EVALUATION OF SESAME MEAL REPLACEMENT IN BROILER DIETS WITH PHYTASE AND PROBIOTIC SUPPLEMENTATION

By

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Accepted: **15/10/2008** Received: **25/2/2009**

ABSTRACT: *Two trials were conducted to evaluate sesame seed meal (SSM) replacement of broiler diets ingredients. The 1st trial included 5 major dietary treatments using 360 day old Ross commercial broilers: 1) Corn + soybean meal (SBM) "control diet"; 2) Corn + SSM; 3) Corn + [50% SBM + 50% SSM]; 4) Corn + [25% SBM + 75% SSM]; and 5) Corn + [75% SBM + 25% SSM]. Each treatment was then divided into 4 sub-treatments of: 0 supplements; + 0.1% phytase; + 0.1% probiotic; and/ or + 0.1% phytase + 0.1% probiotic to total all dietary treatments to 20 treatments. The 2nd trial consisted of 336 Ross commercial broiler chicks utilizing 4 major dietary treatments including 1) Corn + SBM "control diet"; 2) Corn + 5% SSM; 3) Corn + 10% SSM; and 4) Corn + 15% SSM. Each dietary treatment was divided in a similar design to trial one; to 4 sub-treatments to sum up all dietary treatments to a total of 16 sub-treatments. Chickens in both trials were kept under similar management conditions. The following criteria were measured and/or calculated: body weight, body weight gain, feed consumption, mortality rate, and feed conversion ratio was calculated starting 1st wk of age. At the end of the experiment, estimated slaughter yield were also carried out. Total protein efficiency (TPE) assay of SSM was evaluated, and plasma cholesterol and triglycerides were measured using enzymatic kits.*

In trail 1, live body weights and weight gains of 6-week old broiler chicks fed the control diet were ($P \leq 0.05$) higher than those of all other dietary treatments. On the other hand, body weights and gains of broilers fed 50% of either SSM or SBM were significantly lower than those of the control diet. Broilers fed diets containing 100% and/ or 75% SSM consumed less feed as compared with that of the control diet of 87.61, 79.91 and 95.08, *respectively. Feed conversion ratio from broilers fed all dietary treatments and the control were below expectations but rather not significantly different from that of the control group. In 2nd trail, at 5 weeks of age, body weights and weight gains of broilers fed 5% SSM or 10% SSM + phytase + probiotic were higher ($P \leq 0.05$) as compared to those fed the control diet. Dietary treatments and phytase or probiotic supplementation did not influence plasma triglyceride levels. On the other hand, cholesterol levels were reduced as dietary SSM increased in comparison to the control diet. Also, phytase and/ or probiotic supplementation to SSM diets followed similar manner and was significantly ($P \leq 0.01$) lower than the control group fed SBM standard diet. The method of processing for oil extraction and temperature used for roasting the seed might have altered the availability of the basic amino acids and in turn affected the feeding value of dietary SSM utilization.*

INTRODUCTION

Due to pathogenic agents often associated with feeding animal protein sources, there is a worldwide trend to feed poultry diets of all plant protein sources. However, soybean meal, the most commonly plant protein used in poultry diets, is becoming extremely expensive in the last decade especially in developing countries.. Therefore, search for alternative vegetable protein sources, which are cheap and locally available, has become an urgent subject to poultry nutritionists (El-Housseiny et al. 2001).

Sesame (*Sesamum indicum*) seed is a traditional health food around the world, and is composed of 45 to 50% lipid, 15 to 20% protein, and 10 to 15% carbohydrate (Lee *et al.*, 2005). Sesame seed meal (**SSM**) may also, constitute to be good vegetable protein sources for use in poultry diets in regions where they are readily available and relatively inexpensive. Because the sesame meal is the residue after pressing the oil from the seed, it is an excellent source of protein ranging from (28.40 %; El-Housseiny *et al,* 2001) to (52.9 % CP; Kaneko *et al.*, 2002) and has an amino acid composition similar to that of soybean meal (47.7% CP; Mamputu *et al,* 1995). The SSM could partially replace soybean meal in the diet as a source of plant protein for chicks (Bell *et al.*, 1990; Pan *et al.*, 1992; Kang *et al.*, 1999) and ducklings (Dey *et al.*, 1982; El-Husseiny *et al.*, 2001).

Research conducted on SSM indicated that it may provide an acceptable alternative to soybean meal in broiler rations when substitution level is 15% or less (Bell *et al.*, 1990; Pan *et al.*, 1992; Kang *et al.*, 1999). Moreover, Jacob et al. (1996) indicated that live body weight was significantly higher for chicks fed on SSM compared with those receiving soybean meal or sunflower seed meal. However, broilers performance was depressed by feeding a diet containing SSM at 30% of dietary CP (Mamputu and Buhr, 1995).

Yeast culture (as probiotics; **Pro**) containing large amount of yeast metabolites which colony with some viable yeast cells. These compositions are the principle functional components of this culture used as probiotics (Miles and Bootwella, 1991). Yeast contains large amount of the metabolites components which inhibiting harmful bacteria by altering intestinal pH (Makled, 1991). Recently, manufacturers produced dry yeast (*Saccharomyces cervisiae*) commercially as growth promoter (as probiotics) to prohibit use of antibiotics in animal feeds to avoid their side effect on human health. It has been used as natural biological feed additives which have beneficial effects to the host animal by improving its intestinal microbial balance (Fuller, 1989) to stimulate the growth processes and improved poultry productive performance (Makled, 1991). According to Hussein, (1998); and Goh and Hwang, (1999), the use of dry yeast in broiler diets has been shown to be responsible for increased body weight, gain, improved feed conversion and reduced mortality rate. Also, similar results were reported by Soliman et al, (2000) with rabbits, Abd El-Azeem et al, (2001) with Japanese quails, and Savage and Mirosh, (1990) with turkey breeder hens. Usage of Pro enables the host animal to return to normal through increasing normal gut flora on the expense of pathogenic organisms (Jin et al, 1997). The improvements attributed to yeast cultures could be due to decreased proliferation of pathogenic bacteria (Miles, 1993), prevent diarrhea (Makled, 1991). Furthermore, Pro produces lactic acid which alter the pH of chicken gut making it improper media for harmful bacteria such as salmonella and pathogenic species of E. coli (Leesson and Major, 1990), improve nutrient availability and absorption (Sellars, 1991), stimulate appetite (Nahashon et al, 1994), produce digestive enzymes (Lee and Lee, 1990), and improve intestinal microbial balance (Fuller, 1989).

Phytase (**Phy**) utilization "supplementation" in poultry diets has become widespread and extensive due to public concern surrounding phosphorus pollution, and its ability to increase non phytate phosphorus **(NPP)** utilization. The positive effects of **Phy** includes broilers (Denbow *et al.*, 1995; Sebastian *et al.*, 1998; Ravindran *et al.*,, 1999; El-Medany and El-Afifi, 2002; Abd-Elsamee; 2002; Abd El-Hakim and Abd El-Samee, 2004) and laying hens are well documented (Van der Klis *et al.*, 1997; Gordon and Roland, 1997, 1998; Boling *et al.*, 2000; Jalal and Scheideler, 2001; Keshavarz, 2003; Wu *et al.*, 2006). Phytic acid also reduces the activity of pepsin, trypsin, and α-amylase (Sebastian *et al* 1998). Cereal based poultry diets supplemented with microbial **Phy** result in increased digestibility and availability of phytate bound phosphorus, calcium, zinc and copper. Microbial phytase supplementation has also been shown to increase the digestibility of crude protein and amino acids (Sebastian *et al* 1998). Phytase enzyme supplementation has been shown to reduce phosphorus and nitrogen excretion (Leske and Coon, 1999; Jalal and Scheideler, 2001; Keshavarz and Austic, 2004). Phytase from different sources have discernable biochemical and physical properties such as pH activity and sensitivity to pepsin which influence their *in vivo* bioefficacy (Wu *et al.*, 2006).

Therefore, the objective of this study is to investigate the effect of feeding different levels of SSM as a replacement for SBM with the supplementation of phytase (**Phy**) and/or pro-biotic (**Pro**) on performance, blood constituents and carcass traits of broiler chicks.

MATERIALS AND METHODS

The current experimental work was carried out at the Agriculture Research Center at Hada El-Sham, Faculty of Meteorology Environmental and Arid Land Agriculture, King Abdulaziz University - Saudi Arabia. Experimental work was conducted in two trials. The 1st trial (n=360 birds) included diets of 5 major dietary treatments (Table 1) including 1) Corn + SBM "*control diet*"; 2) Corn + SSM; 3) Corn + [50% SBM + 50% SSM]; 4) Corn + [25% SBM + 75% SSM]; and Corn + [75% SBM + 25% SSM]. Each treatment was also divided to 4 sub-treatments of: (0 supplements); (+ Phytase); (+ Probiotic); and (+ Phytase + Probiotic) to sum up all dietary treatments to a total of 20 treatments.

In the 2nd trial, (n= 336 birds) dietary diets consisted of 4 dietary major dietary treatments (Table 1) including 1) Corn + SBM "control diet"; 2) Corn + 5% SSM; 3) Corn + 10% SSM; and 4) Corn + 15% SSM. Furthermore, and similar to trial one, each dietary treatment was then divided to 4 sub-treatments of: (0 supplements); (+ Phytase); (+Probiotic); and (+ Phytase + Probiotic) to sum up all dietary treatments to a total of 16 treatments.

Enzyme description: The Phytase (**Phy**) used in this study is Zympex P 5000[2] Phytase which is a dry stabilized preparation manufactured by Impextraco Company, Belgium. It is a phytase preparation from fungal origin. Phytase was added at the level of 0.1%; 100g/ton, with a minimum guaranteed Phytase level of 5,000 PIAU/gram.

[2]Impextraco, Wiekevorstsesteenweg 38. B-2220 Heist-Op-Den-Berg. Belgium.

Probiotic description: The probiotic preparation (**Pro**) used is a commercially available product wet yeast[3]which contains *Saccharomyces Cervistae* (1000 million/ gm product) blended with phytase as a digestive enzyme. Probiotic mixture was added at the level of 1%; 1g/kg diet.

Birds and Diets: Diets calculated chemical analyses are presented in (Table 1). Each experimental diet was formulated to meet nutrients recommendation of Ross management guide which met or exceeded the NRC (1994) nutrients requirements recommendations. In the 1st trial, a total of three hundreds and sixty one day old Ross commercial broiler chicks[4], were randomly assigned to 20 experimental groups, each group was represented by chicks in three replicates pens of six broilers.

The 2nd trial consisted of three hundreds and thirty six one day old Ross commercial broilers, which were randomly assigned to 16 experimental groups, each group was represented by chicks in three replicates pens of seven broilers each. Chickens in both trials were kept under similar management conditions.

Chicks were housed in an environmentally controlled facility with a daily target temperature of 22°C. Feed and water were provided for *ad libitum* consumption. The proximate analysis of sesame in comparison to soybean meal is presented in (Table 3).

Measurements: The following criteria were measured and/or calculated: body weight, body weight gain, feed consumption, and feed conversion ratio was calculated starting 1st wk of age. At the end of the experiment, estimated slaughter yield were also carried out by randomly using four broilers around the average body weight from each treatment group. Selected chickens were deprived from feed for 12 hours, weighed and were slaughtered to complete bleeding, followed by plucking feathers then weighted. Carcass weight, dressing, abdominal fat, and intestine weight were recorded and intestine length was also measured.

Total protein efficiency **(TPE):** Assay of SSM was evaluated according to the procedure described by Woodham *et al.,* (1972), where 40 chicks 14-day old were divided into two groups with 4 replicates of 5 birds each with using experimental diets presented in (Table 2).

TPE = Body weight gain, g. / Total protein consumed, g.

[3]Al-Takamolya Industries. According to specifications of Farmacobia, UK. Sadko trade. Sharkya Egypt
[4]Ross Breeders, Inc. Cummings research park. 5015 Bradford drive. Huntsville, Alabama 35805 USA.

Biochemical Analysis: Cholesterol and triglycerides of plasma were measured using enzymatic kits (Biodiagnostic)[5].

Statistical Analysis: In trials 1 and 2, all data were analyzed using the GLM procedures of SAS for a Complete Randomized Design (CRD). All dietary treatments (20 and 16 dietary treatments in the 1st and 2nd trials, respectively) were considered fixed effects. Significant treatment differences were established using the LSMEANS statement in SAS (SAS, 2003). A one way analysis was implemented and the following model was used to determine differences between treatment groups:

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

Where Y_{ij} = variable measured; μ = overall mean; a_i = effect of the i^{th} level of A; and e_{ij} = error component. Significance of difference was based on the probability of a type III error set at ($P \leq 0.05$). The differences among means were tested utilizing Duncan's multiple range test (Duncan, 1955). A contrast statement was also used to differentiate between main effects of dietary treatments.

RESULTS AND DISCUSSION

Chemical Composition and Amino Acid Content

Proximate analyses of SSM were found to be 8.40, 29.52, 11.40, 40.17, 5.36, and 5.15% for moisture, CP, EE, NFE, CF and ash, respectively (Table 3) whereas it contains 2865 kcal ME/kg. These data are in an agreement with those reported by El-Husseiny *et al.* (2001), Hashem (1997) and El-Husseiny *et al.*, (1994) but disagreed with those obtained by El-Hawary (1975) and NRC, (1994). Variations in CP and EE are mainly due to the type of sesame seeds and the method of oil extraction. Amino acid content of SSM revealed that SSM is deficient in Lys and Thr having the values of 2.29 and 3.20 as a percentage of CP for Lys and Thr, respectively. However, SSM is rich in Met and Arg. El-Husseiny *et al.* (2001), NRC (1994) reported that Soybean meal contains about 6.25, 4.00, 7.82 and 4.57 as a percentage of crude protein for Lys, Thr, Leu, and Ile, respectively.

Total protein efficiency of the tested material (SSM) was lower than that of soybean meal (Table 5). The poor protein quality for SSM tested biologically by chicks assay of TPE was probably due to its badly balanced amino acid pattern and /or to its poor availability of some amino acids especially lysine when compared with that of soybean meal.

[5] Biodiagnostic. Tahrer Street Dokki – Giza. Egypt

Broiler Chicks Performance

In experiment 1, live body weight and body weight gain of 6-week old broiler chicks fed the control diet were significantly ($P \leq 0.05$) higher than those of all other dietary treatments. However, body weights and body weight gains of broilers fed diets containing 50% of either SSM or soybean meal (SBM) were significantly lower than those of the control diet (Table 5). Broilers fed diets containing 100% and/ or 75% SSM consumed less feed as compared with that of the control diet of 87.61, 79.91 and 95.08, respectively. Feed conversion ratio from broilers fed all dietary treatments and the control were below expectations but rather not significantly different from that of the control group.

Although all diets utilized in this trail were formulated to be isocaloric, there was a very huge variation in all performance criteria. This might be due to multiple reasons: 1. SSM dietary levels used were very high and caused a poor performance as a result of higher dietary SSM in conjunction with the poor amino acids quality in SSM (El-Husseiny *et al.*2001, NRC 1994); 2. There might be a variation in the determined TME values of SSM. Jucoh *et al.* (1996) reported that variation in TME values for the feedstuffs used in diets formulation may account for the variation observed in performance among tested diets. The higher TME value for the sesame seed cake diets (15.2 MJ kg-‘) as compared to the SBM diets (14.8 MJ kg-‘) may have contributed to the improved performance observed for the SSM fed broilers. However, these reported data utilized lower dietary SSM levels than dietary SSM levels used in our trial.

Dietary SSM utilized in this trial reached a 100% replacement of the SBM, and yet caused a major depression in broiler chicks performance. These results agree with those reported by (El-Husseiny *et al.*, 2001, Ravindran and Blair, 1992) who reported that incorporating SSM in duck diets at level greater than 15% of the diet significantly reduced body weight and feed conversion ratio. This may be due to low net protein utilization of SSM as well as low lysine and high phytic acid content (Ravindran and Blair, 1992). Bell *et al.*, (1990) and Pan *et al.*, (1992) reported that SSM may provide an acceptable alternative to soybean meal in broiler ration when fed at 15% of the diet or less. Sesame seed meal may not be suitable as a sole source of vegetable protein but can be employed at not greater than 30% of total dietary protein for broilers and 23.6% for laying hens to achieve optimal performance (Reddy *et al.*, 1999). Rama Rao, (2008) also reported that the non-linear decrease in food efficiency in broilers fed diets containing higher levels of SSM may have been due to a reduced utilization of nutrients at higher levels of SSM in diet.

In experiment 2, at 5 weeks of age, body weights and body weight gains of broilers fed diet containing 5% SSM or 10% SSM + phytase + probiotic were significantly higher ($P \leq 0.05$) as compared to those fed the control diet and all other dietary treatments. Similar result was observed with female ducks. Increasing SSM to 15% of the diet significantly ($P \leq 0.05$) increased body weights and body weight gains of broilers as compared to the control diet. These results confirm results obtained from experiment 1, which indicated that body weights and body weight gains of 6-week-old broilers fed diet containing 30% SSM were significantly, lower than those of control, corn-soybean diet. These results are also in an agreement with those of Bell et al. (1990) and Pan et al. (1992) who reported that SSM may provide an acceptable alternative to soybean meal in broiler ration when fed at 15% of the diet or less.

Probiotics, which contain viable organisms might exert a beneficial effect on animal performance through modification of gastrointestinal tract (GIT) microflora, and might replace antibiotics in feeds (Reid and Friendship, 2002). The use of probiotics in feeds often enhances growth and health and maintains normal intestinal microflora. Broilers performance data reported her in the 2nd trail are in agreement with the previously mentioned data.

Another advantage of probiotics was reported by (Potter, 1972) who found that probiotics, *i.e.* Fermacto may provide nutrients and mycelial fiber, effectively stimulates the growth of beneficial micro flora in the small and large intestine and the result would be better balance of bacterium population.

Furthermore, El-Deek, *et al.*, (2008) reported that it could be recommended that probiotic addition to the experimental diets including different levels of CGM has been found to improve growth performance in broiler. These finding may be due to the mode of action of probiotic in poultry, which include: maintaining normal intestinal microflora by competitive exclusion and antagonism, altering metabolism by increasing digestive enzymes activities and decreasing bacterial enzymes activities and ammonia production, improving feed intake and digestion and neutralizing enterotoxinsand stimulating the immune system, (Jin *et al.*, 1997).

Phytase supplementation of maize and soybean meal based diets has been reported to improve BWG and FCR (Biehl and Baker, 1997; Sebastian *et al.*, 1997; Wu *et al.*, 2003), although contrasting data exist (Ibrahim *et al.*, 1999; Waldroup *et al.*, 2000; Yan *et al.*, 2003). The requirement of available P for broilers beyond 6 weeks of age is lower for growth performance than tibia ash (Waldroup *et al.*, 2000; Yan *et al.*, 2003).

Carcass characteristics:

Results presented in (Table 6) illustrate carcass traits during experiment 1, of which data showed that parameters of blood, feather, and heart percentages were not affected by either the inclusion level of SSM, phytase and/ or probiotic supplementation to the experimental diets. Exceptions were noted with breast, thigh, gizzard and liver percentages of which phytase and/ or probiotic supplementation to the SBM control diet was significantly ($P \leq 0.01$) higher as compared to supplementing phytase all other dietary treatments. These results are in accordance with findings of El-Deek *et al.*, (2008), Panda *et al.*, (2000) and Ali,(1999), who indicated that no significant influence on the dressing percentage and weight of internal organs were observed in chicks receiving diets supplemented with probiotic.

Results presented in Tables (9 & 10) show carcass traits of experiment 2, of which data revealed that parameters of carcass characteristics were not affected by either the phytase, probiotic supplementation or inclusion level of SSM in the experimental diets. Exception was seen with thigh percentage which was significantly ($P \leq 0.01$) higher as probiotic was supplemented to the SBM control diet 485.54 g. followed by Probiotic supplementation to the 10% SSM (430.66 g), respectively. These results are also in agreement with the findings of El-Deek *et al.*, (2008), Panda *et al.*, (2000) and Ali,(1999), who indicated that no significant influence on the dressing percentage and weight of internal organs were observed in chicks receiving diets supplemented with probiotic. It is interesting to note that increasing SSM dietary levels up to 15% resulted in a numerically reduction in breast weights in the 2nd experiment. This is in line with findings of El-Husseiny *et al.*, (2001) who reported that Percent breast meat was significantly decreased when ducks were fed 30% SSM diet compared with that obtained from the groups fed the control diet.

Furthermore, in the 2nd experiment spleen percentage significantly ($P \leq 0.01$) increased as SSM inclusion level increased up to 15% plus phytase as compared to all other dietary treatments. Moreover, bursa percent was also significantly ($P \leq 0.01$) decreased with probiotic inclusion in the elevated dietary SSM levels. These finding may be due to the mode of action of probiotic in poultry, which include: maintaining normal intestinal microflora by competitive exclusion and antagonism, altering metabolism by increasing digestive enzymes activities and decreasing bacterial enzymes activities and ammonia production, improving feed intake and digestion and neutralizing enterotoxinsand stimulating the immune system, (Jin *et al.*, 1997). Furthermore, Rama Rao, (2008) reported that the RTC yields and the weights of giblet, liver and abdominal fat were reduced in groups given

SSM as a total substitute for SBM. Similar to these observations, Kaneko et al. (2002) also reported reduction in relative weights of breast, thigh meat, abdominal fat and fat content in breast meat with an increase in SSM level in broiler ,. Reduced food efficiency and possibly poor utilisation of dietary protein (as seen in serum protein concentration) in broilers receiving SSM as a total substitute for SBM might be responsible for low muscle protein accretion.

Dietary treatments and phytase or Probiotic supplementation did not influence plasma Triglyceride levels (Table 11). On the other hand, cholesterol level reduced as dietary SSM increase in comparison to the control diet. Also, phytase and/ or probiotic supplementation to SSM diets followed similar manner and was significantly ($P \leq 0.01$) lower than the control group fed SBM standard diet.

Finally, there is a variation in results observed in the literature on dietary SSM utilization in chicken diet Rama Rao, (2008). This might be due to greater variability in processing temperature during oil extraction from the seeds. High temperatures (>115 C°) were reported to reduce the availability of lysine (Caldwell, 1958) to an extent of 17.9 to 50% (Villegas *et al.,* 1968; Mamputu and Buhr, 1995). The method of processing for oil extraction (screw press or solvent extraction) and temperature used for roasting the seed might have altered the availability of the basic amino acids (Mamputu and Buhr, 1995) and in turn affected the feeding value of SSM for poultry. Future field trials are encouraged in order to clarify possible utilization of these feed ingredients in poultry feed rations.

Table (1): Calculated composition and nutrients contents of experimental diets, trial 1 and 2

Ingredients, (%)	Trial 1					Trial 2		
	SBM[1]	SSM[2]	50 So + 50% SSM	25 So + 75% SSM	75 So + 25% SSM	5% SSM	10% SSM	15% SSM
Corn yellow	51.50	51.50	51.500	51.500	51.500	51.500	51.500	51.500
Soybean Meal	40.20	—	20.100	10.050	30.150	35.200	30.300	25.300
Sesame meal	—	40.60	20.300	30.450	10.150	5.00	10.00	15.00
Di-Ca Ph	1.668	1.527	1.598	1.563	1.633	1.65	1.63	1.63
Lime Stone	1.595	0.000	0.715	0.275	1.385	1.38	1.16	0.95
Salt	0.500	0.500	0.500	0.500	0.500	0.50	0.50	0.50
Veg. oil	4.112	4.103	4.107	4.105	4.109	4.13	4.11	4.12
Lys	0.000	0.597	0.250	0.420	0.065	—	—	0.09
Meth.	0.0381	—	—	—	—	0.070	0.099	0.130
Pre-Mix[3]	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Sand	0.087	0.873	0.630	0.837	0.207	0.280	0.396	0.498
Total	100.000	100.000	100.000	100.000	100.000	100.00	100.00	100.00
Calculated analysis, %								
CP	22.07	22.04	22.05	22.05	22.06	22.041	22.06	22.04
ME, kcal/kg	3000	3000	3000	3000	3000	3000	3000	3000
Lys	1.215	1.100	1.109	1.101	1.102	1.126	1.040	1.041
Meth	0.380	0.588	0.465	0.527	0.403	0.441	0.502	0.563
Iso-Leu	0.937	0.762	0.850	0.806	0.894	0.914	0.894	0.871
Ca	1.000	1.063	1.000	1.000	1.087	1.000	1.000	1.000
Avail P.	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Total P.	0.756	1.021	0.888	0.955	0.822	0.788	0.821	0.853

SBM[1]: Soybean meal SSM[2]: Sesame seed meal

[3]**Minerals & vitamins premix:** Added as 3 Kg/ton of diet and supplied the following (as mg or I.U. /kg of diet): Vit. A 12,000 I.U., Vit. D_3 2,000 I.U., Vit. E 10 mg, Vit. K_3 2 mg, Vit B_1 1 mg, Vit. B_2 4 mg, Vit. B_6 1.5 mg, Pantothenic acid 10 mg, Vit. B_{12} 0.01 mg, Folic acid 1 mg, Niacin 20 mg, Biotin 0.05 mg, Choline Chloride 500 mg, Zn 55 mg, Cu 10 mg, Fe 30 mg, I 1 mg, Se 0.1 mg, Mn 55 mg, Ethoxyquin 3,000 mg.

Table (2): Composition of diets used in the total protein efficiency experiment for sesame seed meal protein evaluation

Ingredients, %	Diets	
	Control	Tested
Wheat	50.00	50.00
Soybean meal (44%)	25.40	---
Sesame seed meal (30%)	---	37.40
Yeast	1.15	1.15
Veg. oil	0.02	0.017
Di-Calcium P	2.03	1.65
Limestone	1.42	1.02
Min. & Vit. Premix*	0.30	0.30
NaCl	0.50	0.50
HCl-Lysine	0.17	0.46
DL-Methionine	0.05	---
Sand	17.96	7.50
Total	**100.00**	**100.00**
Calculated values, (%):		
ME Kcal/Kg	3000	3000
Crude protein	18.73	18.63
Crude fiber	0.24	1.01
Ether extract	1.25	3.68
Methionine	0.32	0.56
Lysine	1.07	1.02
Calcium	1.08	1.50
Avail. Phosphorus	0.50	0.50

***Minerals & vitamins premix:** Added as 3 Kg/ton of diet and supplied the following (as mg or I.U. /kg of diet): Vit. A 12,000 I.U., Vit. D_3 2,000 I.U., Vit. E 10 mg, Vit. K_3 2 mg, Vit B_1 1 mg, Vit. B_2 4 mg, Vit. B_6 1.5 mg. Pantothenic acid 10 mg, Vit. B_{12} 0.01 mg, Folic acid 1 mg, Niacin 20 mg, Biotin 0.05 mg, Choline Chloride 500 mg, Zn 55 mg, Cu 10 mg, Fe 30 mg, I 1 mg, Se 0.1 mg, Mn 55 mg, Ethoxyquin 3,000 mg.

Table (3): The chemical composition and amino acid contents of sesame seed meal and soybean meal used in the experiment

Nutrient, (%)	Sesame seed meal	Sesame seed meal, NRC (94)	Soybean meal 44%
Moisture	8.40	7.00	9.00
CP	29.52	43.80	43.98
EE	11.40	6.50	0.80
NFE	40.17	---	33.32
CF	5.36	7.00	5.90
Ash	5.15	---	6.5
Amino acids (%)			
Met.	0.71	1.22	0.64
Cys.	0.64	0.72	0.67
Met + Cys	1.35	1.94	1.31
Lys.	0.60	0.91	2.75
Thr.	0.93	1.40	1.76
Arg.	3.36	4.68	3.28
Ile.	0.90	1.51	2.01
Leu.	1.23	2.68	3.44
Val.	1.06	1.91	2.08
His.	0.83	0.99	1.21
Phy-Ala.	1.12	1.93	2.31
Try.	0.41	1.48	0.57

Table (4): Total protein efficiency assay comparing sesame seed meal protein and soybean meal protein in broiler diets throughout 14 to 28 days of age

Parameter	Soy	Sesame	Probability
Body weight gain (g)	381.00	358.50	NS
Feed consumption (g)	1008.00	1018.17	NS
Protein consumed (g)	186.48	188.36	NS
Total protein efficiency	2.04	1.90	0.05

Table (5): Effect of sesame meal in broiler diets supplemented with phytase and probiotic on production performance 1st trial

		BW^1	BWG^2	FC^3	FCR^4
Treatments		**wk 6**		**1-6 wks**	
Soy		1204.60^{a}	1151.1^{a}	95.08	0.12
	+ Phytase	1009.75^{b}	952.70^{ab}	97.63	0.15
	+ Pro	1018.67^{b}	972.94^{ab}	95.38	0.14
	+ Phy + Pro	704.25^{fghij}	654.53^{cde}	96.00	0.20
Sesame		678.12^{fghij}	638.42^{cde}	87.61	0.28
	+ Phytase	620.50^{ij}	574.28^{de}	90.43	0.25
	+ Pro	564.94^{j}	522.06^{e}	85.53	0.32
	+ Phy + Pro	586.63^{ij}	547.86^{e}	95.92	0.30
50 % + 50%		974.17^{bc}	930.78^{ab}	92.94	0.13
	+ Phytase	793.53^{defg}	752.81^{bcde}	90.68	0.20
	+ Pro	819.60^{def}	753.09^{bcde}	95.54	0.18
	+ Phy + Pro	779.50^{defgh}	746.49^{bcde}	93.04	0.17
25%+ 75%		801.06^{defg}	759.62^{bcde}	94.87	0.18
	+ Phytase	889.50^{bcd}	852.60^{bc}	97.57	0.18
	+ Pro	863.94^{cde}	816.10^{bcd}	99.78	0.19
	+ Phy + Pro	657.71^{ghij}	620.14^{de}	98.31	0.20
75%+ 25%		730.00^{efghi}	674.58^{cde}	96.64	0.22
	+ Phytase	713.50^{efghij}	668.50^{cde}	93.21	0.20
	+ Pro	587.82^{ij}	544.10^{e}	79.91	0.22
	+ Phy + Pro	637.78^{hij}	593.44^{de}	93.61	0.28
SEM		45.57	74.87	4.09	0.03
Probabilities					
Treatment		**	**	NS	0.001
Contrasts					
Pos cont *vs.* Neg cont		**	**	NS	0.01
Pos cont *vs.* All cont		**	**	NS	0.02
Pos Phtase *vs.* All phytase		**	**	NS	NS
Pos Pro *vs.* All Pro		**	**	NS	0.01
Pos Phy/Pro *vs.* All Phy/Pro		NS	NS	NS	NS
Pos cont *vs.* All Phytase		**	**	NS	0.03
Pos cont *vs.* All Pro		**	**	NS	0.01
Pos cont *vs.* All Phy/Pro		**	**	NS	0.02

^{abcd} Means within a row with no common superscripts differ significantly ($P \leq 0.05$).
BW^1: Body weights (gm.) BWG^2: Body weight gains (gm.)
FC^3: Feed Consumption (gm./ bird)
FCR^4: Feed conversion ratio (gm. Feed/ gm. gain)

Table (6): Effect of sesame meal in broiler diets supplemented with phytase and probiotic on slaughter Traits 1st trial

Treatments	Slaughter Traits, %									
	Carcass	Breast	Thigh	Gizzard	Liver	Heart	Spleen	Bursa	Thymus	Intestine length cm
Soy	1181.3^{a}	587.50	467.50	41.73	34.18	7.28	4.31	3.14	4.32	173.75
+ Phytase	1134.3^{ab}	566.25	470.00	46.86	40.43	8.54	3.96	3.36	5.42	178.33
+ Pro	1231.4^{a}	662.50	525.00	47.07	38.70	7.51	3.17	3.37	6.18	188.75
+ Phy + Pro	516.1^{def}	318.75	256.25	30.21	23.88	5.17	1.86	2.59	2.60	141.25
Sesame	408.6^{f}	200.75	163.00	25.33	17.54	4.51	1.16	0.85	1.64	147.50
+ Phytase	387.6^{f}	158.76	196.25	20.85	13.51	4.25	0.75	0.52	1.00	141.25
+ Pro	433.3^{f}	262.50	212.50	25.58	21.83	4.13	1.65	1.13	1.18	146.25
+ Phy + Pro	539.8^{def}	375.00	225.00	25.54	17.80	4.22	1.69	2.23	2.74	137.50
50 % + 50%	1086.3^{abc}	500.00	575.00	38.14	33.72	7.47	2.39	3.24	4.84	172.00
+ Phytase	966.4^{abc}	550 00	425.00	37.61	39.45	6.89	2.66	2.76	4.31	176.25
+ Pro	675.9^{cdef}	350.00	275.00	35.38	24.12	5.00	2.09	2.16	2.78	182.50
+ Phy + Pro	947.9^{abc}	442.50	375.00	46.52	30.28	7.48	2.64	2.79	4.45	187.50
25%+ 75%	709.6^{cdef}	412.50	500 00	31.19	28.12	7.52	2.50	2.47	5.10	177.50
+ Phytase	873.4^{abcde}	375.00	292.50	40.07	23.37	6.15	2.77	2.17	3.16	171.25
+ Pro	753.9^{bcdef}	337.50	275.00	31.72	20.08	4.84	3.48	1.91	3.54	140.00
+ Phy + Pro	488.8^{ef}	225.00	175.00	24.51	22.37	3.89	2.66	0.61	1.36	130.60
75%+ 25%	921.4^{abcd}	400.00	362.50	38.71	40.81	5.95	2.55	1.58	3.82	167.50
+ Phytase	769.5^{bcdef}	325.00	300.00	34.06	24.61	6.72	1.67	1.98	2.96	162.50
+ Pro	522.2^{def}	245.00	218.75	36.75	23.98	5.45	1.07	1.85	3.05	155.00
+ Phy + Pro	690.3^{cdef}	336.25	302.50	28.80	21.45	4.67	2.10	2.00	2.05	135.00
SEM	123.39	53.65	60.06	5.01	5.18	3.80	0.90	0.46	0.73	11.60
Probabilities										
Treatment	0.0001	0.0001	0.0001	0.004	0.003	NS	NS	0.001	0.001	0.01
Contrasts										
Pos cont vs. Neg cont	0.0001	0.0001	0.0001	0.02	0.03	NS	0.02	0.001	0.01	NS
Pos cont vs. All cont	0.01	0.001	NS	NS	NS	NS	0.04	0.04	NS	NS
Pos Phtase vs. All phytase	0.0001	0.001	0.02	0.02	0.01	NS	NS	0.01	0.01	NS
Pos Pro vs. All Pro	0.0001	0.0001	0.0001	0.01	0.01	NS	NS	0.003	0.0001	0.01
Pos Phy/Pro vs. All Phy/Pro	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pos cont vs. All Phytase	0.001	0.001	0.05	NS	NS	NS	0.05	0.06	NS	NS
Pos cont vs. All Pro	0.001	0.001	0.02	NS	NS	NS	0.05	0.04	NS	NS
Pos cont vs. All Phy/Pro	0.001	0.0001	0.001	0.06	0.06	NS	0.04	0.03	0.04	0.03

Table (7): Effect of sesame meal in broiler diets supplemented with phytase and probiotic on body weights during the 2nd trail

Treatments		BW gm	BWG gm	FC gm	FCR g./ g.
		5wks		1-5 wks	
Soy		323.38	1016.32	1547.42	1.52
	+ Phytase	364.57	1297.28	1591.35	1.23
	+ Pro	310.76	1166.83	1615.94	1.38
	+ Phy + Pro	318.43	1250.90	1624.51	1.30
5% Sesame		347.67	1448.68	1581.50	1.10
	+ Phytase	303.38	1399.15	1539.05	1.10
	+ Pro	307.14	1287.02	1536.45	1.20
	+ Phy + Pro	321.14	1289.48	1576.20	1.23
10% Sesame		324.14	1295.98	1507.11	1.17
	+ Phytase	303.43	1212.37	1676.81	1.38
	+ Pro	296.85	1202.64	1733.75	1.45
	+ Phy + Pro	328.19	1434.52	1716.81	1.20
15% Sesame		318.33	1352.71	1593.90	1.18
	+ Phytase	349.05	1348.36	1723.23	1.29
	+ Pro	355.29	1336.43	1788.49	1.34
	+ Phy + Pro	327.71	1364.60	1589.00	1.18
SEM		11.19	41.40	31.82	0.05
Probabilities					
Treatment		0.05	0.0001	0.0001	0.0001
Contrasts					
Pos cont vs. Neg cont		0.001	0.0001	NS	0.0001
Pos Phtase vs. All phytase		NS	NS	NS	NS
Pos Pro vs. All Pro		0.03	0.04	0.06	NS
Pos Phy/Pro vs. All Phy/Pro		0.02	0.03	NS	NS
Pos cont vs. All Phytase		0.0001	0.0001	0.02	0.0001
Pos cont vs. All Pro		0.0001	0.0001	0.001	0.005
Pos cont vs. All Phy/Pro		0.0001	0.0001	0.03	0.0001

[abcd] Means within a row with no common superscripts differ significantly ($P \leq 0.05$).
BW[1]: Body weights (gm.) **BWG[2]**: Body weight gains (gm.)
FC[3]: Feed Consumption (gm./ bird)
FCR[4]: Feed conversion ratio (gm. Feed/ gm. gain)

Table (8): Effect of sesame meal in broiler diets supplemented with phytase and probiotic on slaughter traits in 2[nd] trail

Treatments		Slaughter Traits, %						
		Carcass	Feather	Breast	Thigh	Gizzard	Liver	Heart
Soy		970.75	9.85	483.86	390.69	24.65	40.01	7.41
	+ Phytase	1158.40	5.46	503.93	416.98	21.48	41.74	6.68
	+ Pro	1042.00	8.66	493.49	485.54	26.5	43.80	9.16
	+ Phy + Pro	1126.89	6.07	557.90	450.67	29.02	43.42	9.98
5% Sesame		1166.08	6.96	589.63	471.28	22.94	41.58	8.87
	+ Phytase	1148.25	9.13	557.07	466.32	25.03	40.03	7.95
	+ Pro	923.44	6.66	456.74	365.39	21.87	33.63	6.86
	+ Phy + Pro	1073.28	6.42	518.17	408.80	27.47	43.13	7.19
10% Sesame		954.94	7.64	484.37	386.29	23.21	39.90	9.03
	+ Phytase	1080.38	7.61	480.77	429.82	26.04	41.47	8.38
	+ Pro	1152.35	7.26	515.59	430.66	25.46	41.76	7.98
	+ Phy + Pro	1115.35	6.33	545.69	474.61	29.18	42.81	9.36
15% Sesame		1125.94	4.40	517.38	440.47	25.99	43.08	7.78
	+ Phytase	1129.45	6.77	506.58	483.69	25.85	43.13	7.82
	+ Pro	1009.58	6.48	491.80	393.63	26.58	35.69	7.30
	+ Phy + Pro	1044.55	6.75	516.68	414.52	23.23	37.30	9.02
SEM		78.66	1.71	33.93	30.10	2.79	43.81	1.12
Probabilities								
Treatment		NS	NS	NS	NS	NS	NS	NS
Contrasts								
Pos cont vs. Neg cont		NS	NS	NS	NS	NS	NS	NS
Pos Phtase vs. All phytase		NS	NS	NS	NS	NS	NS	NS
Pos Pro vs. All Pro		NS	NS	NS	0.01	NS	NS	0.04
Pos Phy/Pro vs. All Phy/Pro		NS	NS	NS	NS	NS	NS	NS
Pos cont vs. All Phytase		0.05	NS	NS	NS	NS	NS	NS
Pos cont vs. All Pro		NS	NS	NS	NS	NS	NS	NS
Pos cont vs. All Phy/Pro		NS	NS	NS	NS	NS	NS	NS

[abcd] Means within a row with no common superscripts differ significantly ($P \geq 0.05$).

Table (9): Effect of sesame meal in broiler diets supplemented with phytase and probiotic on slaughter traits in 2nd trail

Treatments		Slaughter Traits, %			
		Spleen	Bursa	Thymus	Intestine length, cm
Soy		3.67	4.43	9.06	170.00
	+ Phytase	1.89	3.20	19.03	170.00
	+ Pro	2.64	5.17	15.28	181.67
	+ Phy + Pro	5.45	4.11	16.51	180.00
5% Sesame		2.44	3.12	15.22	173.33
	+ Phytase	3.46	4.76	16.08	178.33
	+ Pro	2.21	2.97	13.14	166.67
	+ Phy + Pro	1.69	.1.70	13.72	173.33
10% Sesame		2.59	2.00	8.84	183.33
	+ Phytase	2.47	3.24	12.59	176.67
	+ Pro	2.77	3.00	12.20	176.67
	+ Phy + Pro	3.40	3.10	18.20	166.67
15% Sesame		2.94	2.47	13.87	163.33
	+ Phytase	4.24	2.95	9.16	163.33
	+ Pro	3.11	2.78	13.88	160.00
	+ Phy + Pro	4.06	2.90	13.46	170.00
SEM		0.63	0.59	2.46	9.48
Probabilities					
Treatment		0.02	0.01	NS	NS
Contrasts					
Pos cont vs. Neg cont		NS	0.007	NS	NS
Pos Phtase vs. All phytase		0.05	NS	0.03	NS
Pos Pro vs. All Pro		NS	0.003	NS	NS
Pos Phy/Pro vs. All Phy/Pro		0.003	0.04	NS	NS
Pos cont vs. All Phytase		NS	NS	0.04	NS
Pos cont vs. All Pro		NS	NS	NS	NS
Pos cont vs. All Phy/Pro		NS	0.02	0.02	NS

[abcd] Means within a row with no common superscripts differ significantly ($P \leq 0.05$).

Table (10): Effect of sesame meal in broiler diets supplemented with phytase and probiotic on blood biochemical traits 2[nd] trail

		Blood	
		Triglyceride mg/ dl	Cholesterol mg/ dl
Soy		0.078	271.79
	+ Phytase	0.068	221.01
	+ Pro	0.079	216.73
	+ Phy + Pro	0.066	156.23
5% Sesame		0.079	276.46
	+ Phytase	0.073	182.88
	+ Pro	0.078	185.21
	+ Phy + Pro	0.073	175.88
10% Sesame		0.085	216.34
	+ Phytase	0.071	217.41
	+ Pro	0.096	166.34
	+ Phy + Pro	0.079	167.22
15% Sesame		0.067	193.77
	+ Phytase	0.113	191.44
	+ Pro	0.072	160.89
	+ Phy + Pro	0.085	174.71
SEM		0.009	15.19
Probabilities			
Treatment		NS	0.0001
Contrasts			
Pos cont vs. Neg cont		NS	0.02
Pos Phtase vs. All phytase		NS	NS
Pos Pro vs. All Pro		NS	0.01
Pos Phy/Pro vs. All Phy/Pro		NS	NS
Pos cont vs. All Phytase		NS	0.0003
Pos cont vs. All Pro		NS	0.0001
Pos cont vs. All Phy/Pro		NS	0.0001

[abcd] Means within a row with no common superscripts differ significantly ($P \leq 0.05$).

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الملخص العربي

تأثير احلال كسب السمسم فى أعلاف كتاكيت التسمين مضاف اليها انزيم الفايتيز ومنشط نمو

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اجريت تجربتين لتقييم كسب السمسم كبديل لكسب فول الصويا لكتاكيت التسمين. التجربة الأولى تضمنت ٥ معاملات تجريبية باستخدام ٣٧٨ كتكوت تسمين روص ١) عليقة كنترول صويا، ٢) عليقة كنترول سمسم، ٣) عليقة كنترول + ٥٠% صويا + ٥٠% سمسم، ٤) عليقة كنترول + ٢٥% صويا + ٧٥% سمسم، ٥) عليقة كنترول + ٧٥% صويا + ٢٥% سمسم. قسمت المعاملات الرئيسية بعد ذلك الى ٤ معاملات فرعية : بدون إضافات، + انزيم الفايتيز، + بروبيوتك، + انزيم الفايتيز، بروبيوتك لتنتهى عدد المعاملات الكلية للتجربة بـ ٢٠ معاملة تجريبية. فى التجربة الثانية تم استخدام عد ٣٣٦ كتكوت روص وتم تغذيتهم على اربعة معاملات رئيسية روص ١) عليقة كنترول صويا، ٢) عليقة كنترول + ٥% سمسم، ٣) عليقة كنترول + ١٠% سمسم، ٤) عليقة كنترول + ١٥% سمسم و تم تقسيم كل معاملة رئيسية الى اربعة معاملات فرعية كما فى التجربة الاولى.

تم تقدير وزن الجسم و الزيادة فى وزن الجسم و استهلاك العلف و الكفاءة الغذائية. عند نهاية التجربة تم تقدير صفات الذبيحة على عدد من الكتاكيت. كذلك تم تقدير الكفاءة الكلية للبروتين لكسب السمسم و تم تقدير الكوليسترول و الجليسريدات الثلاثية فى البلازما. فى التجربة الأولى وجد ان الكتاكيت المغذاه على العلف الكنترول كانت اعلى معنويا فى وزن الجسم و الزيادة فى وزن الجسم مقارنة بكل المعاملات الأخرى. على العكس كانت الكتاكيت المغذاه على ٥٠% سمسم اقل معنويا فى الوزن و الزيادة فى وزن الجسم مقارنة بالمعاملات الاخرى. كذلك بالنسبة للكتاكيت المغذاه على ٧٥ او ١٠٠% سمسم استهلكت علف اقل معنويا مقارنة بالمعاملات الأخرى. الكفاءة الغذائية لكل المعاملات التجريبية كانت اقل من المتوقع و لم تختلف كثيرا عن الكنترول. فى التجربة ٢، فان الكتاكيت المغذاه على ٥ او ١٠% كسب سمسم + انزيم + بروبيوتك كانت اعلى فى كلا من وزن الجسم و الزيادة فى وزن الجسم مقارنة بالمعاملات الأخرى و الكنترول. لم تتأثر مستويات الكوليسترول معنويا بالمعاملات فى حين انخفضت معنويا الجليسريدات الثلاثية مع زيادة كسب السمسم فى العلف.

مع وجود تضارب فى نتائج الأبحاث المنشورة بالنسبة لتأثير احلال كسب السمسم فى العلف و الراجع معظمها لتأثير معاملات التصنيع للسمسم للحصول على الكسب و طرق استخلاص الزيت من السمسم كنتيجة لتأثير درجة حرارة الإستخلاص و طريقة تحميص حبوب السمسم التى لها تأثير مباشر على مدى اتاحة الأحماض الأمينية فى الكسب و بالتالى تأثير مباشر على كفاءة استخدام كسب السمسم فى اعلاف الدواجن (كتاكيت التسمين). فإنه يستحسن إجراء تجارب تغذية مستقبلية لدراسة مدى تأثير هذه المخلفات كمواد علفية فى تغذية الدواجن.