Egypt. J. Vet. Sci., pp. 1-9

Egyptian Journal of Veterinary Sciences
https://ejvs.journals.ekb.eg/

Incorporation of Olive Oil in Japanese Quail Feed: Effect on Zoo-technical Performance, Biochemical and Carcass Characteristics

Dahia Saidj [1.2*], Zahia Dorbane [3], Razika Boukert [1], Wahiba Zane[1], Louiza Ferhat[1], Nourelhouda Belbachir[1], Nassim Moula [4], Hakima Mefti Korteby [1] and Si Ammar Kadi[3]

[1]*Veterinary Sciences Institute, Saad Dahleb University, B.P. 270, Route de Soumâa, 09000. Blida, Algeria.*
[2]*Health and Animal Productions Laboratory SPA, High National Veterinary School, Oued Smar, Algiers, Algeria.*
[3]*Agronomic Sciences Department, Biologic and Agronomic Sciences Faculty. Mouloud MAMMERI University, Tizi-Ouzou, Algeria.*
[4]*Fundamental and Applied Research for Animals & Health (FARAH), University of Liege, Boulevard de Colonster, 20, building B43, 4000 Liege, Belgium.*

Abstract

THE PRESENT work aims to study the influence of the incorporation of olive oil in the diet of quails at different proportions: control C (0%), E1 (2%) and E2 (4%). 360 quails of one day of age were randomly divided into three groups of 120 individuals and reared on the ground for five weeks. The weight of the subjects and the feed intake were recorded weekly. The results showed that quails-fed olive oil showed better zootechnical performances (average live weight, average daily gain and feed conversion ratio) than the control group, with an even better effect in the E2 group. The average live weights at the fifth week were 184.1g for the E2 group; 181.6g for the E1 group versus 178.1g for the C group, corresponding to average weight gains of 5.1; 5.0 and 4.9 respectively. The feed conversion ratio seems to be positively influenced by the incorporation of olive oil since it goes from 5.04 in group C to 4.51 in group E2 and 4.65 in group E1. Moreover, the incorporation of olive oil did not modify the blood parameters of the animals nor the weight of the carcasses and organs, except for the weight of the heart, the quail of group E2 being the heaviest (P=0.001). Therefore, olive oil may represent an interesting alternative for improving the feed efficiency of Japanese quails. However, further studies are needed to estimate the economic efficiency of this strategy as well as the optimum rate of olive oil incorporation.

Keywords: Japanese quail, olive oil, zoo-technical performance, carcass parameters.

Introduction

Throughout the world, poultry farming has focused mainly on the production of eggs and broiler chicken to meet the increased demand for animal proteins. Algeria is no exception, and has launched, for about forty years, of developing the poultry sector based mainly on the species chicken (Gallus genus) and more recently on the turkey [1, 2]. However, the price of poultry meat has risen dramatically in recent years [3]. especially during the summer and religious holidays. In addition, the breeding of quails can be an interesting alternative.

The Japanese quail *Coturnix japonica* or *Coturnix japonica domestica* [4], is a small bird belonging to the order *Galliformes*, family *Phasianidae* and native to Japan and China [5]. It constitutes a very interesting poultry for protein production [6]. In addition, it is easy to set up breeding due to the productive and reproductive performance of this species [5]. Indeed, rapid growth and early breeding characterize the quail. It is breeding also allows the diversification of poultry farms by offering consumers new tastes [7]. Quails have been known since ancient times in European, Asian and African countries. They have gained economic importance as a poultry species producing eggs and meat valued for

*Corresponding authors: Dahia Saidj, E-mail: dyhiasdj1@yahoo.fr, Tel.: 00213669357274
(Received 27 August 2024, accepted 28 November 2024)
DOI: 10.21608/EJVS.2024.316082.2340

their different flavor from large poultry and their high nutritional value [8].

For the success of a poultry farm in general and of quail in particular, the control and improvement of feed, representing two-thirds of production costs, is essential. Today, poultry feed covers almost all nutritional needs. Deficiencies are rare and are usually due to problems of absorption or, even more, to human error. According to Leclercq [9], the incorporation of fats such as olive oil in poultry feed increases the energy density and thus improves the zootechnical performance of the animals. According to Bilal *et al*. [10], it also positively influences the health of poultry. In addition, olive oil is rich in essential fatty acids (omega 3 and omega 6) and antioxidants beneficial to the body. Indeed, the results of the Anses study [11], have demonstrated the beneficial effect of a good ratio of omega-6/omega-3 (close to 1) in poultry feed on their growth rate and their physiological functions.

Mediterranean countries represent 65% of the world's cultivated area of olive trees with the largest producing countries being Spain (45%), Italy (31%) and Greece (22%) [12]. Algeria is among the main Mediterranean countries producing olive oil (*Oleaeuropea L.*), and the Chemlal variety is the most exploited. With an area of more than 450,000 ha, several olive trees reaching 6200000 trees, the national production of olive oil reached nearly 70000 tons in 2018 [13]. Unfortunately, some of the olive oil harvested in this region is unfit for human consumption, which led us to consider its use in animal feed, as it is a source of energy, necessary for growth and production. The present work aimed to study the effect of olive oil incorporated in the feed at increasing rates, on the zootechnical, biochemical and carcass characteristic performances in Japanese quail..

Material and Methods

Experimental protocol and rearing behavior

360 quail (*Coturnix japonica*) of one-day age were randomly divided into three groups of 120 birds with 10 replicates for each group. The control group C received a commercial feed. The raw components of the feed distributed are: corn grain, soybean meal, wheat bran, sodium bicarbonate, limestone, phosphate, soybean oil, mineralovitamin complex, synthetic amino acids and enzymes. The diet chemical analysis covered dry matter, crude ash, ether extract ((NA654-1992), crude protein (NA652-1992) and crude fiber (Table 1). The other two experimental groups E1 and E2 received the same basal diet of (C) to which 2% and 4% olive oil were manually incorporated, respectively. The oil used was that of olives (*Olea europea L. var.Chemlal*) and produced in the region of Bouira, Algeria. Feed and water were distributed to the quails *ad libitum*.

During the five weeks of the trial, a daily control of the rearing house carried out. A gas heater provided the heating; the temperature monitored and regulated according to the age of the quails. The quails continuously illuminated with a 100-Watt lamp during the first five days of rearing. After the 5th day, a specific lighting program of type 16L/8O (L: light, O: darkness) was applied. Weekly during the five-week experiment, individual body weights were monitored and the amounts of feed intake (amounts distributed - amounts refused) were recorded by group. The average weight gain of experimental quails was deducted (final quail weight - initial quail weight; per period) and feed conversion index was calculated. Mean daily gain (MDG) was calculated (weight gain/ number of days per period), total intake of individual quail of all experiment was recorded and global daily intake (total intake/35 days).

Blood parameters

Blood samples were taken to measure the following biochemical parameters by spectrophotometry. Two to five milliliters of blood were collected in heparinized tubes and centrifuged at 3000 rpm for 10 minutes. For each sample, the plasma was collected and aliquoted into eppendorf tubes, stored in a cooler, and then placed in a freezer at -20°C for subsequent assays for determination of glucose, cholesterol, triglycerides, total protein, urea creatinine and uric acid. Biochemical assays for each parameter were determined using a spectrophotometer (LKB Novastek) according to the commercial kit SPINREACT.SA. Spain.

Slaughter parameters

Animals were weighed before slaughter by bleeding, which was performed on the 35th day of age. After bleeding, the weights of the viscera (heart; liver; full gizzard; empty gizzard; pro-ventricle) and the weight of the eviscerated carcass were determined.

Statistical analysis

The data are represented by the least mean square ± standard error. An analysis of variance, using SAS software (Statistical Analysis Systems Software, 2001) was performed to compare the results obtained for the different parameters studied between the three experimental groups. The results were considered different when the value of P was lower than 0.05.

Results

Live weight and weight gain

The results showed no significant difference (P>0.05) during the first four weeks of rearing for the live weight and weight gain parameters of the animals of the different groups studied (Table 2).

During the fourth and fifth weeks, the difference in live weights was not significant between the three groups C, E1 and E2 but a trend in results was noticed (p= 0.055) during the fifth week. Indeed, subjects in group E2 (154.29±1.50g; 184.09±1.76g) showed a higher live weight versus the subjects in group C (151.27±1.50g; 178.11±1.75g) and those in group E1 (152.51±1.53g; 181.62±1.80g) in the last two weeks, respectively. In addition, the mean daily gain MDG of group E2 was higher (P=0.018) than that of group C (5.06±0.05g vs. 4.89±0.05g) and group E1, (5.06±0.05g vs. 4.99±0.05g; P=0.18), respectively, although the overall difference between the three groups was not significant (P=0.063). It should also be noted that the incorporation of olive oil had no impact on the mortality rate of the quail, which was similar for the three groups, with a peak noticed during the first days of the installation.

Feed intake

No significant difference was observed between the three experimental groups on the average daily feed intake (P>0.05) per rearing week (Table 3). However, the difference in the overall average daily feed intake of the quails of the three groups was highly significant (P<0.0001); the quails of group C fed the control diet without incorporation of olive oil ingested greater quantities compared to the quails of the other two experimental groups fed a diet supplemented with olive oil. As a result, the feed conversion of animals in the control group C was significantly (P<0.0001) higher than that of birds in groups E1 and E2. On the other side, feed conversion was improved adding olive oil.

Blood parameters

The values recorded for the blood parameters (Table 4), were similar between the three experimental groups with no significant difference (P>0.05) obtained

Slaughter parameters

In comparison among the groups, the quails of the E1 and E2 groups appear to be heavier in absolute value than those of the control group (Table 5). The results also showed that there was no significant difference in carcass weight among the three groups (p>0.05).

Regarding the viscera, no significant difference was observed with the weights of liver, solid gizzard and proventricle among the birds of the three groups (p>0.05). However, the incorporation of olive oil in the diet had a significant effect on heart weight (P=0.001); quails fed the experimental diets of E1 or E2 had a heavier heart than those fed the control diet.

Discussion

Average live weight

The average weight at the first week of age recorded in the quails among the different groups (Table 2), was close to that reported by Özbey *et al.* [14] of 28.6g, but higher than the weight obtained by Almeida *et al.* [15] of 21.4g. At the second week, the average weight recorded among the different groups (Table 5), was higher than the value of 47.2g reported by Adeogun and Adeoye [16]. The genetic type of the quails used could explain this variability in weight; some lines were early for meat production, while others were early for egg production. Furthermore, Özbey *et al.* [14] reported an average weight of 178 g at the sixth week of age, which was already reached at the fifth week of this trial by the birds of the three groups and even exceeded by the birds of the groups fed a diet with olive oil (181.6 g for group E1 vs. 184.1 g for group E2). This may be related to the quality of the feed distributed with more than 23% crude protein (Table 1), to the good rearing conditions, as well as to the positive effect of the olive oil incorporation for the E1 and E2 groups that were the heaviest. In broilers, Fraga *et al.* [17] showed that an intake of 2.5% of sunflower oil improves the growth of the chicken, due to the high proportion of linoleic acid.

Feed intake

The average feed intake per quail of C group in the first week of age (3.11 g) was close to the value (5.31g/quail/day) reported by Nazligul *et al.* [18]. On the other hand, the daily intake of quails for groups E1 and E2, 8.38 vs. 8.68, respectively was higher than Nazligul *et al.* [18]. During the whole study period, the overall daily intake recorded for the three groups was higher than (14.4 g/quail/d) that reported by Dzhuvinov and Mihailov [19]. This can be explained by the influence of the diet used and the rearing management. These results showed that the overall daily intake was lower in quails of groups E1 and E2 compared to C group. Veldkamp *et al.* [20] reported that increasing the energy concentration of the diet leads to a decrease in feed intake and rapid growth.

Average daily gain and feed conversion

Carbohydrates (sugars, starch) and lipids (fats of animal or vegetable origin) were the main sources of energy. Indeed, fats from oil mills (vegetable oils) or slaughterhouses (tallow, fat, lard) were important sources of metabolizable energy for poultry diet [21]. They increased the energy value of the feed while decreased feed conversion rates. The highest average daily gain was recorded during the first weeks of age, reflecting very rapid growth at start-up in quail. Between the first and fifth week of age, the MDG indicated a rapid growth during this period, which was well marked in groups E1 and E2. Lessire [22] indicated that the incorporation of fats (oils or oilseeds) in poultry feeds increased the energy density, thus improving the growth performance of the animals, especially broilers [23]. Thus, Ciewe Ciake [24]. reported an average weight gain of 68.45 g in subjects receiving a diet containing 1% peanut oil compared to 64.89 g for the control group receiving a feed that did not contain peanut oil. Moreover, according to Parigi Bini [25]. Vegetable fats better used and absorbed than animal fats, because vegetable fats were rich in unsaturated fatty acids, which essential for chicken, such as linoleic, linolenic and arachidonic acids. Therefore, poultry was an excellent means of favorably modifying the nutritional status of fats, particularly by enriching meat with Omega3 [26]. Indeed, the digestive physiology of birds preserved relatively well the polyunsaturated fatty acids they consume. Trials by Galea *et al.* [27] showed that a decrease in the ratio of ω6 PUFA/ω3 PUFA (polyunsaturated fatty acids) or an increase in an important ω3 PUFA family fatty acid such as DHA (docosahexaenoic acid) could change the fatty acid profile of the egg produced.

During the rearing period, quails fed a diet with olive oil incorporated, regardless of the rate (2% or 4%), showed the lowest feed conversion associated with the highest average daily gain. The bibliography pointed out that the better the diet quality, the lower the feed intake and the better the feed efficiency [28, 29]. Larbier and Leclercq [30] showed that the energy level of the feed was negatively correlated with feed intake and feed conversion ratio; increasing the energy level always leads to an improvement in feed conversion ratio and growth rate.

Metabolic profile

Glucose level was the primary parameter for assessing carbohydrate metabolism [30]. Basal blood glucose was influenced according to Leclercq *et al.* [31] by the genetic origin of the animals, their age and nutritional status. Scholtz *et al*. [32], showed a highly significant difference between the males and females of adult quails at 16 weeks of age, which is more than understandable given that these quails are not only reproducing (their metabolic needs are focused on the synthesis of reproductive hormones), but are also at the peak of egg-laying, which requires a lot of glucose, protein, cholesterol and triglycerides to set the eggs (the white, the yolk and the egg).

The results showed slightly higher blood glucose values in the animals of the group fed the diet richest in olive oil but without any significance. This seems to be explained by the energy level of the feed. The liver is the main site of cholesterol synthesis and its conversion to bile acids. In addition, triglycerides, non-esterified fatty acids and phospholipids often increase with increasing cholesterol levels. According to Lamant [33], the assimilation of saturated fatty acids increased plasma cholesterol levels, unlike polyunsaturated fatty acids (omega 3), which according to the study by Kouakou *et al.* [34], when assimilated in large quantities, reduce the total cholesterol content by 38.6%, thus improving the nutritional quality of the products. The results regarding blood cholesterol levels in animals of groups E1 and E2 closed to those observed in animals of the control group, which could be explained by the low incorporation rates of olive oil in this study.

The increase in triglycerides can attributed to the energy level of the feed. In fact, excessive energy intake throughout the rearing period and the *ad libitum* feeding method used, intensify lipid metabolism. This hypothesis was not far from that of Hassan and Leqlercq [35], who suggested that overfeeding increases lipogenesis by increasing hepatic anabolism, which, together with other factors (minerals, vitamins, lysine, etc.), contributed to the transfer of triglycerides from the liver to the blood. This may explain the slightly elevated the blood triglyceride levels in of group E2 animals. Most plasma proteins, except for immunoglobulins produced by B cells, can used as indicators of the liver's ability to synthesise protein. The capacity to synthesize proteins reduced after cellular damage. When this phenomenon was significant, plasma levels of these proteins tended to decrease, indicating that the rate of synthesis required to maintain normal plasma levels was low. Rather, the decrease in plasma proteins reflected chronic damage [36]. Protein levels in quail were consistent with the control group [37]. Higher levels (37.5 to 48.7g/l) observed in the Japanese quail monitored in the work of Ayub Ali *et al.* [38] and even much higher (304.64 g/l) in the work of Kabir [39].

Creatine synthesized from amino acids (glycine, arginine and methionine) with the final step occurring in the liver. The kidneys only excreted creatinine. In birds, creatine excreted in the urine before it converted to creatinine. Urinary excretion of creatine may be one reason why creatinine levels do not provide an accurate assessment of avian renal function [36, 40]. In the present experiment, plasma creatinine levels were not affected by the inclusion of olive oil in the diet. The results of creatinine obtained were very similar to those reported by Scholtz *et al.* [32]. During protein catabolism, proteins e degraded into amino acids, the deamination of which led into the formation of ammonia. Ammonia was almost exclusively absorbed by the liver, which then converted it into urea, which was excreted by the kidneys through glomerular filtration. Animal hydration was an essential parameter in poultry farming and urea generally used as a sensitive indicator of dehydration. When poultry were properly hydrated, all filtered urea was excreted, whereas in dehydrated poultry (almost all) filtered urea was reabsorbed [41]. However, uric acid was the main form of nitrogen excretion, because unlike other animals, they do not produce urea, which explains the low values obtained in this experiment without considering the type of feed distributed.

Carcass parameters

The results of live weights and carcass weights showed values of 183.6g and 140.1g, respectively, close to those obtained by Konca *et al.* [42] in his control group. Lower values (111.58g and 65.7g) were recorded by Caglayan & Erdogan (2013). The liver weights of the quails were similar to the control group [42, 43 & 44]. Lower weights were reported by Khaksar *et al.* [45] and Makinde *et al.* [46]. At the same age (35 days), Stanquevis *et al* [47] found that the liver weight of the quails was higher than that of the quails in this experiment, probably because the live weight of the quails was also greater; the liver weight is proportional to the live weight of the animals. According to Huart [48], the incorporation of fat in the feed induces a decrease in its fiber content. According to Akiba and Matsumoto [49], high fiber diets decreased hepatic lipogenesis resulting in a reduction of hepatic lipid deposition and fatty acid synthesis from glucose. This may explain the increase in liver weight of quails in the E2 group although this difference was statistically insignificant.

The results obtained in this experiment showed a heart weight of C group quails comparable to that reported by Attia *et al.* [50], Konca *et al.* [42] and Tufan *et al.* [37] while lower weights were reported by Tarhyel *et al.* [51] and Makinde *et al.* [46]. High heart weight may be associated with high metabolism and the need for large volumes of blood flow for greater nutrient supply to tissues and increased removal of metabolic waste [52]. This may explain the impact of olive oil incorporation in the diet on heart weight, which was heavier in E1 and E2 groups. A diet rich in unsaturated fatty acids, including n-6 PUFAs, reduced the risk of cardiovascular disease. Indeed, studies showed that as dietary intakes of n-6 PUFAs increased, cardiovascular risk factors decreased by up to 30% [53, 54], with likely increases in heart muscle weight. No differences recorded in the proventricular and gizzard weights of animals in the different groups. The gizzard weight recorded in this study was comparable to that obtained by Hena *et al.* [55] and Tarhyel *et al.* [51] (4.06 to 4.44g), but heavier than the weight recovered by Makinde *et al.* [46] (2.23 to 3.59g).

Conclusion

Olive oil is a source of energy and takes a unique place among the feed oils produced in Algeria. In this experiet, the incorporation of olive oil (rich in omega 3 and 6 polyunsaturated fatty acids) in the diet of Japanese quail led to an improvement in zootechnical performance, carcass and heart weight without any variation in the metabolic profile, lower feed consumption and feed conversion ratio with a high average daily gain giving an ideal average weight for the subjects that received a feed containing olive oil, this improvement was proportional to the quantity of oil incorporated. This incorporation could increase egg production in quail breeders and/or improve egg quality, given the effectiveness of incorporation at a late age during the trial (positive but late incorporation effect, noticed from the 4th week of age). Also, our results suggest the interest of further work to determine the composition as well as the organoleptic and dietary quality of the carcass. The use of olive oil to improve the performance of poultry seems to be a feasible option. However, it raises the question of the economic efficiency and the limits of this solution.

Acknowledgments

Not applicable.

Funding statement

This study didn't receive any funding support

Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

The experiment was carried out by the guidelines for Experimental Animals approved by the Association Algerienne des Sciences en Expérimentation Animale (58 AASEA: N°45/DGLPAG/DVA/SDA/19).

TABLE 1. Proximate composition (% on DM) of the basal diet distributed

Dry mater (DM)	Crude ash	Ether extract	Crude protein (N×6.25)	Crude fiber	Metabolizable energy(kcal/kg)*
90.73	6.16	4.72	23.38	3.95	3558.55

N: nitrogen * : ME (MJ /kg DM) = 16.063-0.115EE-0.027CP.

TABLE 2. Average weekly weight of quails and average daily gain during the rearing period (LSM± SE)

Parameter (g)	Group			P Value
	C (Control)	E1 (2%)	E2 (4%)	
Weight at d1	6.89 ± 0.01	7.02±0.01	6.98±0,01	0.601
Weight at W1	28.01± 0.48	28.62±0.49	27.79±0.68	0.465
Weight at W2	65.37± 0.88	66.35±0.89	65.19±0.87	0.610
MDG at W1-W2	4.18± 0.06	4.24±0.06	4.16±0.06	0.643
Weight at W3	113.3± 1.28	113.8±1.31	112.1±1.29	0.628
Weight at W4	151.3± 1.50	152.5±1.53	154.3±1.50	0.359
Weight at W5	178.1± 1.75 [a]	181.6±1.80 [ab]	184.1±1.76 [b]	0.055
MDG W3-W5	5.37± 0.09 [a]	5.49±0.09 [ab]	5.65±0.09 [b]	0.101
MDG W1-W5	4.89± 0.05 [a]	4.99±0.05 [ab]	5.06±0.05 [b]	0.063

[a,b] Means with different letters on the same row differ significantly (P<0.05) MDG; mean daily gain. W: week.

TABLE 3. Variation in feed intake and feed conversion ratio during the rearing period (LSM± SE).

Parameter (g)	Group			P Value
	C (Control)	E1 (2%)	E2 (4%)	
Daily feed intake at W1	3.11±0.61	8.38±0.61	8.63±0.61	0.643
Daily feed intake at W2	20.59±0.83	19.73±0.83	18.37±0.83	0.180
Daily feed intake at W3	23.62±0.85	22.55±0.85	22.27±0.85	0.468
Daily feed intake at W4	30.39±1.66	29.22±1.66	28.73±1.66	0.772
Daily feed intake at W5	38.74±1.61	35.35±1.61	34.59±1.61	0.172
Total feed intake	854.2±7.46 [a]	804.5±7.67 [b]	788.6±7.49 [b]	<0.0001
Global daily feed intake	24.4±0.21 [a]	23.0±0.22 [b]	22.5±0.21 [b]	<0.0001
Feed conversion	5.04±0.06 [a]	4.65±0.06 [b]	4.51±0.06 [b]	<0.0001

[a,b] Means with different letters on the same row differ significantly (P<0.05). W: week

TABLE 4. Some of blood plasma parameters of quails among the experimental groups (LSM± ES)

Parameter	Group			P Value
	C (Control)	E1 (2%)	E2 (4%)	
Glucose (mg/dl)	3.15±0.13	3.44±0.13	7.32±0.12	0.799
Triglycerids (mg/dl)	2.39±0.54	2.49±0.53	3.15±0.50	0.529
Cholesterol (mg/dl)	1.86±0.11	1.88±0.11	1.87±0.10	0.862
Total proteins (g/dl)	23.62±5.04	28.94±4.84	27.55±4.51	0.951
Urea (mg/l)	0.11±0.01	0.11±0.01	0.11±0.01	0.212
Creatinin (mg/dl)	3.64±2.45	3.79±2.45	4.18±2.42	0.708
Uric Acid (mg/dl)	318.27±57.57	276.76±52.57	330.27±58.62	0.344

TABLE 5. Comparison of slaughter parameters of quails among the experimental groups (LSM± ES)

Parameter (g)	Group			P Value
	C (Control)	E1 (2%)	E2 (4%)	
Final live weight	181.3±35.23	184.7±35.29	189.7±35.23	0.304
Hot carcass	137.6±2.55	139.5±2.65	143.3±2.65	0.314
Liver	3.90±0.16	3.79±0.16	4.13±0.16	0.304
Heart	1.52±0.04[a]	1.66±0.04[b]	1.73±0.04[b]	0.001
Full gizzard	4.87±0.15	4.84±0.15	4.94±0.15	0.879
Empty gizzard	3.40±0.11	3.43±0.11	3.36±0.11	0.908
Pro-ventricle	0.75±0.03	0.76±0.03	0.79±0.03	0.616

[a,b] Means with different letters on the same row differ significantly (P<0.05)

References

1. Mahmoudi, N., Ikhlef, H., Kaci, A. and Mahmoudi, S. Évaluation de la durabilité socioéconomique des ateliers avicoles à M'sila (Algérie). New medit : *Revue méditerranéenne d'économie, agriculture et environnement*, **18**(4), 65- 77 (2019).
2. Belaid-Gater, N., Mouhous, A., Saidj, D. and Kadi, S.A. Production performances of the poultry-laying sector in Algeria: data analysis of a table eggs production complex. *Revue Agrobiologia* **13**(1), 3333-3341 (2023).
3. Belaid-Gater, N., Mouhous, A., Saidj, D. and Kadi S.A. Effect of Quantitative Feed Restriction during the Growing Period on Growth Performance and Economical Efficiency in Broiler Chickens. *Veterinarija ir Zootechnika* **80**(1), 28-34 (2022).
4. Lukanov, H. Domestic quail (*Coturnix japonica domestica*), is there such farm animal? *World's Poultry Science Journal,* **75**(4), 547-558 (2019).
5. Lukanov, H. and Pavlova, I. Domestication changes in Japanese quail (*Coturnix japonica*): a review. *World's Poultry Science Journal,* **76**(4), 787-801 (2020).
6. Santhi, D. and Kalaikannan, A. Japanese quail (*Coturnix coturnix japonica*) meat: characteristics and value addition. *World's Poultry Science Journal*, **73**(2), 337-344 (2017).
7. Ukashatu, S., Bello, A., Umaru, M.A., Onu, J.E., Shehu, S.A., Mahmuda, A. and Saidu, B.A. Study of some serum biochemical values of japanese quails (*Coturnixcoturnix japonica*) fed graded levels of energy diets in North western Nigeria. *Scientific Journal of Microbiology*, **3**(1), 1-8 (2014).
8. Djitie Kouatcho, F., Kana, J.R., Ngoula, F., Nana, N.F.C. and Teguia, A. Effet du niveau de protéines brutes sur la croissance et la carcasse chez la caille (*Coturnix sp*) en phase de finition dans les Hautes Terres du Cameroun. *Livestock Research for Rural Development*, **27** (8), 1-10 (2015).
9. Leclercq, B. Energy requirements of avian species. In : Fisher C. and Boorman K.N (eds), *Nutrient Requirements of Poultry and Nutritional Research*, 125-141. *Butterworths, London* (UK) (1986).
10. Bilal, R.M., Liu, C., Zhao, H., Wang, Y., Farag, M.R., Alagawany, M., Hassan, F., Elnesr, S.S., Elwan, H.A.M., Qiu, H. and Lin, Q. Olive oil: nutritional applications, beneficial health aspects and its prospective application in poultry production. *Frontiers in Pharmacology*, **12** (2021).
11. Anses (*Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail*) Actualisation des Apports Nutritionnels Conseillés pour les acides gras- *Rapport d'expertise collective.* Mai 2011, erratum juillet (2011).
12. Habeeb, A.A.M., Gad, A.E., El-Tarabany, A.A., Mustafa, M.M. and Atta, M.A.A. Using of Olive Oil By-Products In Farm Animals Feeding. *International Journal of Scientific Research in Science and Technology.* 3(6),57-68 (2017).
13. Amrouni-Sais, H., Fethallah, R. and Fahas M. Les exploitations oléicoles en Algérie ; quelle performance économique ? *Recherche Agronomique*, Vol. **19** (1), 65-76 (2021).
14. Özbey, O., Yildiz, N.and Esen, F. The effects of high temperature on breeding characteristics and the living strength of the Japanese quail (Coturnix Coturnix Japonica). *International journal of Poultry Science*, **5**(1), 56 -59 (2006).
15. Almeida, M.I.M., Oliveira, E.G., Ramos, P.R., Veiga, N. and Dias, K. Growth performance of meat male (Coturnix sp) of two lines nutritional environments. *Archives of Veterinary Science,* **7**(2), 103-108 (2002).
16. Adeogun, I.O. and Adeoye, A.A. Heritabilities and phenotypic of growth performance traits in Japanese quails. *Livestock Research For Rural Development,* **16**(12) (2004).
17. Fraga, L.M., Lon wo, E. and Palma, A. Utilization of offal fat in broiler feeding. *Revista Cubana de ciencia avicola,* **16** (2), 111–116 (1989).
18. Nazligul, A., Urkyilmaz, K.T. & Ardakcioglu, B.H.E. A study on some production traits and egg quality characteristics of Japanese quail. *Turk. J. Vet. Anim. Sci.*, 25, 1007-1013 (2001).
19. Djouvinov, D. and Mihailov, R. Effect of low protein level on performance of growing and laying Japanese quails (*Coturnix coturnix Japonica*). *Bulgarian Journal of Veterinary Medicine,* **8**(2), 91–98 (2005).
20. Veldkamp, T., Kwakkel, R.P., Ferket, P.R. and Verstegen, M.W.A. Growth response to dietary energy and lysine at high and low ambient temperature in male turkeys. *Poultry Science Journal*, **84,** 273-282 (2005).
21. Scott, M.L., Nesheim, M.C. and Young, R.J. Nutrition of chicken. Ed. By M.L. *Scott and associates Publishers*. Ithace, NewYork **14850**, 555 (1976).
22. Lessire, M. Qualité des viandes de volaille : le rôle des matières grasses alimentaires. *INRA Productions Animales,* **8**(5), .335-340 (1995).
23. Dale, N.M. and Fuller, H.L.T. (The True Metabolizable Energy of fats at low-level dietary inclusion. *Poultry Science,* **61**, 2415 – 2420 (1982).
24. Ciewe Ciake S.A. Evaluation de l'effet de la nature et de niveau de la matière grasse alimentaire sur la productivité du poulet de chair. Thèse. Méd. Vét :Dakar, Senegal, p100 (2006).
25. Parigi-Bini, R. Bases de l'alimentation du bétail. Padoue Nella litographia felicis partaco.292p (1986).
26. Van Elswyk, M.E., Hatch, S.D. and Stella, G.G. Poultry-based alternatives for enhancing the ω 3 fatty acid content of American diets. *World Rev Nutr Diet*, **83**, 102-105 (1998).
27. Galea, F., Bourdillon, A. and Rouillère, H. Effets de différents niveaux et sources alimentaires d'acides gras polyinsatures omega 3 sur le profil en acides gras de l'œuf chez la poule pondeuse. *Sixièmes Journées de la Recherche Avicole,* St Malo, (2005).
28. Cangullari, S., baylan, M., sahinler, N. and sahin, A. Effects of propolis and pollen supplementations on growth performance and body components of japenese quails (*coturnix coturnix japonica*). *archiv fur Golflugelkunde,* 73(3), 173-178 (2009).
29. Varkoohi, S., Pakdel, A., Morai, M., Nejati, A., Kause, A. and Zaghari, M. Genetic parameters for feed utilization traits in Japanese quail. *Poultry science*, **90**, 42-47 (2011).

30. Larbier, M. and Leclercq, B. Nutrition et alimentation des volailles. *Institut National de la Recherche Agronomique* **274** (1992).

31. Leclercq, B., Simon, J. and Ricard, F.H. Effects of selection for high and low plasma glucose concentration in chickens. *Br. Poult. Sci.,* **28**, 557-566 (1987).

32. Scholtz, N., Halle, I., Flachowsky, G. and Sauerwein, H. Serum chemistry reference values in adult Japanese quail (*Coturnix coturnix japonica*) including sex related differences. *Poultry Science,* **88**(6), 1186-1190 (2009).

33. Lamant, M. Caractérisation d'une Nouvelle apolipoproteine humaine, l'Apo O. Université Paul Sabatier - Toulouse III. *Thèse de Doctorat*. p 238 (2006).

34. Kouakou, N.D.V., Koffi, K.F., Cho E., Angbo-Kouakou, M., Koné, G.A., Kouassi, G.F., Amoikon, K.E. and Kouba, M. Enrichissement en acides gras polyinsaturés oméga 3 du jaune d'œuf de cailles (*Coturnix japonica*) par les graines d'euphorbe (*Euphorbia heterophylla*). *Revue d'Élevage et de Médecine Vétérinaire des Pays Tropicaux,* **70**(3), 99–103 (2017).

35. Hassan, I. and Leclercq, B. Facteurs alimentaires favorable à la stéatose par sur alimentation du poulet. *Ann .Biol. Anim. Bioch. Biophys.* **12**(1), 69-76 (1971).

36. Kaneko, J.J., Harvey, J.W. and Bruss, M.L. Diagnostic enzymology of domestic animals chapter: 12 In *Clinical Biochemistry of Domestic Animals,* (**Sixth Ed**): 354-355 (2008).

37. Tufan, T., Arslan, C., Durna, Ö., Önk, K., Sarı, M. and Erman, H. Effects of chitooligosaccharides and L-carnitine supplementation in diets for Japanese quails on performance, carcass traits and some blood parameters. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia,* **67**(1), 283-289 (2015).

38. Ayub, A.M., Hmar, L., Inaotombi Devi, L., Prava, M., Lallianchhunga, M.C. and Tolenkhomba, .TC. Effect of age on the haematological and biochemical profile of Japanese quails (*Coturnixcoturnix japonica*). *International Multidisciplinary Research Journal* **2**(8), 32-35 (2012).

39. Kabir, A. Blood chemistry analyses of Japanese quail (*Coturnix coturnix Japonica*). *Scholarly Journal of Agricultural Science,* **3**(4), 132-136 (2013).

40. Hochleithner, M. Biochemistries section two patient evaluation chapter 11: *In Avian medicine*: principles and applications. *Wingers Publishing, Ink,* Lake Worth, Florida: 1-23(1994).

41. Lumeij, J.T. and Westerhof, I. Blood chemistry for the diagnosis of hepatobiliary disease in birds. *Vet Quarterly* **9**, 255-261(1987).

42. Konca, Y., Cimen, B., Yalcin, H., Kaliber, M. and Buyukkilic Beyzi, S. Effect of hempseed (*Cannabis sativa sp*.) inclusion to the diet on performance, carcass and antioxidative activity in Japanese quail (*Coturnix coturnix japonica*). *Korean Journal for Food Science of Animal Resources,* **34** (2), 141-150 (2014).

43. Guluma, L.Y., Madaki, Y.A., Machido, H., Dantayi, R.J. and Kulokom, S. Growth performance and carcass evaluation of quails fed graded levels of water soaked Sweet Orange Peel Meal (SOPM). *Advances in Life Science and Technology*, **20**, 1-6 (2014).

44. Nilforoush, H.M., Toghyani, M. and Irandoust, H. Growth performance and gut development of Japanese quails (*Coturnixcoturnix japonica*) fed diets with different ratio of mash and pellet. *International Journal of Poultry Science*, **14** (6), 359-363 (2015).

45. Khaksar, V., Krimpen, M., Hashemipour, H. and Pilevar, M. Effects of thyme essential oil on performance, some blood parameters and ilealmicroflora of Japanese quail. *Journal of Poultry Science*, **49**, 106-110 (2012).

46. Makinde, O.J., Sekoni, A.A., Babajide, S., Samuel, I. & Ibe, E. Comparative response of Japanese quails (*Coturnixcoturnix japonica*) fed palm kernel meal and brewer's dried grain based diets. *International Journal of Agriculture and Biosciences,* **2** (5), 217-220 (2013).

47. Stanquevis, C.E., Cambito de Paula, V.R., Zancanela, V.T., Benites, M.I., Finco E.M., De Aquino, D.R., Moretto Rodrigues, T.P.P, and Marcato, S.M. Levels of vitamin A supplementation for growing meat-type quails. *Emerging Animal Species* **4**, 100008 (2022).

48. Huart, A. Alimentation: les besoins du poulet de chair, dans *Eco-Congo agriculture*, 1-5 (2004).

49. Akiba, Y. & Matsumoto, A. Effects of dietary fibers on lipid metabolism in liver and adipose tissue in chicks. *The Journal of Nutrition,* **112**, 1577-1585 (1982).

50. Attia, Y.A., Abd El-Hamid, A.E., Ellakany, H.F., Bovera, F., Al-Harthi, M.A. & Ghazaly, S.A. Growing and laying performance of Japanese quail fed diet supplemented with different concentrations of acetic acid. *Italian Journal of Animal Science*. **12** (2), 222-230 (2013).

51. Tarhyel, R., Tanimomo, B.K. and Hena, S.A. Organ weight: as influenced by color, sex and weight group in Japanese quail. *Scientific Journal of Animal Science*, **1**(2): 46-49 (2012).

52. Rajkumar, U., Reddy, M.R., Rajaravindra, K.S., Niranjan, M., Bhattacharya, T.K., Chatterjee, R.N., Panda, A.K., Reddy, M.R. and Sharma, R.P. Effect of Naked Neck gene on immune competence serum biochemical carcass traits in chickens under tropical climate. *Asian-Australian Journal of Animal Science,* **23**(7), 867-872 (2010).

53. Michas, G. Dietary fats and cardiovascular disease: putting together the pieces of a complicated puzzle. *Atherosclerosis*, **234**, 320-328 (2014).

54. Sacks, F.M., Lichtenstein, A.H. and Wu, J.H.Y. Dietary fats and cardiovascular disease. A presidential advisory from the American Heart Association. 18; 136 (3):e1-e23(2017).

55. Hena, S.A., Sonfada, M.L., Danmaigoro, A., Bello, A. and Umar, A.A. Some comparative gross and morphometrical studies on the gastrointestinal tract in pigeon (*Columbia livia*) and Japanese quail (*Coturnix japonica*). *Scientific Journal of Veterinary Advances,* **1**(2), 57-64 (2012).

إضافة زيت الزيتون إلى علف السمان الياباني: تأثيره على الأداء التقني في مجال تربية الحيوانات والخصائص البيو كيميائية وخصائص الذبيحة

ضاحية سعيد [1,2]*، زاهية دربان [3]، رزيقة بوكرت [1]، وهيبة زين[1]، لويزة فرحات[1]، نور الهدى بالبشير[1]، نسيم مولى [4]، حكيمة مفتي قرطبي [1] وسي عمار القاضي [3]

[1] معهد العلوم البيطرية، جامعة سعد دحلب، ص.ب. 270، طريق الصومعة، 09000. البليدة، الجزائر.

[2] مختبر الصحة والإنتاج الحيواني، المدرسة الوطنية العليا للطب البيطري، وادي السمار، الجزائر، الجزائر.

[3] قسم العلوم الزراعية، كلية العلوم البيولوجية والزراعية. جامعة مولود معمري، تيزي وزو، الجزائر.

[4] البحوث الأساسية والتطبيقية للحيوان والصحة (فرح)، جامعة لييج، شارع كولونستر، 20، المبنى B43، 4000 لييج، بلجيكا.

الملخص

يهدف هذا العمل إلى دراسة تأثير إضافة زيت الزيتون إلى غذاء السمان بنسب مختلفة: المجموعة الضابطة C (0%)، المجموعة E1 (2%)، المجموعة E2 (4%). تم تقسيم 360 سمان بعمر يوم واحد عشوائياً إلى ثلاث مجموعات كل منها 120 فرداً وتم تربيتها على الأرض لمدة خمسة أسابيع. تم تسجيل وزن الحيوانات وكمية العلف التي تناولتها أسبوعياً. أظهرت النتائج أن السمان الذي تغذت على زيت الزيتون أظهر أداءً حيوانياً أفضل (متوسط الوزن الحي، ومتوسط المكسب اليومي ونسبة التحويل الغذائي) من المجموعة الضابطة، مع تأثير أفضل في المجموعة E2. كان متوسط الأوزان الحية في الأسبوع الخامس 184.1 جرام لمجموعة E2؛ 181.6 جرام لمجموعة E1 مقابل 178.1 جرام لمجموعة C، وهو ما يتوافق مع متوسط مكاسب الوزن 5.1؛ 5.0 و 4.9 على التوالي. يبدو أن معدل التحويل الغذائي يتأثر بشكل إيجابي بإضافة زيت الزيتون حيث أنه يتراوح من 5.04 في المجموعة ج إلى 4.51 في المجموعة هـ2 و4.65 في المجموعة هـ1. وعلاوة على ذلك، فإن إضافة زيت الزيتون لم تغير معايير الدم للحيوانات ولا وزن الذبائح والأعضاء، باستثناء وزن القلب، حيث كان السمان في المجموعة هـ2 هو الأثقل (P=0.001). لذلك، قد يمثل زيت الزيتون بديلاً مثيرًا للاهتمام لتحسين كفاءة تغذية السمان الياباني. ومع ذلك، هناك حاجة إلى مزيد من الدراسات لتقدير الكفاءة الاقتصادية لهذه الاستراتيجية وكذلك المعدل الأمثل لإضافة زيت الزيتون.

الكلمات الدالة: السمان الياباني، زيت الزيتون، الأداء التقني الحيواني، معايير الذبيحة.