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Utilizing Date Seed Waste Meal as an Alternative Feed for Pullets

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استخدام وجبة نوى التمر كعلف بديل للفراخ

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Abstract

The study aimed to investigate the impact of incorporating varying levels of date seed waste meal (DSWM) in the diet of pullets (local strain chicks) aged 1-16 weeks. Three levels of DSWM (0.0, 100 kg, and 200 kg) were tested in the pullets' diets. Additionally, there were five sub-treatments for the 100 kg and 200 kg DSWM levels, including a negative control group, phytase, Optizyme, amino acid supplementation, and crumble diet formulation. The study evaluated productive performance, carcass characteristics, chemical composition of carcass, and economic efficiency.

Results showed that adding amino acids or pelleting diets with 100 kg or 200 kg DSWM improved growth performance from 1-4 weeks of age. Optizyme addition resulted in the best overall productive traits. Feed intake decreased linearly with increasing DSWM levels, but enzyme or amino acid supplementation and crumble treatments did not significantly affect feed consumption. The inclusion of 100 kg or 200 kg DSWM improved feed conversion ratio (FCR) compared to the control, with no significant interaction between DSWM level and dietary treatments. DSWM up to 200 kg did not negatively impact pullet mortality. Carcass characteristics, body organs, and meat composition were not adversely affected by DSWM level, feed additives, or crumble treatments. Economic efficiency analysis suggested that pullets aged 1-16 weeks could be fed diets containing 200 kg DSWM when supplemented with phytase, Optizyme, amino acids, and a crumble diet formulation.

In conclusion, incorporating up to 200 kg of date seed waste meal in the diets of slow-growing pullets did not affect productive performance. The best feed conversion and economic efficiency were observed in pullets-fed diets containing 200 kg DSWM supplemented with various treatments.

Keyword: Pullets-Date Seed Waste Meal-Productive Performance- Economic Efficiency.

الملخص

هدفت الدراسة إلى التحقيق في تأثير دمج مستويات مختلفة من وجبة نوى التمر في نظام غذائي للدجاج (صغار الدجاج المحلي) التي تتراوح أعمارها بين 1-16 أسبوعًا. تم اختبار ثلاثة مستويات من مخلفات نوى التمر وهي 100 ، و200 كجم في اعلاف الدجاجات الصغيرة. بالإضافة إلى ذلك، كان هناك خمس معاملات فرعية لمستويات 100 كجم و200 كجم من مخلفات نوى التمر، بما في ذلك مجموعة التحكم السلبية، الفيتاز، أوبتيزايم، مكملات الأحماض الأمينية، وتكوين اعلاف على هيئة مكعبات. قامت الدراسة بتقييم الأداء الإنتاجي، وخصائص الذبيحة، والتركيب الكيميائي للذبيحة، والكفاءة الاقتصادية..

أظهرت النتائج أن إضافة الأحماض الأمينية أو الاعلاف المصنعة على هيئة حبيبات بوزن 100 كجم أو 200 كجم من مخلفات نوى التمر حسنت أداء النمو من 1-4 أسابيع من العمر. أدى إضافة انزيم الأوبتيزايم إلى نتائج جيده للصفات الإنتاجية بشكل عام. انخفض استهلاك العلف بشكل خطي مع زيادة مستوى مخلفات نوى التمر، لكن إضافة الإنزيمات أو الأحماض الأمينية وتعاملات الغذاء الحبيبي لم تؤثر بشكل كبير على استهلاك العلف. إدراج 100 كجم أو 200 كجم من مخلفات نوى التمر حسّن نسبة تحويل العلف (معامل التحويل الغذائي) مقارنةً بالمجموعة الكنترول، دون

وجود تفاعل كبير بين مستوى مخلفات نوى التمر والمعاملات الغذائية. لم يؤثر نظام مخلفات نوى التمر حتى 200 كجم سلبًا على معدل وفيات الدجاجات الصغيرة. لم تتأثر خصائص الذبيحة، وأعضاء الجسم، والتحليل الكيميائي للحم الدجاج لم يتأثر سلبًا بمستوى مخلفات نوى التمر، أو إضافات الاعلاف، أو العلف المصنع في صورة حبيبات. أشار تحليل الكفاءة الاقتصادية إلى أن الدجاجات الصغيرة التي تتراوح أعمارها بين 1-16 أسبوعًا يمكن تغذيتها بأعلاف تحتوي على 200 كجم من مخلفات نوى التمر عند إضافتها بالفوسفاتاز، وأوبتيزايم، والأحماض الأمينية، والاعلاف المصنعة على هيئة حبيبات.
الخلاصة: لم يؤثر اضافة 200 كجم من مخلفات نوى التمر فى اعلاف الدجاجات الصغيرة (الدجاجات المربأة لإنتاج البيض) على الأداء الإنتاجي. كما اوضحت النتائج ان أفضل تحويل غذائي وكفاءة اقتصادية في الدجاجات الصغيرة التي تم تغذيتها بأنظمة غذائية تحتوي على 200 كجم من مخلفات نوى التمر مضافا اليها المعاملات المختلفة (انزيم الفيتيز – انزيم الاوبتيزيم – الاحماض الأمينية - الاعلاف المصنعة على هيئة حبيبات).

الكلمات المفتاحية: الفراخ، مخلفات بذور التمر، الأداء الإنتاجي، الكفاءة الاقتصادية.

Introduction

Date seeds contain an excessive percentage of carbohydrates expressed as 74.07%, consisting of both soluble and insoluble fibers (23.53%) with total dietary fiber up to 50.5 percent, [9]. They also have an excellent fatty acid profile, [8]. Date seeds may be used in animal feed as a sustainable option. Poultry farming has also been a significant substitution in meeting human nutritional demands for the production of inexpensive, good-quality eggs and animal feed. In many feed formulations, cereal grains are required to fulfill the immediate and future nutritional requirements of developing birds. However, the cereals in poultry diets are costly and responsible for other human uses. As a cost-effective alternative to traditional sources, a wide variety of local by-products can replace maize feed, barley, and sorghum. The date seed meal can replace the traditional grains utilized in poultry feeding. It is expected to reduce food expenses for the poultry sector by utilizing low-cost, easily accessible local raw materials and solving the problem of disposing of excess date seed waste. [3, 4 , 24].

The use of by-products and agro-industrial waste in animal feed has increased globally. In some countries, date seeds are discarded as they are considered unpalatable, leading to environmental issues. Utilizing mealed date seeds as an alternative ingredient in animal feed is a sustainable solution, [25]. While mealed date seeds are available commercially, there is limited information on their use in local poultry diets, particularly Egyptian strains.

This study investigates using date seed waste meal as a substitute for yellow corn in pullet feed to improve performance and egg quality. The goal is to reduce costs and meet feed requirements in the High Dam Lake region. The study also aims to produce progeny with sustained growth and egg production.

Material and methods

Housing and management:

Chickens were housed in battery cages with the house temperature kept at approximately 35ºC for the first 3 days, 32ºC for the next 4 days, and then gradually decreased by 2ºC weekly until the end of the 4th week of age, after which it was maintained at 24ºC. The photoperiod was set at 23 hours of light per day with an intensity of 3 watts per square meter throughout the experiment. The chicks were vaccinated against Newcastle disease using water-soluble vaccine (B1) Hitchner at 7 days old and with Lasota at 18 and 28 days of age. They were also vaccinated against Gumboro disease at 14 and 23 days old. All experimental groups were reared under similar management and hygiene conditions, with fresh water provided automatically through stainless steel nipples in each cage. Pullets were then individually housed in battery cages (25 × 40 × 45) throughout the experimental period. They were exposed to natural daylight until 16 weeks of age, gradually increasing the light duration by half an hour per week until reaching 16 hours per day at 24 weeks of age. This lighting schedule was maintained until the end of the laying period. A routine vaccination program was followed throughout the experimental period.

Feeding experimental design:

This trial was designed to study the impact of different levels of DSWM (0, 100Kg, and 200Kg) without or with amino acid supplementation (increasing methionine, lysine, arginine, threonine, and tryptophan by 10% above the negative control), phytase, optizyme, or by improving DSWM utilization through crumble in the diet on growth performance during the growing period (from 0 to 12 weeks of age) and the rearing period (from 13 to 16 weeks of age). Feed and dried meat was analyzed for moisture, ash, CP, EE, and CF according to the [6] methods. NFE was calculated by difference.

990 unsexed one-d-old Local strain pullets were used in this experiment, chicks were wing banded, individually weighed to the nearest gram, and randomly distributed into 11 experimental dietary treatments; each one was further subdivided into three replicates of 30 chicks each.

The experimental design was confirmed as follow:

1- Control group= fed a basal diet (+ control).
2- Fed a basal diet + 100Kg DSWM (- control).
3- Fed a basal diet + 100Kg DSWM + Phytase) (+ phytase)
4- Fed a basal diet + 100Kg DSWM + Optizyme) (+ Optizyme).
5- Fed a basal diet + 100Kg DSWM + Amino acid) (+ Amino acid).

6- Fed a basal diet + 100Kg DSWM (Crumble formulation).
7- Fed a basal diet + 200Kg DSWM (- control).
8- Fed a basal diet + 200Kg DSWM + Phytase) (+ phytase)
9- Fed a basal diet + 200Kg DSWM + Optizyme) (+ Optizyme).
10- Fed a basal diet + 200Kg DSWM + Amino acid) (+ Amino acid).
11- Fed a basal diet + 200Kg DSWM (Crumble formulation).

DSWM diets were formulated to be nearly isocaloric and isonitrogenous. There were five groups within each DSWM-containing diet, that were fed un-supplemented diet or diets supplemented with microbial phytase (750 U of (Ronozyme®), 0.1% Optizyme-p5® (according to the recommendation by the producing Company; Roche), increasing concentration of amino acids methionine, lysine, tryptophan, threonine and arginine by 10% over the negative controls or improve the DSWM utilization by crumble of the basal diets. When phytase was added calcium and available phosphorus were adjusted for diets according to their equivalent values suggested by the producing company Roche (calcium and available phosphorus were decreased in phytase supplemented diets by 0.1%).

Pellets were made as following: crumble was initiated by molasses addition as binding material and was then pressed at 70º C. The pellet diameter was 2-mm and then the pellets were cooled, and then made into crumbles.

The experimental diets were formulated to cover the recommended feeding levels of protein, metabolizable energy, calcium, AP, lysine and sulfur containing amino acids as reported by the [26].

The experimental diets were fed at first d of age. Feed and water were supplied *ad libitum.* Dietary composition and chemical analyses of the experimental diets are presented in Table 1.

Table1. Conformation (Kg) calculated and examined nutrients and ME contents of the growing and finishing experimental diets.

Iingredients	Growing diets (0-12 Wks of age)			Finishing diets (13-16Wks of age)		
	Date seed waste meal (Kg)					
	0	100	`200	0	100	200
Yellow corn	555	434	330	615	502	398
Soybean meal (44%)	379	385.5	372.5	317	313	301
DSWM	0	100	200	0	100	200
Soybean oil	15.8	30	47	17.8	35	50.5
Molasses	20	20	20	20	20	20
Dicalcium phosphate	18	18.2	18.1	17	17.7	17.5
NaCl	3	3	3	3	3	3
Limestone	5	5	5	6	5	5.5
Vit+Min Mix. [1]	3	3	3	3	3	3
Dl-methionine	1.2	1.3	1.4	1.2	1.3	1.5
Calculated analysis [2] (%)						
ME (kcal/kg)	2886	2876	2880	2976	2975	2970
CP	20.0	20.02	20.0	18.0	18.0	18.03
Methionine	0.45	0.46	0.46	0.43	0.43	0.44
TSAA	0.81	0.80	0.80	0.75	0.74	0.75
Lysine	1.16	1.21	1.26	1.01	1.06	1.11
Threonine	0.93	0.93	0.93	0.84	0.84	0.84
Arginine	1.58	1.62	1.66	1.41	1.45	1.49
Tryptophan	0.31	0.32	0.32	0.27	0.28	0.28
Calcium	0.96	0.97	1.0	0.95	0.94	0.95
A-phosphorus	0.42	0.42	0.40	0.40	0.40	0.39
Determined analysis[3] (%)						
Dry matter	90.99	90.79	90.74	89.92	89.90	90.07
CP	19.95	20.01	19.82	19.10	18.94	18.00
EE	3.22	4.01	5.21	4.21	5.62	6.82
CF	3.41	3.87	4.31	3.13	3.72	4.41

[1]Vit+Min mixture provides per kilogram of diet: Vitamin A, 12000 IU; vitamin E, 20 IU; menadione , 1.3 mg; Vit. D_3, 2500 ICU; riboflavin, 5.5 mg; Ca pantothenate, 12 mg; nicotinic acid, 50 mg; choline chloride, 600

mg; vitamin B_{12}, 10 μg; vitamin B_6, 3 mg; thiamine, 3 mg; folic acid, 1.0 mg; d-biotin, 50 μg. Trace mineral (milligrams per kilogram of diet): Mn, 80; Zn, 60; Fe, 35; Cu, 8; Se, 0.60.
[2]Calculated values [26]. [3]Determined values [6].

Measurements during growing and rearing periods:
Average body weight:

Chicks were individually weighed biweekly from the 1st to the 6th week of age. The body weight gain for the entire experimental period was calculated by subtracting the initial live weight from the average final live weight of the same period for each chick. Feed consumption was calculated biweekly by subtracting the unconsumed feed from the total amount offered during the experimental period. The average feed consumption per bird was calculated by dividing the consumed feed by the number of individuals in each group, taking into account the number of dead chicks, if any. Feed Conversion Ratio (FCR) was calculated as the amount of feed consumed required producing 1 kg of body weight gain for each experimental period and for the entire period as well.

Mortality percentage: It was calculated as the percentage of dead birds from the initial number during the different experimental periods.

Slaughter test:

At the end of the experiment (16 week of age), five pullets from each treatment were randomly selected, fasted overnight, weighed and then slaughtered to complete bleeding and their feather were removed. Empty body weight without giblets, abdominal fat and other internal organs were weighed and divided by live weight, multiplied by 100 to calculate relative carcass weight. Liver, heart, spleen, empty gizzard, pancreas, head, neck, testes, and legs were weighed separately, then divided by live body weight and multiplied by 100 to calculate their relative weights. Meat analyses: A duplicate of samples of 50% breast and 50% thigh meat were dried in air oven at 65º C for 48 h and fine by ground and kept in glass bottel for further analysis.

Economic efficiency:

Economic efficiency is defined as the net revenue per unit feed cost calculated from input-output analysis. The following steps were performed to calculate economic efficiency:

1. Average BWG (kg).

2. Price/ pullets (assuming 125 LE/ pullets).

3. Total revenue /bird (LE) = 1 x 2

4. Total feed intake/bird (kg)

5. Price /Kg feed (LE)

6. Total feed cost /bird (LE) = 4 x 5

7. Fixed cost/chick (LE)

7. Total cost/chick (LE) = 6+7

8. Net revenue (LE) = 3 -6

9. Economic efficiency (EE) = $\frac{\text{Net revenue/bird}}{\text{Total feed cost /bird}}$

10. Relative economic efficiency, assuming control treatment= 100%

Statistical analysis

The data were analyzed using the GLM procedure in the Statistical Analysis System [29] with one-way ANOVA. The model used was

$$Yik = \mu + Ti + eik,$$

where Y is the dependent variable, μ is the general mean, T is the effect of experimental treatments, and e is the experimental random error. Differences among means were assessed using Duncan's new multiple range test [12].

Results and discussion

Effect of enzymes or amino acids additions and crumble on improving nutritional value of diets containing different levels of date seed waste meal (DSWM) for pullets:

Body weight of chicks

Results for the relationship between date seed waste meal levels and treatments are presented in Table 2. A significant collaboration was found between DSWM levels and treatments on body weight at 4, 8, 12, and 16 weeks of age.

It is evident that within the unsupplemented levels of DSWM (0, 100, and 200 kg/ton), there was a gradual decrease in body weight of 4-week-old chicks, which became more pronounced (3.2% vs. 21.6%) especially when 200 kg were included in the diet. Conversely, amino acid supplementation or crumble slightly improved growth by 2.6% and 1.7% on the 100 kg DSWM diet, resulting in no significant difference from the positive control.

The results indicated that supplementation of phytase, multi-enzymes, and amino acids within diets containing 200 kg of DSWM improved growth by a similar extent (approximately 19%). Furthermore, the crumble treatment led to a 24.6% increase in growth for the 200 kg DSWM-fed groups at 4 weeks of age, resulting in growth similar to the positive control. These findings suggest that the responses to enzymes, amino acids, and crumble treatment are dependent on the level of DSWM in the diet.

When analyzing data within the unsupplemented levels of DSWM, the body weight of 8-week-old chicks increased by 4.9% with the inclusion of 100 kg DSWM in the diet. However, including 200 kg DSWM decreased growth by 4.2%, indicating that feeding a diet containing 200 kg DSWM up to 8 weeks of age should be avoided for slow-growing pullets. On the other hand, amino acid supplementation increased growth by 2.7% compared to the respective control. Interestingly, there was no significant effect on growth due to enzyme or crumble treatment in chicks fed a diet containing 100 kg DSWM.

It is evident that supplementation with phytase, multienzymes, and amino acids or crumble treatment resulted in increased body weight in pullets fed a diet containing 200 kg of DSWM compared to the negative control group (200 kg DSWM). The growth enhancement percentages due to phytase, multienzymes, amino acids, and crumble were 5.8%, 17.7%, 5.1%, and 5.4%, respectively, with multienzymes showing the highest effectiveness. Among the unsupplemented levels of DSWM, the growth of 12-week-old pullets improved by 5.8% with the inclusion of 100 kg of DSWM compared to both the positive control and the 200 kg DSWM control diet. The latter group did not have any adverse effects on the growth of 12-week-old pullets, indicating that feeding DSWM up to 200 kg had no negative impact from 8 weeks of age onwards.

Enzyme and amino acid supplementation or crumble treatment did not enhance the growth of pullets fed 100 kg of DSWM. However, these treatments improved the growth of chicks fed 200 kg of DSWM to varying degrees compared to the negative control group. The growth enhancement percentages due to phytase, multienzymes, amino acids, and crumble were 8.3%, 12.1%, 2.7%, and 10.7% compared to the negative control (unsupplemented 200 kg DSWM), respectively. It is evident that multienzymes and crumble were the most effective methods during the 8-12 weeks of age period.

Body weight at the end of the experiment increased by 2.7% and 4% when feeding a diet containing 100Kg DSWM compared to the positive control and 200Kg DSWM control diet, respectively. This suggests that 100Kg DSWM had no negative impact on the growth of slow-growing pullets throughout the entire experimental period.

In contrast, the inclusion of 200Kg DSWM slightly reduced growth by 1.2% in chicks aged 12-16 weeks. This is a smaller decrease compared to the 21.6% and 4.2% reductions observed in the 0-4 and 4-8 week age groups when feeding the unsupplemented 200Kg DSWM-containing diet. The diminishing growth response over time indicates an improved tolerance to DSWM as pullets age. These findings are consistent with those published in 2017 by [32]., 2016 by [15] and 2013 by [16]. They explained this by saying that feed utilisation may eventually improve due to the digestive tract's maturity (gut capacity, microbiota, and enzymatic secretion).

The addition of enzymes and amino acids or crumble treatment did not improve the growth of pullets fed 100 kg of DSWM. However, these treatments significantly enhanced the growth of pullets fed 200 kg of DSWM compared to the control group. The growth improvement at 16 weeks of age due to the addition of phytase, multienzymes, amino acids, or crumble treatment to the 200 kg DSM diet was 5.2%, 8.7%, 1.9%, and 4.5%, respectively, compared to the unsupplemented 200 kg DSWM control. Therefore, multienzymes and phytase showed the most significant impact on improving the growth of pullets at 16 weeks of age.

The response to amino acid supplementation decreased over time, with reductions of 19.6%, 5.1%, 2.7%, and 1.9% during the 0-4-, 4-8-, 8-12-, and 12–16-week age periods, respectively. This indicates that amino acid requirements and efficacy are more pronounced at early ages and diminish as pullets grow older [26]. The effectiveness of amino acids also depends on the order of limitation in the experimental diets [30].

Table 2. Dietary date seed waste meal and addition of enzymes, amino acids or crumble on body weight (g) and number of dead birds of pullets during 0-16 week of age.

Treatments	Body weight, Weeks of age					Number of dead pullets
	initial	4	8	12	16	
(+) Control	28.5	221.5^{a}	534.1^{bc}	821.2^{d}	1066.7^{cd}	2.0
Date seed waste meal 7.5%						
(-) control	28.2	214.4^{bc}	560.5^{ab}	869.1^{b}	1095.8^{c}	5.0
+ Phytase	26.7	209.4^{c}	552.0^{b}	848.0^{c}	1108.6^{b}	1.0
+ Optizyme	29.8	208.5^{c}	561.6^{ab}	842.6^{c}	1088.3^{c}	1.0
+ Amino acids	30.0	220.0^{a}	575.7^{ab}	866.1^{b}	1094.9^{c}	5.0
Crumble	28.9	218.1^{b}	537.0^{c}	844.6^{c}	1076.6^{cd}	0.0
Date seed waste meal 15%						
(-) control	27.1	173.6^{d}	511.6^{d}	821.7^{d}	1053.7^{d}	3.0
+ Phytase	28.2	206.5^{c}	541.3^{bc}	890.3^{ab}	1108.1^{b}	0.0
+ Optizyme	28.0	207.2^{c}	602.0^{a}	921.5^{a}	1145.4^{a}	4.0
+ Amino acids	27.7	207.7^{c}	537.8^{c}	844.1^{c}	1073.2^{cd}	4.0
Crumble	30.5	216.3^{b}	539.2^{c}	909.4^{a}	1101.6^{b}	0.0
SEM	0.44	4.03	9.26	12.9	13.57	nil
P value	0.981	0.0001	0.0001	0.0001	0.004	nil

$^{a-c}$ Means within a column not sharing similar superscripts are significantly different (P<0.05).

Similar growth responses were observed with crumble treatment, showing a decrease in growth improvement over time from 24.6% at 4 weeks of age to 4.6% at 16 weeks of age. The responses to phytase and multienzymes also decreased from approximately 19.7% at 4 weeks of age to 5.2% and 8.7% at 16 weeks of age, respectively. This indicates that the age of the pullets is a contributing factor to the observed growth improvements. This could be attributed to the maturation of the digestive tract in terms of ecology and gut capacity, as well as enzyme secretion. These findings align with previous studies by [7] and [11].

Mortality rate

The number of dead birds ranged from 0 for groups fed crumbles diets containing 100 kg or 200 kg of DSWM and phytase-supplemented 200kg DSWM-containing diet to 5 birds for groups fed a diet containing 100 kg of DSWM without any supplementation or amino acid supplement. It is worth mentioning that the mortality rate amounted to 3.8% of the experimental population, which falls within the normal range for mortality during the growing period. These results were acceptable by [27].

Body weight gain

The results of the relationship between date seed waste meal (DSWM) levels and treatments are shown in Figure 1. A significant interaction was observed between DSWM levels and treatments on body weight gain at 16 weeks of age. Over the entire experimental period (0-16 weeks), there was a 2.8% improvement in growth when feeding a diet containing 100Kg DSWM. However, there was a slight, insignificant decrease of 1.1% when comparing the 200 Kg unsupplemented level of DSWM to the positive control.

There was no significant effect of multienzymes, amino acids, or crumble on the growth of pullets fed a diet containing 100 Kg date seed waste meal. However, phytase supplementation resulted in a slight increase in growth by 1.3% compared to the negative control. Despite this, all groups fed diets containing 100 Kg DSWM showed better growth than the positive control.

The responses to enzymes, amino acids, and crumble treatments appear to be dependent on the DSWM level, as there was an improvement of varying magnitudes with these treatments. The growth increase due to the addition of phytase, multienzymes, amino acids, and crumble treatment was 5.2%, 8.8%, 1.8%, and 4.3%, respectively. This suggests that multienzymes and phytase are the most effective and practical treatments for improving diets containing 100 Kg of DSWM. These findings are consistent with previous studies by [23] who observed improved digestibility and growth in broilers with treatments like optizyme level (250 or 500 mg) and 1500 FTU phytase enhanced the performance of IR broiler chickens in the criteria studied. The results also support the findings of [22]., [10],. [18].and [28]indicating that enzymes are beneficial for enhancing the performance of growing chicks.

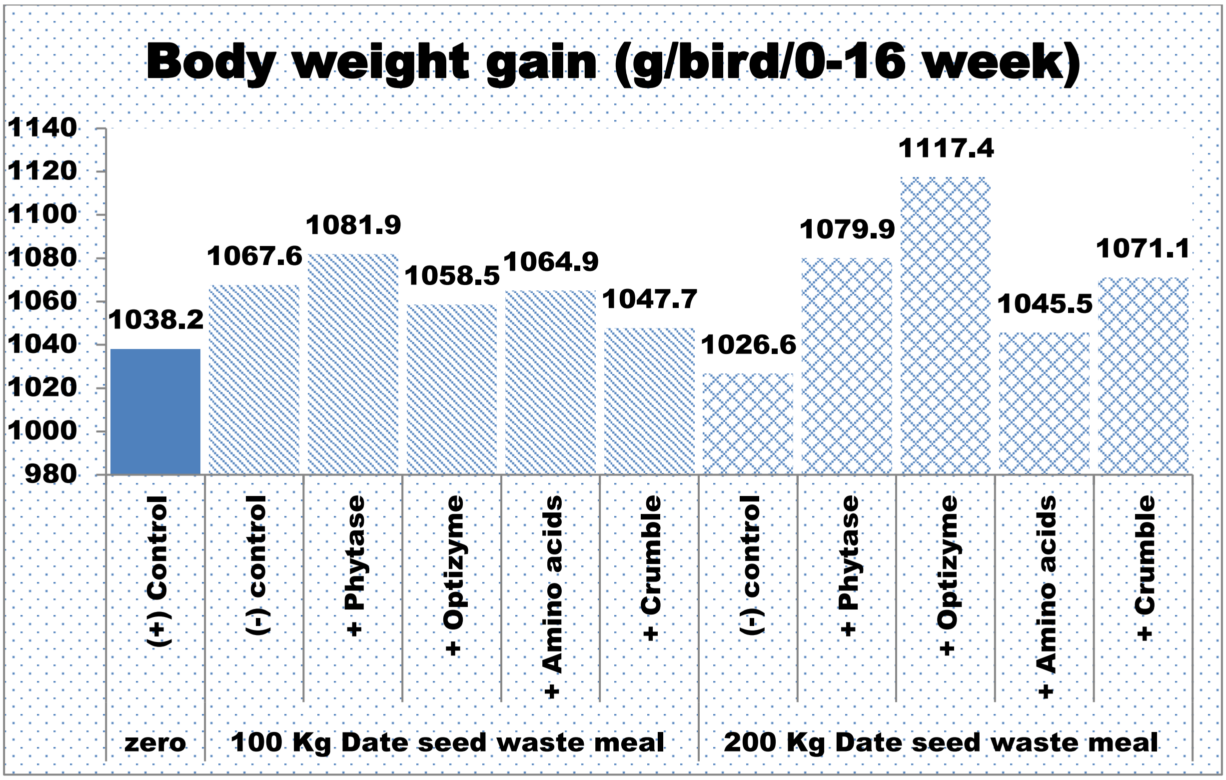

Figure 1: Effects on body weight gain (g/bird/period) of hens due to dietary amounts of date seed waste meal (DSWM) and addition of enzymes, amino acids, and crumble.

Feed intake:

Results for the interface between date seed waste meal and treatments are shown in Figure 3. After 16 weeks on the experimental diets, the level of DSWM did not have a significant impact on feed intake. However, there was a decrease in feed intake when 200 kg of DSWM was included in pullets diets during the 0-16 week period. This decrease may suggest a negative effect of 200 kg of DSWM on the palatability of the experimental diets. [31] also used date seed flour in their broiler diet. The decrease in feed intake observed here with increasing levels of DSWM in pullet pullets diets may be attributed to the unpalatability of the diet due to the increasing fiber content. In this regard, [33] found that a high level of fiber in broiler diets increased the passage of ingesta in the gastrointestinal tract, resulting in poor feed utilization and growth compared to chicks fed a diet with no date pits.

The recent findings suggest that crumble treatment slightly increased feed intake in pullets fed 100 kg of DSWM, while the opposite trend was observed in pullets fed 200 kg of DSWM. Additionally, phytase and multienzymes increased feed intake in pullets fed 200 kg of DSWM, whereas the opposite effect was seen in birds fed 100 kg of DSWM supplemented with multienzymes [19].

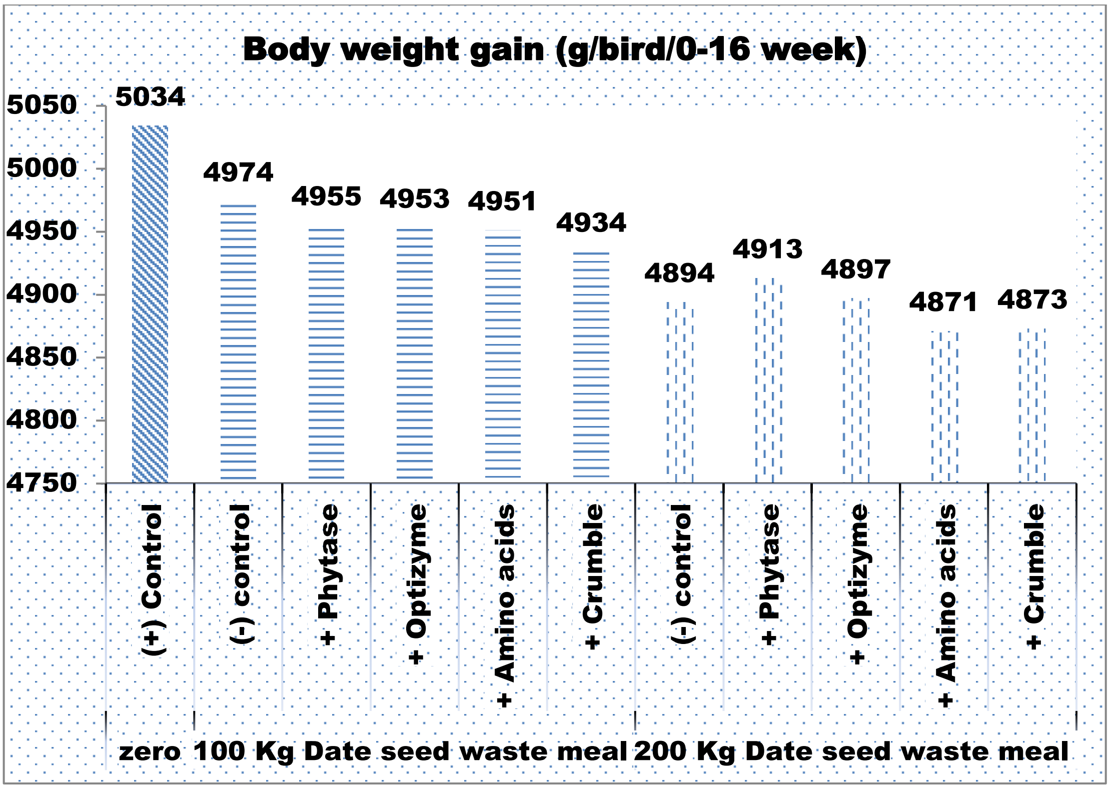

Figure 2: Feed intake (g/bird/period) of hens with differing amounts of date seed waste meal and crumble, enzymes, and amino acids added.

Feed conversion ratio (FCR):

The results of the interaction between DSWM levels and treatments on FCR of local strain pullets aged 0-16 weeks are shown in Figure 3. A significant interaction was observed between DSWM levels and treatments during this period. FCR improved by 4.0% with phytase and crumble treatment, by 2.3% with amino acid additions, and by 7.8% with multienzyme addition to diets containing 200 kg of date seed waste meal, indicating that the responses to experimental treatments depend on the DSWM level. The FCR of groups fed 200 kg DSWM was similar to or better than that of the positive control. The group fed 200 kg DSWM supplemented with 1g multienzymes/kg feed showed the best FCR. These findings aligned with the findings published by [32] and [17]. It was shown that adding date palm kernels to grill meals greatly raised their feed conversion ratio (FCR), which was mostly associated with feeding less to achieve the maximum body weight. The current findings corroborated those of [5]. [13] discovered that the inclusion of kemzyme increased FCR by approximately 5.24% when compared to diets without kemzyme. Furthermore, [20] discovered that, with or without kemzyme, 50% replacement of yellow corn ground date stone enhanced the FCR of male rabbits during the trial period. Similar conclusions were reached by [15] and [1] , who discovered that adding.

In conclusion, multienzymes addition to 200 kg DSWM containing diet yield the best feed conversion ratio followed by phytase supplemented 15% DSM containing diet and 200 kg DSWM crumble diet, respectively.

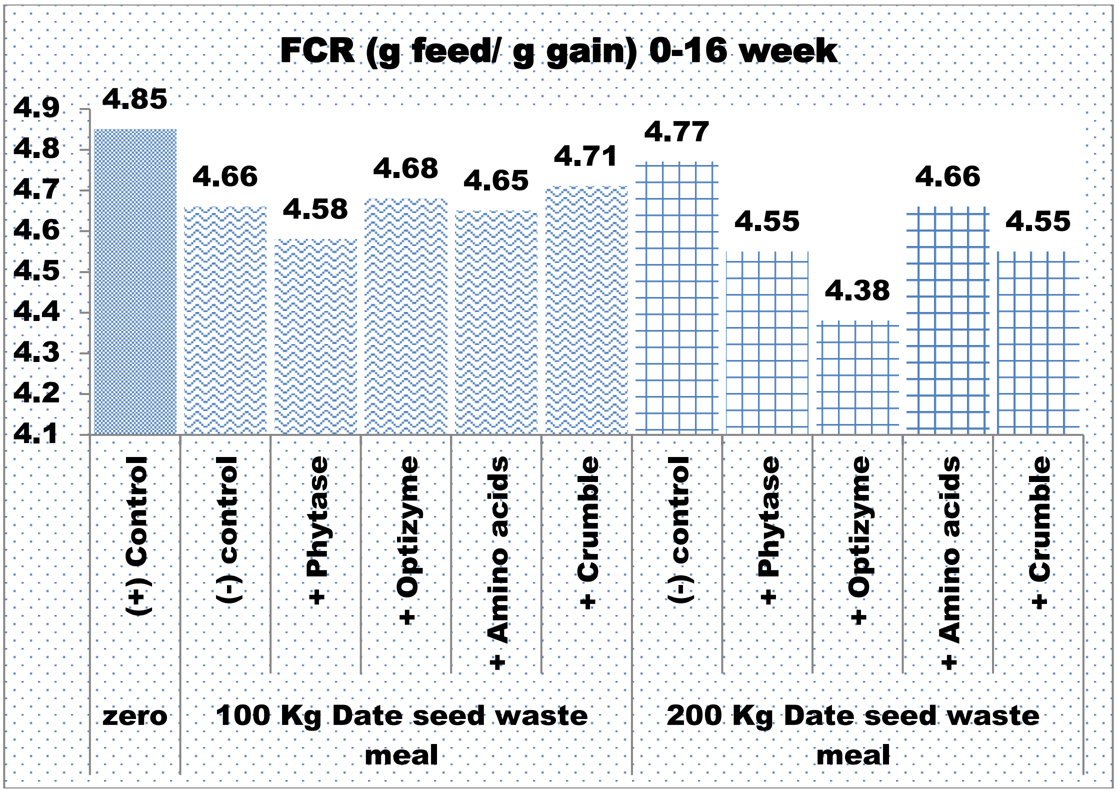

Figure 3 Impact of adding enzymes, amino acids, or crumble to the diet and the amount of date seed waste meal on the ratio (g feed/g gain) of feed for hens aged 0–16 weeks.

Carcass characteristics

Table 3 demonstrated how adding various DSWM doses along with changes such enzymes (optizyme, phytotase), amino acids (methionine, lysine, arginine, threonine, and tryptophan), and crumble formulation to chicks' diets could have a synergistic effect.

Table 3. Effect of dietary levels of date seed waste (DSWM), the addition of enzymes, amino acids or crumble on carcass characteristics of 112 day old pullets.

Treatments	**Carcass characteristics** (%)				
	Dressing	Total edible parts	Total inedible parts	Thigh	Breast
(+) Control	57.25	63.52	36.47	29.19	19.95
Date seed waste meal 100 kg					
(-) control	54.40	60.23	39.76	26.06	18.21
+ Phytase	57.22	63.22	36.77	26.20	18.44
+ Optizyme	58.04	64.44	35.55	29.55	21.20
+ Amino acids	54.10	60.71	39.28	24.06	18.22
+ Crumble	55.28	61.86	38.13	26.72	17.61
Date seed waste meal 200 kg					
(-) control	55.49	61.03	38.96	28.88	19.16
+ Phytase	56.29	62.09	37.90	28.38	17.85
+ Optizyme	56.98	63.12	36.87	28.31	18.92
+ Amino acids	58.14	64.36	35.63	25.20	19.76
+ Crumble	55.11	61.33	38.66	27.34	18.12
SEM	1.18	1.250	1.255	0.995	0.835
P value	0.98	0.31	0.09	0.91	0.99

Means within a column not sharing similar superscripts are significantly different (P<0.05).

There was no significant interaction between DSWM levels and treatments on percentage dressing, total edible and inedible parts, as well as leg and breast. The highest percentage of dressing, total edible parts, leg, and breast was observed in pullets fed a diet with 100kg DSWM supplemented with multienzymes, outperforming the control group. Furthermore, amino acid supplementation to 200kg DSWM significantly improved carcass yield compared to its negative control with or without enzymes or crumble treatment. These results align with [21], who found that carcass characteristics of broilers fed diets with different levels of date pits did not significantly affect dressed weight, kitchen carcass, breast muscle, gizzard, and liver percentage (p>0.05).

Obviously, there was no significant interaction between DSWM levels and treatments on percentage dressing, total edible and inedible parts as well as leg and breast. However, the best percentage of dressing, total edible parts, leg and breast was shown of multienzymes supplemented 100kg DSWM diet which was better than the control group. Also, amino acid supplementation to 200 kg DSWM improved carcass yield considerably compared to its negative control with or without enzymes or crumble treatment.

Body organs

Results for the effect of the interaction between DSWM level and treatments on body organs are displayed in Table 4.

Obviously, there was no significant interaction between DSWM levels and treatments on percentages of testes, pancreas, spleen, liver and gizzard; however, there was a significant interaction with heart percentage. The addition of multienzymes and the crumble treatment, according to the results, reduced the percentage of heart in pullets fed 100 kg DSEM; however, the percentage of liver increased most in pullets fed diet containing 100 lg or 200 kg DSWM and supplemented with amino acids. Overall, date waste did not negatively affect internal organs, which is consistent with findings published by [34] and [14].

Table 4. Effect of dietary levels of DSM, addition of enzymes, amino acids or crumble on organ percentage of 112 d old local strain pullets.

Treatments	Glands percentage, %					
	Testes	Pancreas	Spleen	Liver	Gizzard	Heart
(+) Control	0.75	0.347	0.160	2.38	2.60	0.52[b]
Date seed waste meal 100 kg						
(-) control	0.58	0.325	0.153	2.30	2.30	0.58[a]
+ Phytase	0.67	0.327	0.137	2.33	2.40	0.57[a]
+ Optizyme	0.73	0.333	0.162	2.49	2.63	0.52[b]
+ Amino acids	0.67	0.319	0.159	2.62	2.75	0.55[b]
+ Crumble	0.90	0.315	0.152	2.46	2.70	0.50[bc]
Date seed waste meal 200 kg						
(-) control	0.61	0.284	0.145	2.06	2.52	0.43[c]
+ Phytase	0.62	0.293	0.157	2.16	2.55	0.45[c]
+ Optizyme	0.60	0.303	0.165	2.32	2.73	0.47[c]
+ Amino acids	0.53	0.289	0.153	2.51	2.63	0.53[b]
+ Crumble	0.87	0.302	0.146	2.21	2.60	0.52[b]
SEM	0.175	0.02	0.009	0.12	0.13	0.022
P value	0.11	0.08	0.92	0.09	0.06	0.002

[a-c] Means within a column not sharing similar superscripts are significantly different (P<0.05).

These authors showed that the pancreas, liver, heart, fat pads, and gizzards of grill chickens, as well as the bursa, thymus, and spleen at 49 days of age, were unaffected by whole dates at 175 and 350 g/kg.

In conclusion, there was no significant interaction between DSWM level and addition of enzymes or amino acid or crumble treatment on most of body organs.

Chemical composition of muscles:

The results of the contact between date seed waste meal levels and treatments on the chemical composition of muscle are presented in Table 5. There was no significant interaction between DSWM levels and treatments on moisture and crude ash. However, a weak interface (P< 0.09 and 0.08) was observed with CP and EE.

Table 5. Effect of dietary levels of DSWM, addition of enzymes, amino acids or crumble treatment on the chemical composition of fresh meat of 16 week-old chickens.

Treatments	Chemical analyses of meat, %			
	Moisture	CP	EE	Ash
(+) Control	70.1	26.1	3.99	0.98
Date seed waste meal 100 kg				
(-) control	69.5	26.0	4.30	1.21
+ Phytase	69.8	27.9	3.99	0.88
+ Optizyme	68.9	26.9	4.10	0.89
+ Amino acids	69.5	27.6	4.09	1.12
+ Crumble	71.2	26.1	4.08	0.99
Date seed waste meal 200 kg				
(-) control	69.6	26.6	3.92	0.99
+ Phytase	68.9	25.5	4.11	0.90
+ Optizyme	69.4	26.9	4.25	0.88
+ Amino acids	69.4	25.5	4.00	1.03
+ Crumble	70.1	25.1	4.11	1.02
SEM	0.87	0.89	0.095	0.075
P value	0.119	0.09	0.08	0.391

Means within a column not sharing similar superscripts are significantly different (P<0.05).

Within the unsupplemented levels of DSWM, the inclusion of 100 kg DSWM increased the ether extract of meat by 7.8%, while increasing the DSWM level to 200 kg decreased the ether extract by 1.75% compared to the negative control group. It is worth noting that the addition of phytase, multienzymes, and amino acids, or crumble treatment reduced the ether extract of diets containing 100 kg DSWM, with phytase showing the most significant effect. On the other hand, within diets containing 200 kg DSWM, the addition of enzymes, amino acids, or crumble treatment increased fat deposition in the muscles, with amino acids having the least impact. These results suggest that the effects of enzymes, amino acids, and crumble treatment vary depending on DSWM levels and can influence nutrient deposition in tissues.
In conclusion, there was no significant interaction of practical relevance on the chemical composition of muscle in 16-week-old pullets.

Economic evaluation:
Growing period (1-16 week of age):
The results presented in Table 6 indicated that net revenue was only improved due to phytase supplementation to 100 kg DSWM diet, and resulted in improvement in economic efficiency compared to its negative control. On the other hand, phytase, Optizyme and pelleting increased net revenue and improved economic efficiency compared to its negative control. Thus, the best net revenue, economic efficiency and relative economic efficiency were from optizyme supplemented 200 kg DSWM diet. This confirmed the results of growth performance and FCR where the same group produced the best productive performance among the experimental groups. These results suggest feeding growing pullets during 1-16 week of age diet containing 200 kg DSWM when supplemented with Optizyme to obtain the best economic efficiency.

Table 6. Economic efficiency study as affected by enzymes or amino acid supplementations and crumble treatments to different dietary date seed waste meal levels containing diet during the rearing period (1-16 wk of age).

Treatments	TFC	IPS	NR	EE	REE
(+) Control	128.27	128.27	45.21	54.43	100.0
Date seed waste meal 100 kg					
(-) control	128.49	128.49	47.41	58.48	107.4
+ Phytase	128.59	128.59	47.82	59.21	108.8
+ Optizyme	128.43	128.43	47.70	59.08	108.5
+ Amino acids	128.49	128.49	47.79	59.22	108.8
+ Crumble	128.34	128.34	47.92	59.58	109.5
Date seed waste meal 200 kg					
(-) control	128.17	128.17	49.38	62.67	115.1
+ Phytase	128.59	128.59	49.49	62.57	115.0
+ Optizyme	128.88	128.88	50.04	63.47	116.6
+ Amino acids	128.32	128.32	49.90	63.63	116.9
+ Crumble	128.44	128.44	49.99	63.71	117.1

TFC=Total feeding cost (LE)
IPS=Income from pullets selling (LE)
NR=Net revenue (LE)
EE=Economic efficiency, %
REE=Relative economic efficiency of the control

Conclusion

It is hypothesized that date seed waste meal can be included in local strain pullets diets up to 200 kg/ton by adding enzymes (optizyme, phytotase), amino acids (methionine, lysine, arginine, threonine, and tryptophan), and a crumble formulation. This combination could have a synergistic effect, leading to good growth performance and carcass quality comparable to the control group under Egyptian environmental conditions.

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