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Effect of restricted replacement of soybean meal with different levels of defatted apricot kernel meal on growth performance, carcass traits and blood constituents of broiler chickens

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Abstract
A study was conducted to investigate the effects of deffated apricot kernel meal (DAKM) as a partial replacement for soybean meal (SBM) in broiler diets on growth performance, carcass traits, blood metabolites and economic efficiency. Three hundred; one-day-old Cobb-400 broilers, each with five replicates (n = 15 chicks per replicate), were submitted to one of the four diets containing 0, 25, 50, and 75% SBM were replaced with DAKM in starter and grower diets, respectively for 42 days in a completely randomized design. Body Weight (BW), Body Weight Gain (BWG) and Feed Intake (FI) were significantly lower in broilers fed (DAKM-35) and (DAKM-45) than those fed (DAKM-25) and (DAKM0), whereas Feed Conversion Ratio (FCR) was better significantly when broilers fed on (DAKM-25). Performance Index (PI) was superior in the (DAKM-25) followed by SBM-fed groups when compared to the other groups. Digestibility coefficients of OM, CP, CF and NFE were significantly higher for broilers fed on (DAKM-25) than those fed other diets, however, EE was highest for broilers fed on (DAKM-35) and (DAKM-45). Carcass traits, cut-up parts and yields significantly increased ($P<0.05$) for chicks fed (DAKM0) and (DAKM-25), while the group fed on (DAKM0) recorded lower abdominal fat (%) followed by (DAKM-25) group. The ascending levels of DAKM treatments influenced the carcass meat, which was observed as a decrease in CP contents significant, but an increase in moisture, EE and ash contents significant in breast and thigh meat compared to (DAKM0) group. Broilers fed on (DAKM-45) had the lowest triglycerides, cholesterol, LDL and vLDL concentrations than the other treatments. The best value of Economic Efficiency (EE) was recorded by the group fed on (DAKM-25). High levels of DAKM in broiler diets deleteriously affect growth performance, FI, FCR and blood lipids. It was concluded that the optimal level of DAKM is a low level of 25% without adverse effects on growth performance, carcass traits, blood lipids or economic efficiency of broilers.

Keywords: Defatted apricot kernel meal, performance, carcass, blood constituents, broilers

Introduction
Chicken production has improved dramatically over the last few decades, and this increase has affected practically every area of poultry production, including nutrition and genetic selections. Nutrition is important in poultry production because it has a direct impact on performance and production economics. Feed formulation is an application of nutrition in which nutritional knowledge is used to meet the nutritional needs of at least 60% of the total production expenses in bird production, (Oruseibio and Wariboko 2000) [35]. Thus, further improvements in the feed formulation process would maximize performance and profitability in poultry production, and one way to improve feed formulation is to reduce nutrient variability. Significant nutrient variability can result in under-feeding or over-feeding of essential nutrients, resulting in decreased bird performance, increased input costs, and increased environmental pollution. A possible strategy to optimize the feed formulation is to account for the essential and non-essential amino acid requirements in feed, particularly in low protein diets.
Poultry meat and eggs contribute around 10% of all meat and eggs produced globally each year. Poultry, by providing meat and eggs, continues to be an important and inexpensive source of animal nutrition for many populations, including Egypt.; and the meat nutrients,

quality depends largely on the composition of poultry feed. Energy sources are the most important and, in most cases, contains any harmful preservatives, which speeds up their growth that can easily be transferred from birds to humans, (Afolayan *et al* 2002) [3]. This recurring problem has pushed the research for options to reduce mycotoxins like zearalenone (ZEN), (Adeyemi 2005) [2]. Until recently, many published studies on bird feeding have concentrated on seed and feeder preferences, (Johnson *et al* 2014) [19]. Feed formulation can also be enhanced by precisely determining the maximum safe level of feed ingredients. Potential feed ingredients and novel cultivars may contain limiting characteristics (e.g. anti-nutritional factor, fibre, amino acid profiles, etc.) These chemicals are assessed in feeding trials that involve giving increasing quantities of the test ingredients and eventually assessing the response, such as growth, (Baurhoo *et al* 2011) [9]. Egypt was formerly known to be having an active boom in poultry production, but is now facing the difficulty of rising poultry production costs caused by high chicken feed costs, as well as fungal development and mycotoxin generation in poultry feeds during processing. Mycotoxins contamination of agricultural commodities and derivatives has sparked global concern due to the serious health risks they pose to humans, poultry, and livestock in general (Hussein and Brasel 2001) [17].

Domestic wastes are one among the major sources of the municipal solid wastes which are presently not exploited, but dumped at landfills which is provoking environmental threat. Thus, domestic waste or agricultural waste in general from food processing industries, markets, roadside vendors and even from our kitchens can be exploited for the production of fortified feeds, which can be used in feeding poultry birds, cattle, fishes, rabbits, pet animals and pigs as they are highly nutritious and cost effective than the conventional (commercial) feeds. They are also good sources of minerals such as Ca, P, Mn, K, Mg, and Zn. These can further be used in the pharmaceutical process industries for the production of drugs, as these processed by-products are also rich sources of dietary fibre, which has several benefits of health. Apricot (*Prunus armeniaca* L.), because it is a good source of nutrients, is one of the most familiar crops worldwide (Baytop, 1999) [10]. The kernel is also reported to have high antioxidant and antimicrobial activities (Yigit *et al*., 2009) [44]. The protein content of apricot kernels ranges from 14.1 to 45.3% (Alpaslan and Hayta, 2006) [4]. A study found that apricot kernel proteins contain 84.7% albumin, 7.65% globulin, 1.17% prolamin, and 3.54% glutelin, (Abd-El-Aal *et al*., 1986) [1]. Nutritive value of proteins Essential amino acids in apricot kernel constitute 32-34% of the total amino acids (Femenia *et al*., 1995) [15]. The major essential amino acids (mmol/100 g meal) are arginine (21.7-30.5) and leucine (16.2-21.6), and the predominant nonessential amino acid is glutamic (49.9-68.0) (Kamel and Kakuda, 1992) [21]. The kernels contain thiamine, riboflavin, niacin, vitamin C, a-tocopherol, and d-tocopherol (Slover *et al*., 1983) [41]. The mineral content ranges of apricot kernel (mg/100 g dry matter) are as follows: Na, 35.2-36.8; K, 473-570; Ca, 1.8-2.4; Mg, 113-290; Fe, 2.14-2.82; and Zn, 2. 33-3. 15 (Alpaslan and Hayta, 2006) [4].

Amygdalin (known as laetrile or vitamin B17) is commonly found in the kernels of almonds, apricots, cherries, peaches, and apples. The amount of cyanogenic glycosides in plants varies with plant species and environmental effects. Amygdalin contains a cyanide group between a glycoside and a benzene ring that can be released after hydrolysis (Cho *et al*., 2006) [12]. The amygdalin content of apricot and bitter almond kernels (*Prunus armeniaca* L.) has been reported to be approximately 3 or 4% by weight (Niels, 1996) [29]. Apricot kernels contain approximately 20-80 mmol/g of amygdalin, and it is very high (5.5 g/100 g) in bitter apricot cultivars and not detected in sweeter ones. On average, an apricot kernel contains approximately 0.5 mg of cyanide (Femenia *et al*., 1995) [15]. Hydrolysis of cyanide can be catalyzed by either endogenous enzymes contained within the kernels or exogenous b-glucosidase released from bacteria within the gastrointestinal tract or from ingested foods inside the intestine. Cyanogenic glycosides are nontoxic but can release free hydrogen cyanide (Cho *et al*., 2006) [12]. The hydrogen cyanide content is 8.9 - 11.7 mg/100 g in bitter cultivars and 200 mg/100 g in the wild cultivars (Baytop, 1999) [10].

Therefore, the objective of the current study to determine the effect of using different levels of DAKM, as a partial replacement for SBM in commercial broiler diets, on performance, digestibility, carcass traits and blood metabolites of Cobb-400 broilers.

Materials and Methods

Preparation of defatted apricot kernel meal

Firstly seeds by-product was collected from Faragla Manufacture, New Borg El-Arab Alexandria – Egypt. Seeds were removed from the fruits and the seeds, the outer shell was washed with water to remove the remaining fruit pulp and sun-dried for 3 weeks, then the outer shell of the seeds was cracked manually and the apricot kernels were cooked to approximately 60 °C. The kernel is then squeezed to remove any liquids, then toasted and subsequently cooled. Then the kernel meal was stored in bags until added to poultry feed.

The experimental work was carried out in Borg El Arab station, Animal Production Research Institute, and Agricultural Research Cent from January to March 2022. A total of 300 unsexed one-day-old Cobb-400 (45.8±0.39) chicks were randomly distributed into four dietary treatments replicated five times in such a way that each had 15 birds. Treatments included 0, 25, 35, and 45% SBM were replaced with deffated apricot kernel meal (DAKM) in starter (1-21 days) and grower (22-42 days) diets fed to chicks for 42 days. The composition of experimental diets is shown in Table 1. Experimental diets were formulated according to NRC guidelines NRC (1994) [31] and the proximate analyses of the starter and grower diets were calculated as shown in Table 2. The total chick's weight of each pen was established to be equal and the feeder was separately allocated at each pen. Feed and water were provided *ad-libitum*. All birds were kept under the same management, hygienic and environmental conditions. The chicks were vaccinated against the common broiler diseases, according to the conventional program used for broilers. Live body weight and feed consumption were recorded at weekly intervals throughout the experimental period. Daily weight gain, feed conversion ratio and economic efficiency were calculated. Economic Efficiency (EE) and Relative Economic Efficiency (REE) were calculated according to input-output analysis data. Besides Performance Index (PI) was calculated according to North (1981) [30].

Table 1: Chemical composition of soybean meal and defatted Apricot kernel meal (% DM).

Item	Soybean meal	Defatted Apricot kernel meal
Dry matter	88.59	89.49
Organic matter	94.11	90.96
Crude protein	43.87	40.09
Crude fiber	6.11	7.66
Ether extract	2.64	6.04
N free extract	41.49	42.33
Ash	5.89	3.88
Metabolic energy (kcal kgG[1])	3055.00	3991.00
Total energy (kcal kgG[1])	3980.00	5050.00
Amino acid		
L-lysine	2.37	1.88
L-methionine	1.25	1.25
Arginine	2.64	3.50
Cystine	1.06	1.26
Isoleucine	2.22	2.24
Valine	2.47	2.31
Tryptophan	1.42	1.05

A digestibility trial was undertaken at the end week of the experimental period (6 weeks of age), 10 chicks were randomly selected from each group; birds were housed individually in metabolism cages. The experimental diets were offered daily and fresh water was provided all the time. Feed consumption was accurately determined. Faeces were collected for 5 days a collection period, then the faeces was dried at 60 °C for 24 h. All collected faeces for each bird were mixed, and then representative faeces samples were ground for chemical analysis. Chemical analysis of different diets and faeces was determined according to AOAC (2012) [6].

On day 42, two chicks were randomly selected from each pen, fasted for 16 h before slaughtering, weighed and manually slaughtered. Carcass weight (Dressing, breast, thigh, abdominal fat, liver, heart, empty gizzard and other total edible parts) were calculated as a percentage of live body weight. Chemical analysis of meat was done according to AOAC (2012) [6] and the values were expressed on a DM basis.

Blood samples were collected from sacrificed birds in clean, sterile tubes and then were immediately centrifuged at 3000 rpm for 15 min and stored at -20°C until use. Total Protein (TP), albumin (ALB), globulin (GLB) (TP-ALB), urea, cholesterol, HDL, LDL, vLDL and triglyceride concentrations were determined by spectrophotometer (Spectronic 21 DUSA) using commercial diagnostic kits (Combination, Pasteur Lap.).

Statistical analysis Data on feed intake, live body weight, feed conversion, nutrient digestibility, carcass data, and blood constituents were subjected to one-way analysis of variance using SPSS (2008) [42]. Duncan's multiple range test (Duncan 1955) [14] was used to separate means when the dietary treatment effect was significant, according to the following model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:
Y_{ij} = observation
μ = overall mean
T_i = effect of experimental diets for i = 1–4; 1 = control diet contained 0% DAKM, 2 = diet contained 25% DAKM, 3 = diet contained 35% DAKM, 4 = diet contained 45% DAKM
e_{ij} = the experimental error.

Table 2: Composition and chemical analysis of the experimental diets

Feed ingredient (%)	Starter (0-21) day				Grower (22-42) day			
	DAKM0	DAKM-25	DAKM-35	DAKM-45	DAKM0	DAKM-25	DAKM-35	DAKM-45
Corn yellow	58.50	59.50	60.50	61.00	65.50	66.50	67.00	67.50
Soybean meal (44%)	27.00	20.25	17.55	14.85	25.00	18.75	16.25	13.75
Defatted Apricot kernel meal	0.00	6.75	9.45	12.15	0.00	6.25	8.75	11.25
Corn gluten meal (60%)	10.00	9.00	8.00	7.50	5.00	4.00	3.50	3.00
Limestone	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
Dicalcium phosphate	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit-mineral*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Dl-methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Coccidiostate	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total feed	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total price feed/100 kg	1100.0	1000.0	950.0	900.0	1050.0	975.0	915.0	885.0
Calculated chemical composition (%)								
Crude protein	23.00	22.80	22.65	22.51	19.50	19.41	19.38	19.30
ME kcal/kg diet	3100.00	3105.00	3108.00	3111.00	3200.00	3220.00	3213.00	3220.00
Calcium	1.26	1.29	1.33	1.34	1.22	1.23	1.27	1.30
Phosphorus available	0.84	0.87	0.88	0.84	0.81	0.83	0.84	0.83
Lysine	1.19	1.25	1.27	1.30	1.14	1.18	1.22	1.26
Methionine	0.66	0.61	0.58	0.56	0.62	0.58	0.56	0.53
Methionine+cystine	0.92	0.91	0.89	0.88	0.89	0.86	0.86	0.82

*Provided the following per kilogram of diet: Vit. A: 1200 IU, Vit. D: 3000 IU, Vit. E: 100 IU, Vit. C: 3 mg, Vit. K: 4 mg, Vit. B1: 3 mg, Vit B2: 3 mg, Vit B6: 5 mg, Vit B12: 0.03 mg, Bantothinic acid: 15 mg, Folic acid: 2 mg, Biotin: 0.20 mg, Cobalt: 0.05 mg, Copper: 10 mg, Iodin: 50 mg, Manganese: 90 mg, Selenium: 0.20 mg and Zinc: 70 mg, ME: Metabolic energy

Results and Discussion

Growth performance

Performance evaluation of the birds fed varying levels of DAKM substitute instead of SBM at different ages are presented in Table 3 indicating that LBW of (DAKM-25) fed groups were inferior to (DAKM-35 and DAKM-45) fed ones when measured at week 3 and 6 of age, but insignificant differences were observed between (DAKM0) and (DAKM-25) at week 3 of age.

Table 3: Performance of broiler chicks fed different levels of defatte Apricot kernel meal.

Items	Defatted Apricot kernel meal supplement				SEM	P-value
	DAKM 0	DAKM-25	DAKM-35	DAKM-45		
BW (g)						
IBW	46.2	44.5	46.6	48	0.55	0.768
At 3 weeks	894[a]	915.5[a]	738.8[b]	674[c]	24.76	0.001
At 6 weeks	2135[b]	2215[a]	1775[c]	1670.5[d]	35.98	0.0001
BWG (g) 1-3 weeks	847.8[a]	871[a]	692.2[b]	626[b]	46.57	0.01
3-6 weeks	1241[a]	1299.5[a]	1036.2[b]	996.5[b]	37.99	0.02
1-6 weeks	2088.8[a]	2170.5[a]	1728.4[b]	1622.5[c]	44.15	0.0001
FI (g) 1-3 weeks	961.5[a]	957.25[a]	899[b]	895[b]	12.86	0.05
3-6 weeks	2255[a]	2175[b]	1889[c]	1818[d]	22.95	0.007
1-6 weeks	3216.5[a]	3132.25[b]	2788[c]	2713[d]	17.46	0.0001
FCR (g feed/g gain)						
1-3 weeks	1.13[c]	1.10[d]	1.30[b]	1.43[a]	0.03	0.005
3-6 weeks	1.82[a]	1.67[b]	1.82[a]	1.82[a]	0.02	0.01
1-6 weeks	1.54[b]	1.44[c]	1.61[a]	1.67[a]	0.05	0.001
PI (%)	135.65[b]	150.41[a]	107.15[c]	97.03[c]	9.06	0.003

[a, , b, c and d]: Means in the same row with different superscript are significantly different (*P*<0.05), BW: Body weight, BWG: Body weight gain, FI: Feed intake, FCR: Feed conversion ratio, IBW: Infant body weight

It is noted that when SBM was partially replaced with DAKM at 35 and 45% levels, LBW significantly decreased at weeks 3 and 6 of age. A similar trend of BWG of chicks fed graded levels of DAKM had highly significant (p=0.001) differences in the entire experimental period. As DAKM level increased 35 and 45% substituted instead of SBM, BWG significantly decreased by 1-3, 3-6 and 1-6 weeks. While BWG of broilers in (DAKM-25) group was better than those in the (DAKM0) group by 2.66, 4.50 and 3.74% in 1-3, 3-6 and 1-6 weeks, respectively. Feed intake (DAKM0) and (DAKM-25) groups were increased (p=0.05) than those (DAKM-35) and (DAKM-45) groups in starter, grower and the entire experimental period. It is observed that when the DAKM level increased, the amounts of feed intake significantly decreased (p=0.0001). The feed conversion ratio was better (p=0.005) in (DAKM-25) the group followed by the (DAKM0) group than that of the (DAKM-35 and DAKM-45) groups, both in the growth period and in the entire experimental periods (p=0.001).

These results are similar to the findings of Boubekeur *et al.* (2021) [11] who reported that the addition of 30% apricot kernel cake by-products for quail diets did not have adverse effects on the growth performance. Also, Omer *et al.* (2020) [34] and Mennani *et al* (2017) [28] found no adverse effects of apricot seed kernel or apricot kernel meal on growing rabbit's performance even at levels as high as 4.5% or 30%, respectively. The lower LBW in (DAKM-35) and (DAKM-45) groups during the experimental periods were since the Apricot kernel contained cyanogenic glycosides. Arbouche *et al*. (2012) [7] demonstrated that apricot kernel from the *Rosaceae* family, containing cyanogenic glycosides, impairs the broiler performance. Cyanogenic glycosides are converted to hydrogen cyanide in the intestinal epithelium and deteriorate growth performance and nutrient digestibility in broiler chickens (Rodríguez *et al*., 2001; Senica *et al*., 2016) [38, 40]. However, LBW of broilers fed on a diet containing 25% DAKM was better than those fed a basal diet by 2.35 and 3.61% respectively, at weeks 3 and 6 of age. The comparable results between the (DAKM-0) and (DAKM-25) groups reflect the ability of these chicks to adequately handle and tolerate anti-nutritional factors at this level. Kalia *et al* (2017) [20] and Dragovic-Uzelac *et al* (2007) [13] reported that an increase in body weight back to the presence of bioactive molecules (carotenoids, catechins, neochlorogenic acid, caffeic acid) in *P. armeniaca* extract chicken diet which can stimulate increased digestion and metabolism of nutrients causing higher efficiency in the utilization of feed which results in enhanced growth in chickens. Kalia *et al* (2017) [20] mention to that addition *Prunus armeniaca* seed extract at different levels (100, 150, 200, 300, 400, and 800 mg/kg body weight) of chicken in drinking water resulted an increased (P = 0.036) in body weight as compared with the control group. Chicks fed 25% DAKM had the best FCR values during the periods 1-3, 3-6 and 1-6 weeks of age by about 1.10, 1.67 and 1.44 compared with a control group which recorded 1.13, 1.82 and 1.54, respectively, at the same periods. However, chicks fed (DAKM-35) and (DAKM-45) groups had the worst values of FCR compared to the control group. Whereas, Kalia *et al*. (2017) [20] concluded that adding *Prunus armeniaca* seed extract at different levels (100, 150, 200, 300, 400, and 800 mg/kg body weight) of chicken in drinking water enhanced feed conversion ratio (FCR) values at 300 and 400 mg/kg body weight significantly (P = 0.024).

A high level of DAKM 35 and 45%, which replaced instead of SBM in the diet had a high concentration of tannins which depress digestion and the feed intake. This may explain the poor chicks' performance in (DAKM-35) and (DAKM-45) fed groups. Apricot kernel contains anti-nutritional components: linatin, cyanogenic glycosides, phytones, trypsin inhibitors, lignans, and saponins (Hamid and Kumar, 2017; Westbrook and Cherian 2019) [16, 43]. These factors can limit the potential of these seeds to be used in poultry production to a certain extent. Such doubts were raised by Ryhänen *et al*. (2007) [39] and Pekel *et al*. (2009) [37]. They reported a negative effect of oilseeds in poultry diets on production effects, especially when used in high doses. They noted impaired feed conversion and decreased feed intake during the starter period. However, saponins can reduce intestinal motility (Klita *et al*., 1996) [23], inhibit gastric emptying (Yoshikawa *et al*., 2001) [45] and decrease the growth rate (Makkar and Becker, 1996) [26]. They also lower digestion rate (Killeen *et al*., 1998) [22], depress mucosal enzyme activity in the lower intestine (Olli *et al*., 1994) [33] and inhibit the absorption of vitamins A and E in chicks (Jenkins and Atwal, 1994) [18].

Economic Efficiency

The final body weight, length of the growing period and feeding cost are generally among the most important factors involved in the achievement of maximum efficiency values of meat production. The EE of the different formulated diets as affected by different treatments is shown in Table 4.

Table 4: Economic analysis of broiler fed diets containing different levels of defatted Apricot kernel meal.

Item	Defatted Apricot kernel meal supplementation			
Economic efficiency	DAKM 0	DAKM-25	DAKM-35	DAKM-45
Average total weight gain/chick (kg)	2.135	2.215	1.775	1.671
Total revenue/chick (LE)(1)	64.05	66.45	53.25	50.13
Total feed intake/rabbit (kg)	3.217	3.132	2.788	2.713
Price of feeding/kg (LE)	11	10.5	9.5	8.75
Total cost of feed/chick (LE)	35.39	32.89	26.49	23.74
Total cost of/chick (LE)	10	10	10	10
Total cost of medication/chick (LE)	3	3	3	3
Total cost/chick (LE)	48.39	45.89	39.49	36.74
Net revenue/chick (LE(2))	15.66	20.56	13.76	13.39
Economic efficiency (EE)(3)	0.32	0.45	0.35	0.36
Relative economic efficiency (REE)	100	140.6	109.4	112.5

(1): Price of one kg/live body weight on selling was 30 LE, (2): Net revenue: Price of sell chick (LE): Total cost (LE) (3), Economic efficiency: Net revenue/Total cost (LE)

It should be pointed out that the EE values were calculated according to the prevailing market selling price of 1 kg LBW, which was 30 L.E. Results indicated that the recommended levels of DAKM improved slightly the EE and reduced the cost of kilogram BW as compared to the control group. Data showed that adding 25% DAKM to broiler diets gave the best economic efficiency (0.45) followed by the 35 and 45% groups (0.35 and 36), when compared to the control group (0.32), respectively. The results indicated that the replacement of 25% DAKM as a partial replacement for SBM improved the relative economic efficiency of diets by 40.6% compared to the control diet. However, the other treatments containing 35 and 45% DAKM slightly increased the relative economic efficiency when compared to the control group by 9.4 and 12.5%, respectively. The results of this study are in agreement with those of Makled *et al.* (2019) [27] who found that economic efficiency values were increased when SBM was partially replaced with food industry byproducts and wastes by about 20 g kgG[1] in pre-starter, 50 g kgG[1] in starter and finisher in the diets. Also, The utilization or incorporation of at least 20% domestic waste in poultry feed can help reduce the cost of livestock production as well as the burden and dangers posed by the disposal and poor management of domestic waste in the environment, while also reducing the act of artificial growth substances added to commercial poultry feed.

Nutrient digestibility

Data of digestion coefficients are presented in Table 5. Broilers in the (DAKM-25) group recorded the highest CP digestibility (p=0.0001), but the (DAKM-0) and (DAKM-25) groups recorded the lowest EE digestibility (P=0.05) compared to the other groups. Apparent OM, CF and NFE digestibility showed no significant difference between (DAKM-0) and (DAKM-25) groups, while OM, CF and NFE in (DAKM-0) and (DAKM-25) groups surpassed those (DAKM-35) and (DAKM-45) groups.

Table 5: Nutrients digestibility coefficient (%) of diets with different levels of Defatted Apricot kernel meal.

Items	Defatted Apricot kernel meal supplement				SEM	P-value
	DAKM 0	DAKM-25	DAKM-35	DAKM-45		
OM	77.59^a	77.85^a	70.12^b	68.20^c	0.28	0.001
CP	76.89^b	79.59^a	72.26^c	70.14^d	0.33	0.0001
EE	74.37^b	75.97^b	77.78^a	77.96^a	0.47	0.05
CF	40.19^a	38.86^a	35.63^b	32.66^c	0.62	0.001
NFE	76.77^a	76.36^a	67.17^b	62.42^c	0.84	0.001

$^{a,\ ,\ b,\ c\ and\ d}$: Means in the same row with different superscript are significantly different ($P<0.05$), OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract

The improvement of digestibility percentages for most nutrients is associated with the increase of BW and BWG results (Table 3) and the improvement of feed utilization which improves the FCR (Table 3) for the broilers fed on (DAKM-25). Omer *et al* (2020) [34] demonstrated that the addition of different levels (0.75, 1.5, 3, and 4.5) of apricot seed kernel (ASK) in a rabbit's diet did not significantly affect nutrient digestibility and nutritive values except for EE, which was realised when ASK 3 percent, with the corresponding value of EE digestibility of (81.54 percent). Apricot kernel meal contain other anti-nutritional substances, such as cyanogenic glycosides, which can exert a negative effect on nutrient digestion, (Konieczka *et al* 2017 and Amerah *et al* 2015) [24, 5]. Saponins have long been known to inhibit the absorption and utilization of minerals by animals. Saponins decrease protein quality by reducing digestibility and palatability (Ogunbode *et al*., 2014) [32]. Saponins were recognized as antinutrient constituents, due to their adverse effects such as growth impairment and reduced food intake due to the bitterness and throat-irritating activity of saponins. In addition, saponins were found to reduce the bioavailability of nutrients and decrease enzyme activity and it affects protein digestibility by inhibiting various digestive enzymes such as trypsin and chymotrypsin (Liener, 1974) [25].

Carcass traits

Carcass traits of birds for different groups are shown in Table 6. Generally, the group fed on (DAKM 0) showed significantly (p=0.05) the highest dressing, breast and thigh percentages followed by (DAKM-25) while (DAKM-45) had the lowest percentages. Dressing, breast and thigh percentages were significant (p=0.05, 0.001 and 0.001) increased for the broiler fed on (DAKM-25) as compared to those fed on (DAKM-35 and DAKM-45), respectively. While the percentage weight of the heart was nearly similar for the different groups. However, DAKM led to a significant (p=0.004 and 0.005) increase in liver and abdominal fat percentage weight as presented in (DAKM-35) and (DAKM-45), respectively.

Table 6: Carcass traits and chemical composition of meat of chicks fed different levels of Apricot kernel meal.

Items	Defatted Apricot kernel meal supplement				SEM	P-value
	DAKM 0	DAKM-25	DAKM-35	DAKM-45		
Carcass characteristics and body organs (%)						
Dressing	69.65^{a}	68.95^{a}	66.35^{b}	66.75^{b}	0.52	0.05
Breast	38.54^{a}	38.22^{a}	34.60^{b}	30.55^{c}	0.14	0.001
Thigh	29.35^{a}	28.89^{ab}	26.44^{b}	25.28^{c}	0.54	0.001
Liver	2.65^{c}	2.85^{b}	3.15^{a}	3.22^{a}	0.08	0.004
Heart	0.62	0.66	0.67	0.64	0.05	0.078
Gizzard	2.06^{a}	1.97^{b}	1.88^{c}	1.84^{d}	0.02	0.0001
Abdominal fat	1.97^{c}	2.22^{b}	2.32^{a}	2.39^{a}	0.08	0.005
Chemical composition of meat on DM basis (%) Breast						
Moisture	67.84^{b}	67.87^{b}	68.83^{a}	68.96^{a}	0.23	0.05
Protein	23.22^{a}	23.57^{a}	21.98^{b}	21.74^{b}	0.21	0.05
Ether extract	1.76^{b}	1.83^{b}	1.98^{a}	2.08^{a}	0.10	0.05
Ash	1.62^{b}	1.71^{b}	1.87^{a}	1.98^{a}	0.13	0.02
Thigh						
Moisture	73.63^{b}	73.12^{b}	74.53^{a}	74.88^{a}	0.58	0.01
Protein	20.11^{a}	20.47^{b}	19.78^{c}	18.66^{c}	0.27	0.002
Ether extract	2.26^{b}	2.56^{b}	2.88^{a}	2.98^{a}	0.14	0.05
Ash	2.12^{b}	2.41^{b}	2.64^{a}	2.75^{a}	0.11	0.05

$^{a,\ ,\ b,\ c\ and\ d}$: Means in the same row with different superscript are significantly different (P<0.05), NS: Non significant

These results was paralleled with those obtained by Boubekeur *et al*. (2021) [11] who reported that the use of high levels of apricot kernel cake in quail feeding resulted the highest (74.4%, p=0.02) with an optimum meat protein level (30.6%, p=0.024) and the lowest fat content (2.26%, p=0.001) in carcass yield compared with the control group. Apricot seed kernel at different levels (0.75, 1.5, 3 and 4.5) had no effect on both digestive tract and head weights of rabbits, while giblets and carcass weights were increased (P<0.05) compared to the control rabbits-diet, (Omer *et al* 2020) [34]. Whereas, Arbouche *et al* (2021) [8] found that the incorporation of detoxified apricot kernel meal (DAKM) in substitution of soybean meal for up to 60% in a rabbit diet has not affected slaughter parameters or carcass characteristics (p>0.05). On the other hand, replacing SBM with graded levels of DAKM 25, 35 and 45%, significantly (P<0.05) decreased relative thigh and gizzard weights compared to the control diet. Liver relative weight was significantly increased in those groups fed on (DAKM-35 and DAKM-45).

There were significant differences (p=0.05 and 0.02) in the contents of moisture, protein, ether extract and ash among the different groups, respectively. Results indicated that replacing SBM with 25% DAKM in the diet significantly (p=0.01, 0.002 and 0.05) decreased moisture, ether extract and ash contents in the breast and thigh meat compared to those fed on control and 35 and 45% DAKM, respectively. Ether extract and ash contents of meat were significantly (p=0.05) increased as increasing the levels of DAKM in the diet. The high protein content in the breast and thigh meat was recorded for broilers fed on DAKM 0 and 25% DAKM, however, groups fed on 35 and 45% DAKM had the lowest protein content. Omer *et al* (2020) [34] found that rabbits-diet contained apricot seed kernel (ASK) with level 0.75, 1.5, and 3% were significantly (P<0.05) increased crude protein content of best 9th, 10th, and 11th ribs. Meanwhile, ASK-diet (0.75, 1.5, and 3%) significantly (P<0.05) decreased ether extract content of best 9th, 10th, and 11th ribs.

Blood parameters

The concentrations of total protein, albumin and globulin in blood serum decreased significantly (p=0.05, 0.005 and 0.002), respectively, while serum urea concentration, non significantly (p=0.091) affected with DAKM diets for the different groups (Table 7).

Table 7: Blood serum parameters of chicks fed diets with different levels of Apricot kernel meal.

Items	Defatted Apricot kernel meal supplement				SEM	P-value
	DAKM 0	DAKM-25	DAKM-35	DAKM-45		
TP (g dLG^{1})	3.57^{a}	3.49^{a}	3.17^{b}	3.05^{b}	0.17	0.05
ALB (g dLG^{1})	2.16^{a}	1.99^{a}	1.79^{b}	1.69^{c}	0.12	0.005
GLB (g dLG^{1})	1.41^{a}	1.50^{a}	1.38^{b}	1.36^{b}	0.04	0.002
Urea (mg dLG^{1})	15.33	15.77	15.71	15.22	0.28	0.091
Cholestrol (mg dLG^{1})	139.77^{d}	144.46^{c}	165.99^{b}	170.64^{a}	1.33	0.0001
HDL (mg dLG^{1})	93.65	95.15	92.42	93.75	1.85	0.124
LDL (mg dLG^{1})	43.11^{a}	40.27^{b}	39.11^{bc}	33.33^{d}	0.32	0.001
vLDL (mg dLG^{1})	4.75^{a}	3.96^{ab}	3.68^{ab}	3.05^{b}	0.22	0.003
Triglyceride (mg dLG^{1})	23.26^{a}	22.11^{ab}	20.65^{b}	19.98^{b}	0.16	0.006

$^{a,\ ,\ b,\ c\ and\ d}$: Means in the same row with different superscript are significantly different (P<0.05).

However, serum triglycerides, LDL and vLDL concentrations decreased significantly (p=0.001, 0.003 and 0.006) for the group fed on (DAKM) followed by the group fed on (DAKM-25), while (DAKM-45) had the lowest concentrations. Of blood parameters, cholesterol was not significantly affected by experimental treatments. Kalia *et al*. (2017) [20] revealed that plasma cholesterol and Plasma triglyceride were considerably lower ($P<0.05$) in chicken drinking water using 200 mg of *Prunus armeniaca* seed extract when compared with the control group. Apricot seed kernel in rabbits diets had no significant effect on total protein, albumin, ALT, total cholesterol, triglycerides, urea, and creatinine. Meanwhile, rabbits received a diet containing 4.5% Apricot seed kernel significant ($P<0.05$) increased total globulins and AST contents, (Omer *et al* 2020) [34].

Blood serum proteins are a significant indicator of the health condition and production features of the organism because of their numerous roles in physiology. Among the numerous factors that influence the concentration of serum proteins, feeding plays an important role in physiology. However, replacing soybean meal with graded levels of DAKM 35 and 45%, significantly (p=0.05, 0.005 and 0.002) decreased the blood serum total protein, albumin and globulin with high per cent replacement of SBM compared with the control diet and DAKM-25, respectively. The described changes are related to the most important physiological role of blood proteins; e.g., as a source of amino acids for the synthesis of tissue proteins. As well as, *Prunus armeniaca* seed extract increased ($P<0.05$) the level of plasma total protein, albumin, and globulin in the broiler - diet as compared to control group, (Kalia *et al* 2017) [20].

Conclusion

The addition of the defatted apricot kernel meal as a partial replacement for soybean meal as a protein source in poultry diets may be a useful economic strategy for decreasing feed costs. The results of this study suggest that defatted apricot kernel meal can be fed to chicks at levels up to 25% replacement of the soybean meal without negative effects on growth performance, economic efficiency, carcass traits and blood parameters.

Reference

1. Abd-El-Aal MH, Hamza MA, Rahma EH. In vitro digestibility, physico-chemical and functional properties of apricot kernel proteins. Food Chemistry. 1986;19:197e211.
2. Adeyemi OA. Nutritional evaluation of broilers diets formulated with enriched unpeeled cassava root meal fermented with rumen filtrate. Ph. D. Thesis. University of Agriculture Abeokuta, Nigeria, 2005, 185.
3. Afolayan GG, Olorode BR, Uko JO. The replacement value of maize bran for maize in broiler finisher diets. Proceedings of 27th Annual Conference Animal Science of Nigeria, 2002, 91-93.
4. Alpaslan M, Hayta M. Apricot kernel: Physical and chemical properties. J Am. Oil Chem. Soc. 2006;83:469e471.
5. Amerah AM, Van de Belt K, van Der Klis JD. Effect of different levels of rapeseed meal and sunflower meal and enzyme combination on the performance, digesta viscosity and carcass traits of broiler chickens fed wheat-based diets. Animal. 2015;9:1131-1137.
6. AOAC. Official Methods of Analysis 19th Ed. Association of Official Agriculture, Washington DC. Analytical Chemists International Arligton, Virginia, U.S.A, 2012.
7. Arbouche R, Arbouche F, Arbouche HS, Arbouche Y. Effects on growth performance of the incorporation of apricot kernel meal in the broiler ration. Rev. Méd. Vét. 2012;163(10):475-479.
8. Arbouche Y, Mennani A, Ouzzir L, Arbouche R, Arbouche F. Agro-industrial byproducts in rabbit food: Case of the complex of detoxified apricot kernel cake and dehydrated tomato pulp, Veterinary World. 2021;14(3):744-750.
9. Baurhoo N, Baurhoo B, Mustafa AF. Comparison of corn-based and Canadian pearl millet-based diets on performance, digestibility, villus morphology, and digestive microbial populations in broiler chickens. Poultry Science. 2011;90:579-586.
10. Baytop T. Tu¨ rkiyede bitkilerle tedavi. Istanbul: Istanbul Eczacilik Faku¨ltesi Yayinlari, 1999.
11. Boubekeur F, Arbouche R, Arbouche Y, Arbouche F. By-products of apricot processing in quail feed: Effects on growth performance, carcass characteristics, and meat physicochemical quality, Veterinary World. 2021;14(4):878-883.
12. Cho AY, Yi KY, Rhim JH, Kim KI, Park JY, Keum EH. Detection of abnormally high amygdalin content in food by an enzyme immunoassay. Mol. Cells. 2006;21:308e313.
13. Dragovic-Uzelac V, Levaj B, Mrkic V, Bursac D, Boras M. The content of polyphenols and carotenoids in three apricot cultivars depending on stage of maturity and geographical region. Food Chemistry. 2007;102:966-975.
14. Duncan DB. Multiple range and multiple F tests. Biometrics. 1955;11:1-42.
15. Femenia A, Rosello C, Mulet A, Canellas J. Chemical composition of bitter and sweet apricot kernels. Journal of Agricultural and Food Chemistry. 1995;43:356e361.
16. Hamid NT, Kumar P. Anti-nutritional factors, their adverse effects and need for adequate processing to reduce them in food. Agric. Int. 2017;4:56-60.
17. Hussein HS, Brasel JM. Toxicity, metabolism and impact of mycotoxins on humans and animals. Toxicology. 2001;167:101-134.
18. Jenkins KJ, Atwal AS. Effects of dietary saponins on fecal bile acids and neutral sterols and availability of vitamins A and E in the chick. J Nutr. Biochem. 1994;5:134-138.
19. Johnson C, Wills VY, Nill R. The yeast Sks1p kinase signaling network regulates pseudohyphal growth and glucose response. PLoS Genet. 2014;10:1004-1083.
20. Kalia S, Bharti VK, Giri A, Kumar B. Effect of *Prunus armeniaca* seed extract on health, survivability, antioxidant, blood biochemical and immune status of broiler chickens at high altitude cold desert. Journal of Advanced Research. 2017;8:677-686.
21. Kamel BS, Kakuda Y. Characterization of the seed oil and meal from apricot, cherry, nectarine, peach and plum. Journal of the American Oil Chemists' Society, 1992;69:493e494.
22. Killeen GF, Madigan CA, Connolly CR, Walsh GA, Clark C. Antimicrobial saponins of Yucca Schidigera and the implications of their in vitro properties for their in vivo impact. J Agric. Food Chem. 1998;46:3178-3186.
23. Klita PT, Mathison GW, Fenton TW, Hardin RT. Effects of alfalfa root saponins on digestive function in sheep. J. Anim. Sci. 1996;74:1144-1156.

24. Konieczka P, Czauderna M, Smulikowska S. The enrichment of chicken meat with omega-3 fatty acids by dietary fish oil or its mixture with rapeseed or flaxseed-Effect of feeding duration: Dietary fish oil, flaxseed, and rapeseed and n-3 enriched broiler meat. Anim. Feed Sci. Technol. 2017;223:42–52.
25. Liener IE. Phytohemagglutinins: Their nutritional significance. J Agric. Food Chem. 1974;22:17-22.
26. Makkar HPS, Becker K. Effect of Quillaja Saponins on in vitro Rumen Fermentation. In: Saponins Used in Food and Agriculture, Waller, G.R. and K. Yamasaki (Eds.). Plenum Press, New York, USA., ISBN-13: 978-1-4613-0413-5, 1996, 387-394.
27. Makled MN, Sharara HH, Galal AE, Sayed AM. impact of food industry byproducts and wastes on broilers performance. Egypt. Poult. Sci. 2019;39(I):275-290.
28. Mennani A, Arbouche R, Arbouche Y, Montaigne E, Arbouche F, Arbouche HS. Effects of incorporating agro-industrial by-products into diet of New Zealand rabbits: Case of rebus of date and apricot kernel meal, Veterinary World. 2017;10(12):1456-1463.
29. Niels T. Extraction of amygdalin from fruit kernels. Patent No. WO 9, 620, 716, 1996.
30. North DC. Structure and Change in Economic History. Norton and Co., New York, USA., ISBN-13: 9780393952414, 1981, 228p.
31. NRC. Nutrient Requirements of Poultry. 9th Rev. Edn., National Academy Press, Washington, DC., USA., ISBN-13: 978-0309048927, 1994, 176p.
32. Ogunbode AA, Ogungbenro SD, Raji MO, Oyebanji MO. Performance and nutrient digestibility of broiler fed graded levels of raw pride of barbados seed meal. Int. J. Agric. Biosci. 2014;3:123-126.
33. Olli JJ, Hjelmeland K, Krogdahl A. Soybean trypsin inhibitors in diets for Atlantic salmon (*Salmo salar*, L): Effects on nutrient digestibilities and trypsin in pyloric caeca homogenate and intestinal content. Comp. Biochem. Physiol. Part A: Physiol. 1994;109:923-928.
34. Omer HAA, Ahmed SM, Abedo AA, EL-Nomeary YAA, Nasr SM, Nassar SA. Incorporation apricot seed kernel as untraditional source of protein in rabbit rations. Bulletin of the National Research Centre. 2020;44:37 https://doi.org/10.1186/s42269-020-00292-1.
35. Oruseibio SM, Wariboko NO. Evaluation of methionine in growth performance of broiler chicks under humid tropical conditions. In: Proc. of the 5th Annual Conf. of Anim. Sci Association of Nigeria, Sept. 19-22, Port Harcourt, Nigeria, 2000, 53-56.
36. Lamya Ouzzir, Fodil Arbouche, Yasmine Arbouche Byproducts in rabbit food: case of detoxified apricot kernel meal. Veterinary World · March 2021 DOI: 10.14202/vetworld.2021.744-750.
37. Pekel AY, Patterson PH, Hulet RM, Acar N, Cravener, TL, Dowler DB, Hunter JM. Dietary Camelina Meal versus Flaxseed with and without Supplemental Copper for Broiler Chickens: Live Performance and Processing Yield. Poult. Sci. 2009;88:2392-2398.
38. Rodríguez M, Alzueta C, Rebole A, Ortiz L, Centeno C, Trevino J. Effect of inclusion level of linseed on the nutrient utilisation of diets for growing broiler chickens. Br. Poult. Sci. 2001;42(2001):368-375.
39. Ryhänen EL, Perttilä S, Tupasela T, Valaja J, Eriksson C. Larkka K. Effect of Camelina sativa Expeller Cake on Performance and Meat Quality of Broilers. J. Sci. Food Agric. 2007;87:1489-1494.
40. Senica M, Stampar F, Veberic R, Mikulic-Petkovsek M. Transition of phenolics and cyanogenic glycosides from apricot and cherry fruit kernels into liqueur. Food Chem. 2016;203:483-490.
41. Slover HT, Thompson HR, Jr., Merola GV. Determination of tocoferols and sterols by capillary gas chromatography. Journal of the American Oil Chemists' Society. 1983;60(8):1524e1528.
42. SPSS. Statistical package for social sciences, Statistics for Windows, Version 17.0. Released 2008. SPSS Inc, Chicago, U.S.A, 2008.
43. Westbrook LA, Cherian G. Egg quality, fatty-acid composition and gastrointestinal morphology of layer hens fed whole flaxseed with enzyme supplementation. Br. Poult. Sci. 2019;60:146-153.
44. Yigit D, Yigit N, Mavi A. Antioxidant and antimicrobial activities of bitter and sweet apricot (*Prunus armeniaca* L) kernels. Brazilian Journal of Medical and Biological Research. 2009;42:346e352.
45. Yoshikawa M, Murakami T, Kishi A, Kageura T, Matsuda H. Medicinal flowers. III. Marigold. (1): Hypoglycemic, gastric emptying inhibitory and gastroprotective principles and new oleanane-type triterpene oligoglycosides, calendasaponins A, B, C and D, from Egyptian Calendula officinalis. Chem. Pharm. Bull. 2001;49:863-870.