcal/kg DM) was calculated according to Blaxter (1968), where, each g of crude protein (CP) = 5.65 kcal, each g of ether extract (EE) = 9.40 kcal, and each g crude fiber (CF) and nitrogen-free extract (NFE) = 4.15 kcal. [2]Digestible energy (Kcal/kg DM) was calculated according to Fekete and Gippert (1986) using the following equation: DE (kcal/ kg DM) = 4253 – 32.6 (CF %) – 144.4 (total ash).

[3]Non fibrous carbohydrates (NFC) were calculated according to Calsamiglia et al. (1995) using the following equation: NFC = 100 – {CP + EE + Ash + NDF}.

Cell wall constituent digestibility data illustrated in Table (4) showed were significant improved digestibility of all rations containing CSS, the best cell wall constituent results recorded with ration (3), followed ration (4), the lowest increased significant values recorded with ration (2) compared with control. The cell wall constituent digestibility in ration (3) were significant increased by 49.98, 50.25, 47.30, 39.17 and 9.38 % for NDFD, ADFD, hemicellulose dig., cellulose dig. and NDF-cell soluble digestibility, respectively.

Nutritive values are shown in Table (4). Rabbits received ration containing caraway seeds sieving recorded the highest nutritive values compared with the control, the best results observed with ration (3) by 13.80%, 16.96% and 12.46 (kcal/kg), respectively. The relative important in digestibility coefficient by CSS supplementation might be due to higher value of nutritive values. Moreover, the higher nutritive values for CSS rations could be contain some active components stimulating the active enzymztic digestible. Wichtl (1994) reported that caraway seed promotes gastric secretion, stimulates appetite, and is used as a remedy for very disease for example colic, loss of appetite, and digestive disorders and intense taste and (Hassan and Abdel-Ra-heem, 2013) reported that the Using caraway seed , as veterinary medicine was improvement of endogenous digestive enzyme secretion, activation of immune response and anti-bacterial, antiviral, antioxidant and anthelminthic activities . Platel *et al.* (2002) reported that spices are desirable for stimulating digestion and had a high stimulatory influence particularly on bile secretion and pancreatic enzyme activity. Adams *et al.* (1988) stated that olfactory feed ingredients enhanced Tilapia zillii growth through enhancing fish capability to eat more feed than normal. The usefulness of caraway seed meal (CSM) may be because it contains 3-7% essential oil, which is mostly dominated by carvone (50-85%) and limonene (20-30%); the other components carveol, dihydrocarveol, α- and β-pinene, sabinene, and perillyl alcohol are of much minor importance (Murray *et al.*, 1991). It also contains vital compounds such as vitamin E, essential fatty acids. Sedlakova *et al*. (2001). Hassan *et al.* (2016) observed the enhanced growth in the caraway seed meal (CSM)-supplemented diet may be because CSM enhanced the nutrient digestibility leading to improved nutrient utilization, which in turn could also explain the better growth. Bimbo and Crowtber (1992) Hence, the fish feed needs to be fortified with feed additives. Feed additives are edible substances that are added to

animal feeds in small quantity to enhance the feed quality which in turn enhances growth performance and reduces mortality in fish (Dada, 2015).

Table (4): Digestion coefficients, *Cell-wall constituent digestibility and Nutritive values* (%) of the experimental rations.

Item	Experimental rations			
	R_1 Control (0% CSS)	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
Digestion coefficients:				
Dry matter (DMD)	$72.46^{c} \pm 2.95$	$75.71^{bc} \pm 0.64$	$83.75^{a} \pm 0.90$	$79.96^{ab} \pm 1.14$
Organic matter (OMD)	$77.65^{c} \pm 2.67$	$79.58^{bc} \pm 0.67$	$86.79^{a} \pm 0.83$	$83.28^{ab} \pm 1.35$
Crude protein (CPD)	$74.14^{c} \pm 3.43$	$78.03^{bc} \pm 2.22$	$86.39^{a} \pm 0.09$	$84.87b^{a} \pm 1.25$
Crude fiber (CFD)	$31.65^{b} \pm 11.92$	$41.9^{ab} \pm 1.54$	$57.95^{a} \pm 2.87$	$52.67^{ab} \pm 3.90$
Ether extract (EED)	90.31 ± 1.94	94.39 ± 3.57	95.31 ± 0.64	94.45 ± 0.16
Nitrogen-free extract (NFED)	$85.23^{b} \pm 2.01$	86.09^{b} 0.84	$91.20^{a} \pm 0.58$	88.40^{ba} 0.51
Cell-wall constituent digestibility:				
2- Cell wall constituents (%)				
Neutral detergent fiber (NDFD)	$27.13^{c} \pm 5.79$	$34.91^{bc} \pm 2.92$	$54.24^{a} \pm 4.97$	$43.35^{ab} \pm 3.07$
Acid detergent fiber (ADFD)	$26.73^{b} \pm 8.58$	$34.06^{b} \pm 1.70$	$53.73^{a} \pm 3.47$	$39.58^{ab} \pm 2.84$
Hemicellulose	$28.87^{b} \pm 5.40$	$36.3^{b} \pm 7.09$	$54.51^{a} \pm 10.13$	$52.08^{ab} \pm 12.08$
Cellulose	$39.52^{b} \pm 8.88$	$46.31^{b} \pm 0.20$	$61.79^{a} \pm 3.23$	$50.23^{ab} \pm 2.62$
NDF-cell soluble	$80.99^{c} \pm 2.64$	$84.09^{bc} \pm 0.82$	$89.37^{a} \pm 0.33$	$86.78^{ab} \pm 1.25$
Nutritive value:				
Total digestible nutrient (TDN%)	$73.14^{c} \pm 2.91$	$77.27b^{c} \pm 1.29$	$84.85^{a} \pm 0.63$	$83.99^{ab} \pm 2.73$
Digestible crude protein (DCP%)	$15.23^{c} \pm 0.84$	$16.30b^{c} \pm 0.64$	$18.34^{a} \pm 0.14$	$17.70^{ab} \pm 0.28$
Digestible energy(kcal/kg)	$17412^{b} \pm 927$	$18472^{ab} \pm 478$	$19890^{a} \pm 173$	$19388^{a} \pm 256$

a, b and c: Means in the same row having different superscripts differ significantly (P<0.05). SEM, standard error of the mean. R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving.

Blood serum constituents:

The result of blood serum parameters in Table (5) cleared that the dietary rations had no significant effect (P<0.05) on blood serum total protein; albumin; globulin; albumin: globulin ratio; total lipids; triglycerides, alkaline phosphatase, LDH and HDL. Also, serum Glutamic Oxaloacetic Transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) activities were not affected by caraway seeds sieving which suggests no change in fat mobilization. Blood serum concentrations of creatinine (mg/dl) of caraway seeds sieving (CSS) which was significantly higher than control ration.

These results agree with those of Hassan and Abdel-Raheem (2013), who supplemented (2g/ kg) caraway seeds with basil diet of sheep. They showed that the blood serum of total protein (7.28 (g/dl); albumin 3.69 (g/dl); globulin 3.6(g/dl); albumin: globulin ratio 1.04(g/dl); Glutamic Oxaloacetic Transaminase (GOT) 44.22 (U/ml) and Glutamic Pyruvic Transaminase (GPT) 20.11(U/ml) but the total cholesterol was higher 198.78 (mg/dl) and nearest the result found by Abo El-Nor *et al*. (2007) blood serum constituent of caraway seeds. (added 50g/ kg feed buffalo) of total protein, albumin, creatinine, globulin albumin: globulin ratio, GOT, GPT, Alkaline phosphatase, Total lipids and cholesterol values were 7.29, 3.86, 3.45, 1.13, 4.14, 32.47, 17.87, 37.69, 261.40 and 138.40, respectively.

Caecum activity:

Caecal pH, ammonia-nitrogen and total volatile fatty acids (TVFA's) concentration are shown in Table (6). The caecal PH and TVF,s were not significant affected by the level of incorporation of CSSW in the rations. There was a nonsignificant trend to higher NH_3-N for higher ratios of CSSW. The same results were in agreement with El -Manylawi *et al.* (2005) who noticed that, no differences in TVFA concentration when growing rabbits fed diets contained with Geranium or Spearmint compared with the control group. But these results disagreement with Abd-El-Hady (2014) noticed that the herbal feed substances Digestarom 1315, MICRO- which contained active components: 1-Menthol (3.00% of Peppermint), Anethol (0.45% of Anise, Fennel) and 1- Carvon (0.035% of Caraway) their added

in diet rabbits ration (300 and 400 gm digestarom/ ton feed) , the caecal activity of TVFA,s (MEq/100gm) was increased significantly when added 300 and 400 gm. Digestarom 7.20 and 7.27 (MEq/100gm) compared with control 5.17 , NH_3N (mg/100gm) increased from 17 to 19.10 and 18.53 but Ph not affected. Moheghi (2010) who added Caraway-Seed Pulp (CSP) in basil diet by level 33.3 and 66.6 and 100% which substituted by Wheat Bran (WB) of lactating Holstein cattle observed Rumen N-NH3 and pH was not affected by any treatment.

Table (5): Blood serum constituents of the experimental animal groups.

Item	Experimental rations			
	R_1 Control 0% CSS	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
Total protein (g/dl)	7.19±0.89	6.35±0.25	6.54±0.13	6.30±0.40
Albumin (g/dl)	3.88±0.04	3.77±0.13	4.02±0.16	3.98±0.18
Globulin (g/dl)	3.31±0.90	2.58±0.21	2.52±0.27	2.32±0.25
Albumin: Globulin ratio	1.34±0.3	1.48±0.1	1.65±0.3	1.74±0
Lipids:				
Triglycerides (mg/ dl)	75±5.51	84.67±16.50	56±19.76	58.67±15.72
Total cholesterol (mg/ dl)	90±14.57	126±20.11	92±17.04	80±33.33
LDL-Cholesterol (mg/ dl)	45±13.42	66.73± 16.49	42.47±8.32	60.6±32.32
HDL-Cholesterol (mg/ dl)	30.2±1.33	42.18±4.28	38.38±4.80	41.13±4.40
Kidney function:				
Urea	60.78±0.57	60.29±3.62	62.58±4.20	61.11±3.80
Creatinine (mg/dI)	1.73^{b} ± 0.05	$2.07^{a\pm}$0.09	1.90ab±0.15	$1.78^{ab\pm}$ 0.03
Liver function:				
Alkaline phosphatase (IU/L)	169.07±19.66	156.35±14.55	147.87±20.65	143.62± 9.62
GPT (U/ml)	27.67±5.36	29.33±1.86	23.67±1.45	27.67±1.45
GOT (U /ml)	30.33±5.49	29±0.58	26±1.15	25±2.52

a, b and c: Means in the same row having different superscripts differ significantly (P<0.05). GOT: Glutamic Oxaloacetic Transaminase, GPT: Glutamic Pyruvic Transaminase. R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving.

Table (6): Caecum parameters of the experimental animal groups.

Item	Experimental rations			
	R_1 Control (0% CSS)	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
pH	6.42 ±0.1	6.15±0.3	6.19±0.5	6.78±0.1
Ammonia-nitrogen (NH_3-N mg/100gm)	21.31±3.6	29.04±7.4	25.73±0.7	32.73±3.2
Total volatile fatty acids (TVFA's MEq/100gm)	9.74±0.1	9.75±0.1	9.95±0.1	9.44±0.1

R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving.

Growth performance of the experimental animal groups:

Growth performance of the experimental rations (Table 7) showed that, dietary rations supplemented with CSS significantly (P<0.05) improved final weight, body weight gain and average daily gain. Final weight was improved by 22.14%, 37% and 27.27%, meanwhile, both body weight gain was significantly (P<0.05) improved by 37.77%, 61.88% and 46.43% and average daily gain by 37.73, 61.85and 46.38% for R_2, R_3 and R_4, respectively compared to the control (R_1). Rabbits received R_3 that contained 4% CSS recorded the best final weight, body weight gain and average daily gain. These results in agreement with those obtained by Kaki *et al.* (2018) who found that crushed caraway supplementation (basal diet plus 30 g/kg DM caraway) increased final BW in lambs by 6.98% compared with control. Also, Hassan and Abdel-Raheem (2013) found that the average daily weight gain of calves fed experimental rations (T1 = caraway seed (CS) 2%, T2= dried garlic (DG) 2% and T3= 2%CS+2% DS) were 0.679, 0.675 and 0.692

Kg, respectively compared with control 0.614. The caraway groups showed higher significantly average daily gain (g/day) compared to the control animals, the best results recorded with ration containing 4% CSS (the value 31.27g/day), followed R4 (the value 28.28g /day) , the lowest values recorded with R2 (the value 26.61 g/day)compared with control. These results agreement with (Kaki *et al.* 2018) noticed that the effects of 30gm/kg DM crushed caraway seed (CCS) supplementations on average daily gain of Sanjabi lamb was increased from 166.85gm in control to 203.47gm in ration CCS.

Table (7): Growth performance of the experimental animal groups.

Item	Experimental rations (%)			
	R_1 Control (0% CSS)	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
Live body weight:				
No. of animals	9	9	9	9
Initial weight (g)	704.08 ± 6.83	690.92 ± 2.28	695.43 ± 17.03	688.87 ± 32.14
Final weight (FW, g)	1785.67^{c} ±34.37	$21*81b^{c}$ ±133.01	2446.33^{a} ±128.97	2272.67^{ab} ± 59.68
Total body weight gain (TBWG, g)	1081.59^{c} ±0.49	1490.08^{bc} ±135.06	1750.9^{a} ±112.07	1583.8^{b} ± 82.99
Experimental duration	56 days			
Average daily gain (ADG, g/day)	19.32^{c} ± 0.49	26.61^{bc} ±2.41	31.27^{a} ±2.00	28.28^{b} ± 1.48
Feed intake of:				
Dry matter (DMI), g	94.42^{a} ± 3.62	78.61^{b} ± 2.25	82.2^{ab} ±6.56	78.22^{b} ± 2.99
Total digestible nutrient (TDNI), g	69.19± 4.77	60.74 ± 1.91	69.51 ± 5.69	65.74 ± 4.07
Crude protein (CPI), g	19.21±1.08	16.82 ± 0.63	17.16 0± 1.39	16.33 ± 0.62
Digestible crude protein (DCPI), g	14.40± 0.74	12.81 ± 0.48	15.08 ±1.27	13.83 ±0.41
Gross energy (GEI), kcal	399.34 ± 15.30	338.69 ±9.70	352.24 ±28.50	327.68 ± 12.50
Digestible energy (DEI), kcal	16472 ±1266.33	14524± 604.71	16357± 1390.34	15152± 430.82
Feed conversion (g intake /g gain) of:				
Dry matter (DM)	4.89^{a} ±0.14	3.01^{b}±0.31	2.65^{b} ±0.27	2.79^{b} ± 0.24
Total digestible nutrient (TDN)	3.58^{a} ± 0.24	2.32^{b} ±0.22	2.24^{b} ± 0.23	2.35^{b} ±0.23
Crude protein (CP)	1a ±0.03	0.64b ±0.07	0.55b± 0.06	0.58b ±0.05
Digestible crude protein (DCP)	0.75a ±0.06	0.49b ± 0.04	0.49b ±0.05	0.49b ±0.04
Gross energy (GE), kcal / g. gain	20.68^{a} ±0.57	12.97^{b} ±1.33	11.37^{b} ± 1.16	11.69^{b} ±1.02
Digestible energy (DE), kcal / g. gain	853.52 a± 67.92	554.36b ±51.49	527.4b ±53.06	539.88b ±40.32

Digestible energy (DE) of diets was estimated using the equation adopted by Schiemann et al. (1972) as follow

DE (kcal/kg) = 5.28(DCP g /kg) +9.51 (DEE g/kg) + 4.20 (DCF g/kg) + 4.20 (DNFE g/kg).

R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving.

According to the results obtained in this study, The feed intake of dry matter intake (DMI g), total digestible nutrient intake (TDNI g), crude protein intake (CPI), digestible crude protein (DCPI g), Gross energy intake (GEI Kcal) and digestible energy intake (DEI Kcal) were shown in Table (7) its affected by supplemented CSS. The dry matter feed intake was numerically insignificantly decreased in rations supplemented with CSS compared to the control rations by 16.74%, 12.94 and 17.16% for R_2, R_3 and R_4, respectively, comparing to the control. These results disagreement with Hassan and Abdel-Raheem (2013) observed that the intake of DM was slightly increased (P>0.05) in buffalo calves fed diets containing caraway seed 2% than the control diet.

The feed conversion (g intake/kg gain) of dry matter (g intake/g gain), total digestible nutrient (g intake/g gain), crude protein(g intake/g gain), digestible crude protein (g intake/g gain), Gross energy (Kcal/g gain) and digestible energy (Kcal/g gain) were shown in Table (7). These data in rations containing CSS were significant decreased compared with control ration. The lowest results feed conversion (g intake /g gain) recorded with R3, these results decrease may be referred to decrease dry matter intake. The addition of medicinal caraway seed sieving to rabbits' diets resulted significant improved of final body weight, average daily gain and feed conversion ratio despite lower feed intake daily. Wichtl (1994) reported that the caraway promotes gastric secretion, stimulates appetite, and is used as a remedy for very disease for example colic, loss of appetite, and digestive disorders. Abd-El-Hady (2014) Noticed averages of body weight gain of rabbits fed 300 and 400 gm digestarom/ ton feed was increased by about 4.7 and 7.9 % compared with control group. Jamroz *et*

al. (2003) found that the inclusion of 150 or 300 mg/kg of a plant extract containing capsaicin, carvacrol and cinnamicaldehyde in a diet improved body weight by 5.4 and 8.1%, respectively, improvement of FCR as a result of addition of digestarom to the diets could be attributed to the reduction in feed consumption accompanied with a significant ($P<0.05$) increase in live body weight. In this respect, Denli *et al*. (2004) reported that the addition of fennel essential oil to a quail diet improved feed conversion ratio. Also, Halle *et al*. (2004) noted that the addition of oregano and its essential oil reduced daily feed intake of broilers and significantly improved feed conversion ratio (FCR).

Economical evaluation:

The economic efficiency of dietary rations is shown in Table (8). The using of medicinal plant such as CSS as feed additive supplementation in rabbit rations depends on upon the price of tested rations and the growth performance of rabbits fed these rations. Costing of one kg feed, (LE) was decreased by inclusion caraway seeds sieving in the rations (R2 to R4) compared to control diet (R1). Also, decreasing CSS feed consumed by rabbits compared to control. In addition the marketing weight were increased by added caraway seeds sieving in rations. Dietary rations improved total cost, total revenue, net revenue, economic efficiency, relative economic efficiency and feed cost / kg LBW. Rabbits received R3 which content 4%caraway seeds sieving recorded the best total cost, total revenue, net revenue, economic efficiency, relative economic efficiency and feed cost /Kg LBW (LE).

Table (8): Economical evaluation of the experimental rations.

Item	Experimental rations			
	R_1 Control (0% CSS)	R_2 (2% CSS)	R_3 (4% CSS)	R_4 (6% CSS)
Marketing weight, Kg	1.79	2.18	2.45	2.27
Feed consumed (as it is, kg) / rabbit,	5.29	4.40	4.60	4.38
Costing of one kg feed, (LE)[1]	5.50	5.49	5.48	5.48
Total feed cost, (LE)	29.08	24.17	25.23	23.98
Management/ Rabbit, (LE)[2]	5.00	5.00	5.00	5.00
Total cost, (LE)[3]	54.08	49.17	50.23	48.98
Total revenue, (LE)[4]	71.60	87.20	98.0	90.80
Net revenue	17.35	38.07	47.63	41.92
Economic efficiency[5]	0.32	0.44	0.95	0.86
Relative economic efficiency[6]	100.00	241.43	295.66	266.87
Feed cost / kg LBW (LE)[7]	16.29	11.08	10.29	10.57

*R_1: Control diet. R_2: contained 2% from caraway seeds sieving. R_3: contained 4% from caraway seeds sieving. R_4: contained 6% from caraway seeds sieving. * Based on prices of year 2018. 1: Include medication, vaccines, sanitation and workers. 2: include the feed cost of experimental rabbit which was LE 25/ rabbit + management. 3: Body weight x price of one kg at selling which was LE 40. 4: net revenue per unit of total cost. 5: Assuming that the relative economic efficiency of control diet equal 100. 6: Feed cost/kg LBW = feed intake * price of kg / Live weight*

CONCLUSION

Under these conditions of this study it can be concluded that adding 4% from caraway seeds sieving as feed additives in rabbit rations improved their nutrient digestibility, nutritive values, final body weight, average daily gain and feed conversion ratio as well as realized the highest value of relative economic efficiency and lowered value of feed cost/ kg live body weight. Also, using medicinal plants can be considered as growth promoter that is effective for improving the utilization of rations.

REFERENCES

Abd-El-Hady (2014). Performance, physiological parameters and slaughter characteristics in growth rabbits as affected by a herbal feed additives (DIGESTAROM). Journal of International Scientific Publications: Agriculture and Food Volume 2, ISSN 1314-8591 (Online), Published at: http:// www. Scientific -publications.net

Abo El-Nor S.A.H.; H.M. Khattab; H.A. Al-Alamy; F.A. Salem and M.M. Abdou (2007). Effect of Some Medicinal Plants Seeds in the Rations on the Productive Performance of Lactating Buffaloes. International Journal of Dairy Science, Volume 2 (4): 348-355.

Aboul-Fotouh, G.E.; S.M. Allam; E.I. Shehata and S.N. Abd El-Azeem (2000). Effect of some medicinal plants as feed additives on milk production and composition of lactating buffaloes. Egyptian J. Nutrition and Feeds, 3(1): 31-41.

Adams, M.A.; P.B. Johansen and Z. Hong (1988). Chemical enhancement of feeding for the herbivorous fish Tilapia zillii. Aquaculture, 72: 95-107.

AOAC (2005). Official Methods of Analysis, 18th ed. Association of Official Analytical Chemists, Washington, DC, USA.

Armstrong, W.D. and C.W. Carr (1964). Physiological Chemistry: Laboratory directions 3: 75 Buger. Puplishing Co. inneapolis, Minnesota, U.S.A.

Bartles, H. (1972). Calorimetric determination of creatinine. Clin. Chem. Acte,32:81.

Belfield, A. and D.M. Goldberg (1971). Enzyme 12: 561.

Bimbo, A.P. and B. Crowtber (1992). Fish meal and oil: Current uses. J. l. of Am Chem Soc 69, 221-227.

Blaxter, K.L. (1968). The energy metabolism of ruminants. 2nd ed. Charles Thomas Publisher. Spring field. Illinois, U.S.A.

Chauhan, P.S.; N.K. Satti; K.A. Suri; M. Amina and S. Bani (2010). Chem. Biol. Interac., 185, 66-72.

Calsamiglia, S.; M.D. Stem and J.L. Frinkins (1995). Effects of protein source on nitrogen metabolism in continuous culture and intestinal digestion in vitro. Journal of Animal Science, 73: 1819.

Cheeke, P.R.; N.M. Patton; S.D. Lukefahr and J.I. McNitt (1987). In: Rabbit Production 6th Ed. Interstate Printers and Publishers. INC.

Conway, E.J. (1958). Microdiffusion Analysis and Volumetric Error, 4th edn. Crosby Lockwood, London.

Dada, A.A. (2015). Improvement of tilapia (Oreochromis niloticus Linnaeus, 1758) growth performance fed three commercial feed additives in diets. Journal of Aquaculture Research and Development 6, 325-327.

Denli, M., F. Okan and A.M. Uluocak (2004). Effect of dietary supplementation of herb essential oils on the growth performance carcass and intestinal characteristics of quail (Coturnix japonica). South African Journal. Animal Science, vol. 34, pp. 174 -179.

Doumas, B.; W.W. Wabson and H. Biggs (1971). Albumin standards and measurement of serum with bromocresol green. Clin. Chem. Acta, 31:

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

Eadie, J. M. (1967). Journal of General Microbiology 49, 175-1 94.

El-Manylawi, M. A.; M. R. M. Ibrahim; Fatma G. Ahmed and Walaa A. Salama, (2005). Performance of growing rabbits fed diets containing Geranium and Spearmint By-products. Egyptian Journal Rabbit Science, vol. 15, no. 1 pp.13- 26.

Fossati, P and L. Principe (1982). Clin. Chem. 28, 2077.

Fekete, S. and T. Gippert (1986). Digestibility and nutritive value of nineteen important feedstuffs for rabbits. J. Appli. Rabbit Res., 9 (3): 103- 108.

Halle, I., R. Thomann, U. Bauermann, M. Henning and P. Köhler, (2004). Effects of a graded supplementation of herbs and essential oils in broiler feed on growth and carcass traits, Landbauforshung Volkenrode, vol. 54, pp. 219-229.

Hassan K., F. Kafilzadeh and B. Charaien (2016). Effect of thyme (Thymus vulgaris) or peppermint (Mentha piperita) on performance digestibility and blood metabolites of fattening Sanjabi lambs. Biharean Biologist 10 (2): 118-122.

Hassan E. H. and M. Abdel-Raheem Sherief (2013). Response of Growing Buffalo Calves to Dietary Supplementation of Caraway and Garlic as Natural Additives. World Applied Sciences Journal 22 (3): 408-414.

Jamroz, D., J. Orda, C. Kamel, A. Wiliczkiewicz, T. Wertelecki and J. Skorupinska (2003). The influence of phytogenetic extracts on performance, nutrient digestibility, carcass characteristics, and gut microbial status in broiler chickens. Journal Animal Feed Science, vol. 12, pp. 583-596.

Kaki, S.; M.M. Moeini; F. Hozhabri1and Z. Nikousefat (2018). The Use of Crushed Caraway (Carum carvi) and Black Seed (Nigella sativa) Additives on Growth Performance, Antioxidant Status, Serum Components and Physiological Responses of Sanjabi Lambs. Iranian journal of applied since animal. Iranian Journal of Applied Animal Science. 8 (3), 439-444.

Khafagy, S.M.; T.M. Sarg; N.A. Abdel Salam and O. Gabr (1978). Isolation of two flavone glycosides from the fruits of Cuminum cyminum L. grown in Egypt. Pharmazi 33, 296-2967.

Malini, T and G Vanithakumari (1987). Estrogenic activity of Cuminum cyminum in rats. Indian J. Exp. Biol., 25, 442-444.

Murray, R.K.; D.K. Granner; P.A. Mayes and V.W. Rodwell (1991). The Textbook of Herb's Biotechnology, Twenty-second edition. Appleton & Large, Norwalk, Connecticut Los Anglos, California, USA.

Moheghi M.M.; A.M. Tahmasbi; A.A. Naserian and A. Omid (2010). Assessment of nutritional value of caraway-seed pulp for feeding Holstein dairy cattle. Journal of animal and veterinary advances 9(2): 306-310.

NRC (1977). National Research Council. Nutrient requirements of rabbits. National Academy of Science, Washington, D.C.

Patton, C.J. and S.R. Crouch (1977). Spectrophotomattic and kinetics investigation of the Berthelot reaction for the determination of ammonia. Anal. Chem 49: 464.

Platel, K.; A. Rao; G. Saraswathi and K. Srinivasan (2002). Digestive stimulant action of three Indian spice mixes in experimental rats. Die Nahrung, 46 (6): 394-398. Poult. Sci., 23: 327- 340.

Rahimi, S.; Z. Teymouri Zadeh; M.A. Karimi Torshizi; R. Omidbaigi and H. Rokni (2011). Effect of the three herbal extracts on growth performance, immune system, blood factors and intestinal selected bacterial population in broiler chickens. J. Agr. Sci. Tech., 13: 527-539.

Reitman, S. and S. Frankel (1957). Calorimetric determination of GOT and GPT activity. American Journal Clinical Pathology,

Roeschlau, P.; E. Bernt and W. Gruber (1974). Enzymatic determination of total cholesterol in serum. J. Clin. Chem. Clin. Biochem. 12, 403-407. 28: 56.

Schiemann, R.; K. Nehring; L. Hoffmann; W. Jentsch and A. Chudy (1972). Energetische Futterbevertung und Energienormen. VEB Deutscher Landwirtschatsverlag, Berlin, Germany.

Sedlakova, J.; B. Kocourkova and V. Kuban (2001). Determination of the essential oil content and composition of caraway (*Carum carvi L.*). Czech J. Food Sci., 19: 31-36.

Singh G; I.P. Kapoor; S.K. Pandey; U.K. Singh and R.K. Singh (2002). Phytother Res, 16, 680-82.

SAS (2002). Institute Inc., System 2002® Software: Product Support Manual, Version 1, First Edition, Cary, NC: SAS Institute Inc.,

Wichtl, M. (1994). Herbal Drugs and Phytopharmaceuticals. Boca Raton, CRC Press, Florida, USA.

Van Soest, P.J.; J.B. Robertson and B.A. Lewis (1991). Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal performance. Journal of Dairy Science, 74: 3583–3597

تأثير غربلة بذور الكراوية (*Carum carvi L.*) كإضافات علفية فى تغذية الأرانب الريكس:1. على أداء النمو، هضم المواد الغذائية ، قياسات الدم ونشاط الأعور

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الهدف من هذه الدراسة هو دراسة تأثير غربلة بذور الكراوية التي تم فحصها كإضافات اعلاف في تغذية الأرانب. تم إجراء هذة التجربة في مزرعة خاصة في الجيزة ، مصر. 39 ارنب مختلطة من سلالة الريكس والتى تتراوح أعمارهم ما بين 5-6 أسابيع ومتوسط الوزن 687.25 ± 2.75g. تم تقسيم المجموعات عشوائيا إلى أربع مجموعات تجريبية ، بكل مجموعة 9 أرانب وزعت في 3 مكررات. فترة التجربة في فصل الصيف لعام (2018). غذيت الأرانب على اربعة علائق تجريبية لمدة 56 يوم ،

تم تقسيم العلائق المختبرة كالاتى:العليقة الاولى (عليقة الكنترول) ، العلائق الثانية والثالثة والرابعة تم إدخال ناتج غربلة الكراوية بنسبة 2% ،4% ،6% على التوالى. في نهاية فترة التجربة النمو تم استخدام جميع الأرانب في تجارب الهضم على مدى 7 أيام لتقدير هضم المواد الغذائية ، والقيم الغذائية ، وبعض مكونات الدم ، ودراسة نشاط الأعور وأداء النمو للعلائق المختبرة.

أظهرت النتائج أن التركيب الكيميائي لعلائق المختبرة تمت بحيث يحتوي على نسبة CP متشابه يتراوح بين 20.88 إلى 21.40 ٪ والطاقة الكلية اتراوحت ما بين 4189.51 الى 4308.41 كيلو كالوري / كجم DM . تشير زيادة نسبة غربلة بذور الكراوية فى العلائق المختبرة فى علائق الارانب إلى زيادة مستخلص الأثير ، بينما تقلل من الألياف الخام ومكونات الجدار الخلوى وكانت العلائق الغذائية المضاف اليها ناتج غربلة بذور الكراوية لها تاثير معنوى (عند مستوى معنوية 0.05) على كل المركبات الغذائية المهضومة لـ (OM، CP، CF، EE، NFE، NDF، ADF والسليلوز) ؛ والقيم الغذائية (TDN و DCP). سجلت الأرانب التى تتغذى على علائق تحتوى على 4 % من ناتج غربلة بذور الكراوية أعلى قيم هضمية (OM، CP، CF، NFE، NDF، ADF والسليلوز) واعلى قيم غذائية (TDN، DCP و DE). أظهرت بيانات مكونات بلازما الدم للعلائق الغذائية التي تم الحصول عليها أنها لم تكن لها تأثير كبير على البروتين الكلي ؛ الالبيومين. الجلوبيولين. نسبة البيومين: الجلوبيولين. الدهون الكلية ؛ الدهون الثلاثية ، الفوسفاتيز القلوية ، LDHو .HDL أيضًا ، لم تتأثر (GOT) ، (GPT) بإضافة ناتج غربلة بذور الكراوية فى علائق الارانب بينما تأثرت تركيزات الكرياتينين (mg / dl) وارتفعت بشكل كبير في سيرم الدم للعلائق التى تحتوى على ناتج غربلة غربلة بذور الكراوية مقارنة بعليقة الكنترول.

لم يتأثر caecum pH بمستويات ناتج غربلة بذور الكراوية المستخدم فى العلائق كما كان هناك إتجاه غير معنوى لتركيز كل من الأمونيا- نيتروجين (NH_3-N) وتركيز الأحماض الدهنية الطيارة (TVFA's).

أظهرت المعاملات الغذائية زيادة معنوية (عند مستوى معنوية 0.05) على وزن الجسم الحي النهائي (FLBW) ، وزيادة الوزن الكلي (TBWG) ومتوسط النمو اليومي (ADG) بين النسب التجريبية المختلفة. تراوحت FLBW و TBWG و ADG من 1786 إلى 2446 جم ؛ من 1082 إلى 1751g ومن 19.31 إلى 31.27 ، على التوالي. سجلت الأرانب المغذاه على 4٪ من ناتج غربلة بذور الكراوية أفضل قيم للـ FLBW ، TBWG ، ADG. أدت إضافة ناتج غربلة بذور الكراوية إلى زيادة صافي الإيرادات والكفاءة الاقتصادية وحدث تحسن فى صافي الإيرادات بنسبة 1.52 ، 1.61 ، 1.49% للعلائق المختبرة (R_2, R_3 and R_4) على التوالي مقارنة بعليقة الكنترول (R_1) ، كما تحسنت الكفاءة الاقتصادية بنسبة 58.58% ، 195.66% ، 166.87 % كما انخفضت تكلفة التغذية المقابلة لكل كجم من وزن الجسم الحي مقارنة بعليقة الكنترول. وقد أنخفضت القيم المقابلة لتكلفة الأعلاف لكل كيلو جرام المقابلة للزيادة فى وزن الجسم الحي بنسبة 31.00 ، 36.71 و 35.24 ٪ للعلائق التى تحتوي على 2 و 4 و 6 ٪ من ناتج غربلة بذور الكراوية على التوالي مقارنة بعليقة الكنترول.

ويمكن الإشارة إلى أن استخدام ناتج غربله بذور الكراويه عند مستوى 4% (العليقة الثالثة) ذو تأثير إيجابى معنوى على كلاً من أداء النمو ومعاملات الهضم بالاضافه الى تحقيق صافي ربحية عالية.