

## **THE EFFECT OF ADDING CUTTLEBONE MEAL ON THE PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF JAPANESE QUAIL.**

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### **SUMMARY**

**T**his experiment was conducted to evaluate the effect of adding different dietary levels of cuttlebone meal (CBM) on the productive and reproduction performance of Japanese quail. A total number of 112 birds of the 6-weeks Japanese quail were used and randomly distributed on 4 treatments with 4 replicates per 7 birds (2 males and 5 females). The birds were fed by treatments the following treatment: the first treatment (a control 0.0 % CBM), the second treatment (0.5% CBM), third (1.0% CBM), and fourth treatment (1.5% CBM). Body weight (BW), body weight gain (BWG), feed consumption (FC), feed conversion ratio (FCR), egg laying rate, egg weight, egg mass, fertility, hatchability, weight of chicks hatch, egg quality, and relative economic efficiency (REE) were estimated for the whole experimental period (10 weeks). It was observed that no significant effect on egg weight, egg mass, and feed intake due to addition CBM. There were significant ( $P < 0.05$ ) increases in egg number and egg laying rate during experiment for birds treated with 0.5 % CBM as compared with 0.0% and 1.5% CBM. And the best of FCR was observed in the same treatment (0.5% CBM. No significant difference ( $P > 0.05$ ) for yolk weight, eggshell weight, yolk percentage, albumen percentage, eggshell percentage, shape index, yolk index Haugh Unit (HU), shell thickness, width of egg, ESA and SWUSA between the treatments. However, albumen weight, increase significantly ( $P < 0.05$ ) due to addition 1.5% CBM comparing 0.5% CBM group. Insignificant differences in hatchability rate between the experimental treatments However, fertility rate increased significantly due to addition 0.5 and 1.5 CBM comparing the addition 1% CBM group and the body weight of chicks at hatch increase significantly ( $P < 0.05$ ) due to addition 1 and 1.5% CBM comparing the control group.

**Keywords:** *Cuttlebone, Productive and reproductive performance, Japanese quail.*

### **INTRODUCTION**

The cuttlebone is actually the inner skeleton of the squid. Unlike the hard, hard bones you might think, cuttlebone is softer and chalkier. It is very popular among bird owners. Cuttlebone is an important dietary supplement for birds because it is a major source of minerals and calcium, which helps birds that are made up of bones and blood clots. Cuttlebone is a cheap source of calcium carbonate and other trace minerals. It is a natural product and does not contain toxins or contaminants. The trace elements found in cuttlebone benefit birds as well. Iron helps with the formation of red blood cells and their function. Potassium preserves the activity of the heart and normal muscles, helps zinc in the immune system, helps the copper circulate and heal properly. Since Cuttlebone is mainly composed of  $\text{CaCO}_3$  and 12.29% of C, this is equivalent to 12% of C in  $\text{CaCO}_3$ . According to the average  $\text{CaCO}_3$  obtained size of 92.08%, of 1.879 mg of cuttlebone for CHN analysis, 1.73 mg of  $\text{CaCO}_3$  is calculated, of which 12% is 0.2076 mg C or 11.05% C. This amount is well comparable to 0.231 mg C or 12.29% C in Table (1). The higher amount of C is related to C of chitin and chitosan of cuttlebone. XRF (X-ray fluorescence) analysis of cuttlebone showed existence of the following elements such as Na, Mg, K, Si, S, P, Cl and specially Ca. XRF analysis of cuttlebone is shown as 44.71% CaO (or 31.93% Ca). In comparison to the average of carbonate based on Ca (92.08%) that measured in CB (or 36.83% Ca), so the amount of Ca is well determined Hemmatti *et al.* (2018) (Tables 2 and 3). Moon-Lae *et al.* (2001) they found that the yields and ash contents of cuttlebone were about 7.5% on whole cuttlefish and about 90% on dry basis, respectively. The contents of heavy metal might not invoke health risk in using food resource. The major mineral of cuttlebone was calcium as about 22% in content Table (4). The yield, proximate compositions, heavy metal and

mineral contents were not significantly different between domestic and imported cuttlebone. The solubility of cuttlebone was superior to that of calcium carbonate, but inferior to those of calcium powders on the market. The cuttlebone could be effectively utilized as a calcium source.

**Table (1): X-ray fluorescence analysis of crude cuttlebone**

MgO(%)	K <sub>2</sub> O(%)	Na <sub>2</sub> O(%)	CaO(%)	Fe <sub>2</sub> O <sub>3</sub> (%)	Al <sub>2</sub> O <sub>3</sub> (%)	SiO <sub>2</sub> (%)
0.36	0.07	2.25	44.71	0.03	0.04	0.12
Sr(ppm)	Cl(ppm)	L.O.I(%)	SO <sub>3</sub> (%)	P <sub>2</sub> O <sub>5</sub> (%)	MnO(%)	TiO <sub>2</sub> (%)
1756	24500	53.96	0.255	0.102	0.006	0.012

*Hemmatti et al. (2018)*

**Table (2). Comparison of yield of cuttlebone between Korean and Indian cuttlefish**

Item		Caught area	
		Korea	India
Length (cm)	Body	17.2	8.3
	Whole	27.7	15
Weight (g)	Muscle	331.4	79.6
	Viscera	126.2	22.2
	Cuttlebone	23.6	8.2
	Total	466.6	90.6
Yields (%)	Muscle	66.9	72.3
	Viscera	25.5	20.2
	Cuttlebone	7.6	7.5
	Total	100	100

**Table (3). Proximate composition and chitin contents of cuttlebone**

Component (%)	Caught area	
	Korea	India
Moisture	37.6± 1.4	38.2± 1.2
Crude protein	3.1± 0.0 (5.0)*	2.8± 0.0 (4.5)
Crude lipid	1.2±0.0 (1.9)	1.1±0.1 (1.8)
Crude ash	56.9± 0.1 (90.6)	56.5± 0.3(91.4)
Chitin	1.8±0.1 (2.9)	2.1±0.2 (3.4)

\*The values in the parentheses are dry basis

**Table (4). Content of minerals of cuttlebone**

Component (%)	Caught area	
	Korea	India
Mercury (ppm)	0.05	0.03
Copper (ppm)	0.52	0.33
Zinc (ppm)	2.42	3.17
Lead (ppm)	0.39	0.37
Cadmium (ppm)	0.07	0.06
Calcium (mg/100g)	22341.4	22233.6
Phosphorus(mg/100g)	27.6	26.0
Magnesium (mg/100g)	58.6	49.4
Manganese(mg/100g)	0.5	0.2
Iron(mg/100g)	5.9	6.0
Potassium(mg/100g)	41.7	42.2
Sodium (mg/100g)	583.0	615.3

## MATERIALS AND METHODS

The experiment was conducted at the Poultry Research Farm, Faculty of Agriculture, Assiut University to evaluate the effect of adding different levels of cuttlebone meal (CBM) on the productive and reproductive performance of Japanese quail (*Coturnix coturnix Japonica*). One hundred and twelve Japanese quail, aged 6 weeks, were housed in galvanized wire cages with nutritious nipples and feeders in a traditional shed with galvanized wire mesh. They were randomly selected in four treatment groups (20 females and 8 males each) with four replicates (5 females and 2 males each). All quails were grown in batteries under the same hygienic and environmental conditions throughout the entire experimental period which lasted for 10 weeks. The cuttlebone was purchased from the fish market in Suez, then washed and dried in the free air for moisture loss. After drying, the cuttlebone powder was ground and mixed with the sauce in the required proportions. The treatments were as follows: Control group fed basal diet with 0 % CBM, The second treatment contained 0.5% CBM, the third treatment contained 1.0% CBM, and the fourth contained 1.5% CBM. Experimental diets were based on corn and soybean meal, prepared according to the National Research Council guidelines for the development of Japanese quail (NRC, 1994). Table (5) shows the composition and analysis of the calculated base diet. The feed and water were available ad libitum and had a light system of 17/7 light / dark hours throughout the experimental period.

**Table (5). Composition and calculated values of laying diet**

Ingredient	control	0.5% CB	1.0%CB	1.5%CB
Yellow corn	58.80	58.51	58.21	57.92
Soya bean meal, 44%	23.4	23.28	23.17	23.05
Protein concentrate	10	9.95	9.90	9.85
Oil	2.5	2.5	2.5	2.5
limestone	4.5	4.478	4.455	4.433
mono- cal- phosphate	0.8	0.782	0.765	0.747
Cuttlebone	0.0	0.5	0.1	1.5
Total	100	100	100	100
		Calculated values		
AME(kcal/kg)	2973	2958	2943	2929
Crude protein %	19.97	19.87	19.77	19.67
Crude fiber %	3.18	3.17	3.15	3.14
Ether extract %	5.11	5.08	5.06	5.03
methionine %	0.53	0.53	0.53	0.52
Lysine %	1.10	1.09	1.09	1.08
Arginine %	1.06	1.06	1.05	1.05
Calcium %	2.51	2.60	2.69	2.81
Phosphorus %	0.55	0.55	0.55	0.54
sodium %	0.15	0.18	0.21	0.24
Price (LE/kg diet)	6.47	6.57	6.67	6.77

### ***Egg production and laying performance :***

Production performance characteristics (egg laying rate, feed intake, feed conversion and viability) were measured during the 70-day trial. Changes in body weight (CBW) and feed consumption (FC) were recorded at the beginning and end of the experiment for each replicate. Daily egg weight was recorded. Feed conversion ratio was determined from the relationship between the feed intake and the Egg mass (kg kg<sup>-1</sup>). Viability of birds, expressed in percentage, considered the mortality during the experimental period.

### ***Egg quality measurements:***

Twenty eggs were collected randomly from each treatment every four weeks (5 eggs/ replicate) in the last three days of each cycle, weighed individually to determine subsequent egg quality measurements; eggshell thickness with the shell membrane was measured in three locations on the egg (air cell, equator and sharp end) in micrometers. Eggshell weight Albumen height, Haugh unit, along with albumen height per egg weight value, was calculated using the method of (Eisen *et al.* 1962).

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Yolk index was obtained by the ratio between height and diameter of the yolk (Nesheim, Austic, & Card, 1979).

$$\text{Equation 1: } HU = 100 * \log (H + 7.57 - 1.7 W^{0.37})$$

Where:

H = albumen height (mm) and W = egg weight (g).

A micrometer sensitive in 0.001 mm was used for measuring the eggshell thickness. Variables i.e. egg index (EI), Egg surface area (ESA) was expressed in cm<sup>2</sup> using formula of Carter (1975), and egg shell weight per unit surface area (SWUSA) were investigated by following equations:

$$EI = W/L * 100$$

$$ESA \text{ (cm}^2\text{)} = 3.9782W^{0.7056}$$

$$SR = SW/EW * 100$$

$$SWUSA \text{ (grcm}^{-2}\text{)} = SW/ESA$$

Where: EI is egg index; W is egg weight; L is egg length; EW is egg weight; ESA is egg surface area; SR is shell ratio; SWUSA is shell weight per unit surface area; and SW is shell weight.

### ***Fertility and hatchability of eggs:***

All eggs from each treatment were collected daily for 7 days (weeks 5 and 10 of treatment) and incubated at 37.6 °C with 60% relative humidity for 14 days. They were then transferred to hatching trays in the last 3 days of incubation and were maintained at 37.2 °C and 75% relative humidity until hatch. After being hatched, chicks were counted; weighted and non-hatched eggs were broken to determine the percentages of fertility and hatchability.

$$\text{Fertility\%} = (\text{Number of fertile eggs} / \text{Number of set eggs}) \times 100. \text{ Hatchability\%} = (\text{Number of hatched chicks} / \text{Number of fertile eggs}) \times 100.$$

### ***Fertility and hatchability of eggs:***

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### ***Statistical analysis:***

Statistical analysis: The data collected were analyzed by analysis of variance (ANOVA) using general linear model procedure (GLM) of SAS software (SAS institute, 2009). Percentage values were transformed using arcsine before statistical analysis. Significant differences between treatments means were determined using Duncan multiple range test (Duncan, 1955). The following model was used:

$$Y_{ijk} = \mu + T_i + E_{ik}$$

Where;

Y<sub>ijk</sub> = observation

μ = overall mean

T<sub>i</sub> = treatment effect, i (1 to 4)

E<sub>ik</sub> = Experimental error

## **RESULTS AND DISCUSSION**

The effects of dietary supplementation with CBM 0.0, 0.5, 1.0 and 1.5% on egg production are shown in Table (6). It was observed that no significant effect on egg weight, egg mass, and feed intake due to addition CBM. As shown from Table (6) there were significant (P<0.05) increases in egg number and egg laying rate during experiment for birds treated with 0.5 % CBM as compared with

0.0% and 1.5% CBM. And the best of FCR was observed in the same treatment (0.5% CBM). Regarding characteristics of egg quality of laying quails fed different type of oil, the results are presented in Table (7). There was no significant difference ( $P > 0.05$ ) for yolk weight, eggshell weight, yolk percentage, albumen percentage, eggshell percentage, shape index, yolk index Haugh Unit (HU), shell thickness, width of egg, ESA and SWUSA between the treatments. However, albumen weight

**Table (6). Effect of cuttlebone on egg production performance, feed intake and feed conversion of Japanese quails ( $\bar{X} \pm SE$ )**

Parameter	Treatment			
	Control	0.5%	1 %	1.5%
Egg weight (g)	13.59±0.19	13.51±0.336	13.169±0.087	13.64±0.31
Egg number (egg/h/wk)	5.666±0.426 <sup>b</sup>	6.5225±0.114 <sup>a</sup>	5.80±0.109 <sup>ab</sup>	5.609±0.1037 <sup>b</sup>
Egg mass (g/h/day)	11.01±0.89	12.591±0.377	10.917±0.168	10.94± 0.415
Egg laying rate (%)	80.95± 6.09 <sup>b</sup>	93.179±1.63 <sup>a</sup>	82.91±1.563 <sup>ab</sup>	80.13±1.48 <sup>b</sup>
Feed intake (g/h/d)	32.24± 0.94	29.78 ± 0.928	30.18±0.150	30.129±0.369
FCR (g feed/ g egg)	2.99± 0.25 <sup>a</sup>	2.371±0.099 <sup>b</sup>	2.766±0.0498 <sup>ab</sup>	2.768±0.133 <sup>ab</sup>

1 NS not significant, \* Significant at ( $P \leq 0.05$ ), \*\* Significant at ( $P \leq 0.01$ )

2 a, b, c and d: means in the same rows having different letters are significantly different at ( $P \leq 0.05$ )

**Table (7). Effect of cuttlebone on egg quality of quails of Japanese quails ( $\bar{X} \pm SE$ )**

Parameter	Treatment			
	Control	0.5%	1 %	1.5%
Egg weight (g)	13.06±0.18	12.89±0.20	13.08±0.15	13.41±0.21
Yolk weight (g)	4.15±0.08	4.15±0.06	4.15±0.06	4.28±0.08
Albumen weight (g)	7.87±0.13 <sup>ab</sup>	7.65±0.15 b	7.78±0.12 <sup>ab</sup>	8.12±0.14 <sup>a</sup>
eggshell weight (g)	1.1289±0.015	1.09±0.02	1.11±0.012	1.12±0.027
Yolk percentage (%)	31.67±0.317	32.26±0.33	31.85±0.39	31.65±0.32
Albumen percentage (%)	59.69±0.36	59.30±0.37	59.55±0.40	60.03±0.36
Eggshell percentage (%)	8.67±0.1038	8.44±0.11	8.51±0.12	8.319±0.16
Egg length (mm)	34.228±0.244	34.02±0.21	34.10±0.18	34.61±0.31
Egg width (mm)	26.44±0.118	26.29±0.15	26.45±0.11	26.55±0.13
Shape index	77.37±0.519	77.35±0.46	77.64±0.48	76.919±0.48
Yolk index	43.56±0.732	42.41±0.67	43.15± 0.65	43.22±0.51
Haugh units shell thickness (10-2 mm)	89.23±0.545	87.91±0.66	88.86±0.59	87.65±0.79
Shell strength (kg/cm <sup>2</sup> )	1.183±0.604	1.165±0.68	1.297±0.79	1.328±0.66
thickness (10-2 mm)	23.14± 0.23	23.56±0.26	23.90±0.28	23.40±0.38
ESA	24.36±0.24	24.14±0.27	24.40±0.20	24.82±0.28
SWUSA	46.35±0.49	44.99±0.62	45.56±0.63	44.96±0.89

1 NS not significant, \* Significant at ( $P \leq 0.05$ ), \*\* Significant at ( $P \leq 0.01$ )

2 a, b, c and d: means in the same rows having different letters are significantly different at ( $P \leq 0.05$ )

increase significantly ( $P < 0.05$ ) due to addition 1.5% CBM comparing 0.5% CBM group. It is shown from the data in Table (8) that there were insignificant differences in hatchability rate between the experimental treatments However, fertility rate increased significantly due to addition 0.5 and 1.5 CBM comparing the addition 1% CBM group and the body weight of chicks at hatch increase significantly ( $P < 0.05$ ) due to addition 1 and 1.5% CBM comparing the control group.

The effects of dietary supplementation with CBM 0.0, 0.5, 1.0 and 1.5% on body weight (initial body weight, final body weight, body weight gain, and change body weight) are shown in Table (9). It was observed that treatment the quail birds with different levels of CBN have no significant effect on body weight of these birds during of experiment. Bhushan Rao *et al.* (2019) found that the eggshells of lovebird's eggs laid during cuttlebone supplement were apparently thicker than the eggs laid without cuttlebone supplement. The latter eggs had a more chance of breakage than the former. The quality and thickness of eggshells have increased only upon cuttlefish bone which is a rich source of calcium and other minerals. This indicated that cuttlefish bone found on the beaches can indubitably be used as potential calcium and mineral source for laying thick shelled eggs thereby avoiding egg

breakage. Interestingly, it was found that lovebirds have discarded the eggs touched by human from cages and were not at all hatched.

#### **Economic efficiency:**

The economical efficiency of treatment's diets as affected by experimental diets is shown in Table (10). The results indicate that group 2 (0.5% CBM) diets achieved the best value (146.9%). The lowest value

**Table (8). Effect of cuttlebone on fertility, hatchability and body weight at hatch of Japanese quails. ( $\bar{X} \pm SE$ )**

Parameter	Treatment			
	Control	0.5%	1 %	1.5%
Fertility (%)	94.336±1.76ab	96.09±1.83a	89.616±3.36b	98.85±0.71a
Hatchability (%)	88.557±3.77	94.499± 2.93	93.100±2.902	97.2±1.22
Body weight at hatch (g)	8.72±0.08b	8.947±0.10ab	9.029±0.10a	9.059±0.11a

1 NS not significant, \* Significant at ( $P \leq 0.05$ ), \*\* Significant at ( $P \leq 0.01$ )

2 a, b, c and d: means in the same rows having different letters are significantly different at ( $P \leq 0.05$ )

**Table (9). Effect of cuttlebone on body weight of Japanese quails ( $\bar{X} \pm SE$ )**

Parameter	Treatment			
	Control	0.5%	1 %	1.5%
Initial BW(g)	240.48±1.534	236.535±3.297	235.57±4.325	234.21±2.551
Final BW (g)	279.24±2.7409	286.38±9.602	278.041±4.215	272.648±7.466
Body weight gain (g)	38.746±4.4268	49.845±9.368	42.47±1.708	38.434±6.026
Change BW %	16.14±1.986	21.10±3.988	18.055±0.856	16.38±2.539

1 NS not significant, \* Significant at ( $P \leq 0.05$ ), \*\* Significant at ( $P \leq 0.01$ )

2 a, b, c and d: means in the same rows having different letters are significantly different at ( $P \leq 0.05$ )

**Table (10). Input / output analysis and economical efficiency of Japanese quail fed the experimental diets.**

Parameter	Treatment			
	Control	0.5%	1%	1.5%
Total feed intake/(hen+0.4 male)	3.16	2.92	3.00	2.95
Price /kg feed (LE)	6.47	6.57	6.67	6.77
Total feed cost / hen (LE)	20.45	19.18	20.00	20.00
Total chick production (chicks/hen)	47.34	59.23	44.54	53.89
Total price of chicks production2	71.01	88.84	66.81	80.84
Net revenue/ hen (LE)3	50.56	69.66	46.81	60.84
Economic efficiency EEF	2.47	3.63	2.34	3.042
Relative fee (100)	100	146.88	94.69	129.96

a, b, c and d: means in the same rows having different letters are significantly different at ( $P \leq 0.05$ )

of relative economical efficiency (94.7%) was recorded for group 2 (1.0% CBM). However, the next to group 2 relative economic of efficiency value (130%) was recorded for group 4 (1.5% CBM). It can therefore be concluded that addition of 0.5% CBM has led to higher economical efficiency. However, addition of 1.0% CBM has led to lower economical efficiency.

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## تأثير اضافته مسحوق عظام السيبيا على الاداء الانتاجي والتناسلي للسمان الياباني

على السيد جلال

قسم انتاج الدواجن - كلية الزراعة - جامعة أسيوط - مصر.

أجريت هذه التجربة لتقييم تأثير إضافة مستويات مختلفة من مسحوق عظام الحبار في تحسين الأداء الإنتاجي والتناسلي وجودة بيض السمان الياباني. تم استخدام عدد 112 طائرًا من السمان الياباني عمر 6 أسابيع ووزعت بشكل عشوائي إلى 4 معاملات كل معاملة 4 مكررات كل مكررة تحتوي 7 طيور (5 إناث + 2 ذكور). تم تغذية الطيور بالمعاملات التالية: المعاملة الأولى (الكنترول) 0.0 % مسحوق عظام الحبار و المعاملة الثانية (0.5 % مسحوق عظام الحبار) و الثالث (1.0 % مسحوق عظام الحبار) و المعاملة الرابعة (1.5 % مسحوق عظام الحبار). تم قياس وزن الجسم و الزيادة في وزن الجسم و العلف المستهلك و معدل تحويل العلف و معدل وضع البيض و وزن البيض و كتلة البيض و نسبة الخصوبة التفريخ و وزن الكتكوت عند الفقس و جودة البيض و الكفاءة الاقتصادية.

وقد لوحظ أنه لا يوجد تأثير كبير على وزن البيض و كتلة البيض و العلف المستهلك نتيجة لإضافة مسحوق عظام الحبار. و كانت هناك زيادات كبيرة معنوية في عدد البيض و معدل وضع البيض أثناء التجربة عند مستوي 0.5 % وذلك بالمقارنة مع مستوي 0.0 % و 1.5 %. ولوحظ أيضا ان أفضل معامل تحويل للعلف المستهلك في نفس المعاملة (0.5 % مسحوق عظام الحبار. لا يوجد فرق معنوية لوزن صفار ووزن قشر البيض و نسبة صفار البيض و نسبة البياض و نسبة القشرة و معامل الشكل و معامل الصفار و سمك القشرة و عرض البيضة و وجد زيادة معنوية في وزن البياض نتيجة لإضافة 1.5 % مسحوق عظام الحبار مقارنة 0.5 %.

وجد فروق معنوية في معدل الفقس بين المعاملات. و زيادة معدل الخصوبة بشكل ملحوظ نتيجة لإضافة 0.5 و 1.5 مسحوق عظام الحبار مقارنة مع 1 % بالإضافة إلى زيادة وزن جسم الكتاكيت عند الفقس زيادة معنوية نتيجة لإضافة 1 و 1.5 % بالمقارنة بمجموعة الكنترول.