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Valorization of Cashew Industry By-Products in the Diet of Laying Quails (*Coturnix japonica*, Temminck and Schlegel, 1849): Effects on Carcass Traits and Egg Quality

Amani N'Dri Saint-Clair[1*], Loukou Ghohono Angelina[2], Alla Konan Jean Bedel[1], Coulibaly Aboubacar Sié[1], Ganantoré Séydou[1], Coulibaly Moriféré[1] and Ouattara Howélé[1]

[1]*Peleforo GON COULIBALY University, Department of Animal Biology, Korhogo, Côte d'Ivoire*
[2]*Nangui ABROGOUA University, Animal Biology and Cytology Laboratory, 02 BP 801 Abidjan 02, Côte d'Ivoire*

**Corresponding author*

Abstract

The use of readily available, low-cost raw materials in poultry farming is a major asset for its success. Thi study assesses the effect of apple bagasse and cashew nut meal in the diet of laying quails on carcass yield and egg physical characteristics. A total of 270 day-old quails were randomly divided into three groups of 30 animals with two replicates. Three types of feed (control feed, 25% feed, 50% feed) were randomly assigned to the different groups. After eight weeks of rearing, 12 animals, including six males and six females, were randomly selected by treatment and sacrificed for carcass yield analysis. During egg laying, egg measurements were taken for eight weeks. The results show that carcass yield did not vary significantly between diets ($P > 0.05$). The proportions of the breastbone and thigh were not influenced by the feed. However, significant variations were observed between treatments in the proportions of the wings ($P = 0.008$) and back ($P < 0.05$) regardless of sex. As for the proportions of visceral organs, there was no significant variation in the heart, but this was not the case for the liver ($p= 0.002$) and gizzard ($P < 0.05$). There was a significant variation in weight ($P = 2$ x 10-16) and egg shape index ($p= 0.015$). The yolk index and Haugh unit did not vary significantly ($P > 0.05$). These results reveal that apple bagasse and cashew nut meal could be used in combination in quail feed.

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Keywords

Egg, carcass, cashew apple bagasse, cashew nut meal, quail

Introduction

Quail farming has several advantages due to its short production cycle (Duymus *et al.,* 2013) and the low cholesterol content of its eggs, which has earned it the name "diet egg" (Genchev, 2012).

In addition, like its eggs, quail meat is rich in protein and contains vitamins B3, B9, with a low fat content (Duymus *et al.,* 2013). Furthermore, quails are more resistant to disease (Mondry, 2016). Despite these many advantages, Kokoszyński *et al.,* (2024) assert that it was in the 20th century that it was discovered that quails produced more eggs than other poultry species.

As a result, global egg production has risen to 1.3 million tonnes and meat production to 240,000 tonnes (Lukanov *et al.,* 2023).

Despite these impressive results, quail farming faces numerous challenges in Côte d'Ivoire. Certain inputs, such as corn and soybeans used in feed production, are also consumed by the population. Furthermore, wheat bran, a source of fibre, is imported. All these factors lead

to higher raw material prices. However, in poultry farming, feed accounts for 80% of production costs (Yao, 2023).

In this context, due to its high protein content (35% of dry matter) and its rich polyunsaturated fatty acid content, cashew nut meal could be an ideal substitute for soya meal in quail feed (Akande *et al.,* 2015; Panaite *et al.,* 2017). At the same time, fibre-rich apple bagasse (Prommajak *et al.,* 2014) could be used as a source of fibre to replace wheat bran. With this aim of promoting the use of cashew by-products, Dembélé *et al.,* (2015) evaluated the effect of cashew cake on the growth performance and mortality of meat quails. In addition to this work, this study was conducted to evaluate the effect of apple bagasse and cashew nut cake in the diet of laying quails, specifically on carcass yield and the external and internal physical characteristics of eggs.

Materials and Methods

Study site

This work was carried out at the experimental farm of Peleforo GON COULIBALY University in the town of Korhogo, located in northern Côte d'Ivoire, approximately 568 km from Abidjan. The climate is Sudanese, with two seasons: a dry season marked by the Harmattan wind from November to April, and a rainy season from May to October (Boko-Koiadi *et al.,* 2016). Temperatures range from 24°C to 33°C (Boko-Koiadi *et al.,* 2016).

Conducting the trial

A total of 270 day-old chicks with an average weight of 8.14 ± 0.56 g were randomly divided into cages in three groups of 30 animals each with two replicates. Three types of feed were used in this experiment. These were the control feed (At), which is commercially available feed intended for broiler chickens and used by guinea fowl farmers. The 25% feed (A25%) contained 25% apple bagasse and cashew nut meal, and the 50% feed (A50%) contained 50% apple bagasse and cashew nut meal. The biochemical characteristics of the feeds are presented in Table 1.

These feeds were randomly assigned to each batch. The starter feed was distributed for two weeks, followed by the grower feed until the eighth week. Subsequently, the layer feed was distributed. A 3 day feed transition period was observed between each rearing phase.

Data collection

Carcass yield and proportion of different parts

For this study, 12 animals, including 6 males and 6 females, were randomly selected per treatment. They were weighed before being slaughtered. The carcass was evaluated using the method described by Genchev and Mihaylov (2008). The weight of the carcass (without the head, feet, feathers and viscera), head, neck, breastbone, wings, thighs, feet and certain organs such as the liver, heart and gizzard were recorded. All these data were used to calculate the carcass yield and the proportions of the different parts and organs according to the calculation method of Kouatcho *et al.,* 2015.

$$Carcass\ yield = \frac{Carcass\ weight}{Live\ weight} \times 100$$

Carcass weight: weight of the plucked quail without the head, viscera, head and neck

$$Proportion\ of\ the\ organ\ or\ part = \frac{Weight\ of\ the\ organ\ or\ part}{Live\ weight} \times 100$$

External and internal physical characteristics of eggs

After eight weeks of rearing, the male quails were removed from the cages, leaving only the females for the study of egg characteristics. From the start of laying, the eggs were collected weekly and labelled according to treatment. At the end of each week, the eggs were weighed and their height and diameter measured before being broken. The weight of the contents was recorded, then the height and length of the albumen and yolk were measured using a calliper. This stage lasted eight weeks. These data were used to calculate the shape index (SI), yolk index (YI) and Haugh unit (HU) (Haugh, 1937) according to the following formulas:

SI = (Egg diameter / Egg length) * 100 (Nedeljka, 2006)

YI = (Yolk thickness / Yolk diameter) * 100 (Nedeljka, 2006)

$HU = 100 * Log (h + 7{,}57 - 1{,}7 * W^{0,37})$ (Berto *et al.,* 2007)

h: height of the albumen ; W: weight of the egg; 7.57: correction factor for the height of the albumen; 1.7: correction factor for the weight of the egg

Statistical analyses

The normality of the data was verified using the Shapiro-Wilk test, while the equality of variances was verified using Levene's test. In cases of equal variance, the means were compared using the ANOVA 1 test followed by Tukey's post-hoc test. Otherwise, they were compared using the non-parametric Kruskal-Wallis test followed by Dunn's post-hoc test. All these tests were performed using R software version 4.3.0.

Results and Discussion

Carcass yield and proportion of parts and organs

Carcass yield and the proportions of the parts generally consumed are shown in Table 2. Carcass yield ranged from 69.44 ± 2.38 % to 82.43 ± 15.72 % in males and from 69.89 ± 0.95 % to 70.76 ± 3.03 % in females. For both sexes combined, the yield ranged from 69.98±2.58% to 76.16 ± 12.47 %. However, these yields did not vary significantly between diets, regardless of the sex of the birds. As for the proportion of the breastbone, there was no significant difference between diets regardless of sex. The same was true for the proportions of the thighs. The wings of male quails fed the 50% feed had higher average proportions (8.78 ± 1.35 %) than those of animals fed the control feed (6.96 ± 0.64 %) and 25% feed (6.97 ± 0.81 %) ($p < 0.05$). The back proportions were significant between feeds regardless of sex. It was lower in animals fed the 50 % feed in males ($p = 0.003$), females ($p = 6.2 \times 10^{-4}$) and all sexes combined ($p = 7.9 \times 10^{-6}$). These proportions were 13.9 ± 1.99 %, 13.9 ± 1.99 % and 5.98 ± 2.78 % respectively for the control groups, 25% and 50% for all sexes combined.

The proportions of secondary parts consumed and visceral organs relative to carcass weight are shown in Table 3.

The average proportions of the head for all sexes combined were significantly higher ($p = 5.7 \times 10^{-6}$) in the control and 25% groups, with respective values of 4.42 ± 1.31 % and 4.35 ± 0.41 %, than in the 50% group (2.01 ± 0.43 %). At the neck level, the proportions varied significantly ($p = 0.038$) from one feed to another in males. With regard to the heart, the feeds tested had no significant effect on the different proportions regardless of sex. These values were 0.8 ± 0.09 % (At), 0.89 ± 0.1 % (A25%) and 0.87 ± 0.22 % (A50%) for all sexes combined. The proportions of livers were significantly ($p = 0.002$) higher in animals fed the 25% (2.43 ± 0.5 %) and 50% (2.43 ± 0.3 %) diets than in those fed the control diet (1.9 ± 0.32 %) for all sexes combined. As for the gizzard, its proportion varied significantly ($p = 5.3 \times 10^{-4}$) from one diet to another regardless of the sex of the quails, with a high average value in quails fed the 50% feed (2.86 ± 0.77 %) and a low value in the control group (2.05 ± 0.26 %).

Weight of eggs

Table 4 shows the average weight of eggs recorded for the different quail batches during the experimental period. Except for week 2, the average weights of eggs from the 25% and 50% Feed batches were significantly higher during the other weeks of laying. During the first week, the egg weights of the 25% diet (11.56 ± 1.4 g) were significantly ($p= 0.008$) the highest, while the lowest weights were recorded for the control feed eggs (10.52 ± 0.92 g). In week eight, the average egg weights were 110.95 ± 3.57 g, 12.13 ± 0.94 g and 11.95 ± 0.78 g for the control, 25% and 50% treatments, respectively.

External physical characteristics of eggs

The external physical characteristics of the eggs throughout the experimental period, namely the average egg weight, egg length, egg diameter and shape index of the quails in the different treatment groups, are recorded in Table 5. Analysis of this table reveals an overall average weight of 11.75 ± 1.08 g and 11.66 ± 1.16 g for the 25% and 50% diets, respectively, which is significantly higher ($p = 2 \times 10^{-16}$) than that of the control diet (10.43 ± 1.58 g).

The eggs of quails on the experimental diets were significantly larger than those on the control diet. However, they remained comparable. The same was true for the average length of eggs from the three diets, with values of approximately 33 mm for the 25% and 50% diets and 31.35 mm for the control diet. Egg diameters were positively and significantly ($p = 2.2 \times 10^{-16}$) influenced by the 25% and 50% diets, with respective values of 25.89 ± 0.78 mm and 25.69 ± 0.88 mm. Unlike the other parameters, the egg shape index recorded was higher ($p = 0.015$) for eggs from the control diet (79.66 ± 4.91 %) than for those from the 25% (78.60 ± 3.39 %) and 50% (78.33 ± 4.42 %) diets.

Internal physical qualities of eggs

The internal physical quality of the eggs throughout the experimental period is recorded in Table 6. The weights

of the egg contents from the 25% and 50% treatments were identical, with values ranging from 9.88 ± 1.14 g to 9.99 ± 1.09 g. However, they were significantly higher than those from the control treatment. The height of the albumen was greater ($p = 3.4 \times 10^{-5}$) in the eggs from the 25% treatment, with a value of 47.10 ± 5.16 mm, compared to that recorded in the other treatments. The eggs from the experimental treatments recorded significantly higher vitellus lengths and heights, with values ranging from 29.47 ± 3.38 mm and 29.39 ± 2.74 mm to 7.04 ± 1.48 mm and 6.78 ± 1.29 mm, respectively. The yolk index did not vary significantly (p = 0.285) between diets. Its values ranged from 23.29 ± 5.11 % to 24.29 ± 6.50 %. Like the yolk index, the Haugh unit did not vary significantly (p = 0.097) between diets. Its values ranged from 80.38 ± 4.11 to 81.16 ± 5.03.

With regard to the discussion, it should be noted that carcass yield did not vary between feeds regardless of sex. It ranged from 69.98 ± 2.58 % to 76.16 ± 12.47 % for all sexes combined. These values are consistent with those reported by Sharifi *et al.,* (2025), who obtained carcass yields of 72.53 % and 74.09 % for male and female quails raised in free-range systems, respectively. Awan *et al.,* (2017), Kokoszynski *et al.,* (2024) and Kouatcho *et al.,* (2025) found carcass yields in the same range as our values. Our results, compared to those of the above-mentioned studies, indicate that apple bagasse and cashew nut meal would produce interesting results in terms of carcass yield. However, Lukanov *et al.,* (2021), working on the effect of different fattening periods on the meat productivity of domestic quails, found lower carcass yields of 61.77 ± 0.63 % for males and 57.52 ± 0.98 % for females.

Table.1 Biochemical characteristics of feed distributed to quails

Parameter	Start-up			Growth			Ponte		
	At	A25%	A50%	At	A25%	A50%	At	A25%	A50%
Crude protein (%)	20.5	20.51	19.35	19	17.51	16.63	16	18.77	17.72
Crude fat (%)	3.5	3.88	4.93	4.5	3.7515	4.526	4	3.643	4.569
Crude fibre (%)	4.3	3.33	3.24	3.9	3.25	3.21	3	3.36	3.31
Metabolisable energy Kcal/kg	2941.43	2959.44	3047.38	3050.57	2921.44	2995.16	2916	2765.18	2851.65

At: control feed without bagasse or cashew nut cake; A25%: feed with 25% apple bagasse and cashew nut cake incorporated; A50%: feed with 50% apple bagasse and cashew nut cake incorporated.

Table.2 Effect of apple bagasse and cashew nut cake on carcass yield and proportions of the most consumed parts in relation to carcass weight

Parameters (%)	Sexe	Diet			P-value
		At	A25%	A50%	
Carcass	Male	71.35 ± 1.17 [a]	69.44 ± 2.38 [a]	82.43 ± 15.72 [a]	0.191
	Female	70.76 ± 3.03 [a]	70.52 ± 2.87 [a]	69.89 ± 0.95 [a]	0.822
	Average	71.05 ± 2.21 [a]	69.98 ± 2.58 [a]	76.16 ± 12.47 [a]	0.475
breast	Male	29.48 ± 3.49 [a]	26.14 ± 6.82 [a]	51.75 ± 28.02 [a]	0.121
	Female	27.58 ±2.84 [a]	29.16 ± 2.54 [a]	29.72 ± 2.2 [a]	0.345
	Average	28.53 ± 3.19 [a]	27.99 ± 4.64 [a]	40.74 ± 22.17 [a]	0.115
Thighs	Male	16 ± 0.43 [a]	21.13 ± 9.43 [a]	18.21 ± 3.74 [a]	0.926
	Female	15.58 ± 0.96 [a]	15.88 ± 0.77 [a]	15.61 ± 0.69 [a]	0.786
	Average	15.79 ± 0.74 [a]	18.5 ± 6.94 [a]	16.91 ± 2.9 [a]	0.979
Wings	Male	6.96 ± 0.64 [a]	6.97 ± 0.81 [a]	8.78 ± 1.35 [b]	**0.008**
	Female	7.54 ± 1.46 [a]	11.83 ± 7.77 [a]	7.58 ± 1.7 [a]	0.173
	Average	7.25 ± 1.12 [a]	9.4 ± 5.84 [a]	8.18 ± 1.59 [a]	0.266
Back	Male	13.68 ± 2.76 [b]	11.44 ±1.54 [b]	7.43 ± 3.34 [a]	**0.003**
	Female	14.11 ± 0.99 [b]	10.4 ± 2.19 [ab]	4.53 ± 0.85 [a]	**6.2×10^{-4}**
	Average	13.9 ± 1.99 [b]	10.92 ± 1.88 [b]	5.98 ± 2.78 [a]	**7.9×10^{-6}**

At: control feed without bagasse or cashew nut cake; A25%: feed with 25% incorporation of apple bagasse and cashew nut cake; A50%: feed with 50% incorporation of apple bagasse and cashew nut cake.
The values in rows marked with the same letters are not statistically different at P > 0.05.

Table.3 Effect of apple bagasse and cashew nut cake on the proportions of secondary parts consumed and visceral organs relative to carcass weight

Parameters (%)	Sex	Diet			P-value
		At	A25%	A50%	
Head	Male	4.88 ± 1.78 ^{b}	4.33 ± 0.43 ^{b}	2.25 ± 0.36 ^{a}	**1.9 x 10^{-5}**
	Female	3.95 ± 0.29 ^{ab}	4.38 ± 0.43 ^{b}	1.92 ± 0.47 ^{a}	**0.001**
	Average	4.42 ± 1.31 ^{b}	4.35 ± 0.41 ^{b}	2.01 ± 0.43 ^{a}	**5.7 x 10^{-6}**
Neck	Male	4.82 ± 1.14 ^{a}	5.67 ± 1.51 ^{ab}	6.63 ± 1.51 ^{b}	**0.038**
	Female	5.19 ± 1.11 ^{a}	4.73 ± 1.96 ^{a}	5.86 ± 1.11 ^{a}	0.417
	Average	5 ± 1.09 ^{a}	5.2 ± 1.74 ^{a}	6.24 ± 1.32 ^{a}	0.082
Leg	Male	1.91 ± 0.12 ^{a}	1.95 ± 0.13 ^{a}	2.25 ± 0.36 ^{a}	**0.116**
	Female	2.03 ± 0.29 ^{a}	2.01 ± 0.13 ^{a}	1.92 ± 0.47 ^{a}	**0.674**
	Average	1.97 ± 0.22 ^{a}	1.98 ± 0.13 ^{a}	2.76 ± 0.43 ^{a}	**0.848**
Heart	Male	0.84 ± 0.11 ^{a}	0.87 ± 0.05 ^{a}	0.94 ± 0.22 ^{a}	0.281
	Female	0.77 ± 0.06 ^{a}	0.91 ± 0.14 ^{a}	0.79 ± 0.22 ^{a}	0.165
	Average	0.8 ± 0.09 ^{a}	0.89 ± 0.1 ^{a}	0.87 ± 0.22 ^{a}	0.359
Liver	Male	1.81 ± 0.31 ^{a}	2.28 ± 0.67 ^{a}	2.46 ± 0.4 ^{a}	0.083
	Female	1.99 ± 0.33 ^{a}	2.59 ± 0.22 ^{b}	2.39 ± 0.29 ^{ab}	**0.007**
	Average	1.9 ± 0.32 ^{a}	2.43 ± 0.5 ^{b}	2.43 ± 0.34 ^{b}	**0.002**
Gizzard	Male	2.05 ± 1.18 ^{a}	2.43 ± 0.41 ^{ab}	3.18 ± 0.95 ^{b}	**0.008**
	Female	2.04 ± 0.33 ^{a}	2.41 ± 0.14 ^{ab}	2.55 ± 0.39 ^{b}	**0.035**
	Average	2.05 ± 0.26 ^{a}	2.42 ± 0.29 ^{ab}	2.86 ± 0.77 ^{b}	**5.3 x 10^{-4}**

At: control feed without bagasse or cashew nut cake; A25%: feed with 25% incorporation of apple bagasse and cashew nut cake; A50%: feed with 50% incorporation of apple bagasse and cashew nut cake.
The values in rows marked with the same letters are not statistically different at P > 0.05.

Table.4 Effect of apple bagasse and cashew nut cake on the average weekly weight of quail eggs

Periods	Diets			P-value
	At	A25%	A50%	
Week 1	10.52 ±0.92 ^{a}	11.56 ±1.4 ^{b}	10.98 ± 0.69 ^{ab}	**0.008**
Week 2	11.20 ± 0.72 ^{a}	11.27 ± 1.17 ^{a}	11.08 ± 1.01 ^{a}	0.773
Week 3	10.02 ± 0.87 ^{a}	12.02 ± 0.92 ^{b}	11.92 ± 0.96 ^{b}	**3.9 x 10^{-14}**
Week 4	10.42 ± 0.96 ^{a}	11.83 ± 1.2 ^{b}	12.02 ± 1.39 ^{b}	**1.1 x 10^{-6}**
Week 5	10.13 ± 0.95 ^{a}	11.80 ±0.68 ^{b}	11.67 ± 1.42 ^{b}	**3.9 x 10^{-8}**
Week 6	10.18 ± 1.03 ^{a}	11.70 ± 0.97 ^{b}	11.83 ± 1.35 ^{b}	**7.3 x 10^{-8}**
Week 7	10.07 ± 0.95 ^{a}	11.69 ± 1.07 ^{b}	11.82 ± 1.07 ^{b}	**8.6 x 10^{-10}**
Week 8	10.95±3.57 ^{a}	12.13 ± 0.94 ^{b}	11.95 ± 0.78 ^{b}	**1.0 x 10^{-9}**

At: control feed without bagasse or cashew nut cake; A25%: feed with 25% incorporation of apple bagasse and cashew nut cake; A50%: feed with 50% incorporation of apple bagasse and cashew nut cake.
The values in rows marked with the same letters are not statistically different at P > 0.05.

Table.5 Effect of apple bagasse and cashew nut cake on the external physical quality of quail eggs

Parameters (%)	Diets			P-value
	At	A25%	A50%	
Weight of the egg	10.43 ± 1.58 [a]	11.75 ± 1.08 [b]	11.66 ± 1.16 [b]	**2 x 10^{-16}**
Length of the egg	31.35 ± 3.53 [a]	33.00 ± 1.65 [b]	32.90 ± 2.03 [b]	**6.7 x 10^{-14}**
Diameter of the egg	24.83 ± 0.96 [a]	25.89 ± 0.78 [c]	25.69 ± 0.88 [b]	**2.2 x 10^{-16}**
Shape index (%)	79.66 ± 4.91 [b]	78.60 ± 3.39 [ab]	78.33 ± 4.42 [a]	**0.015**

At: control feed without bagasse or cashew nut cake; A25%: feed with 25% incorporation of apple bagasse and cashew nut cake; A50%: feed with 50% incorporation of apple bagasse and cashew nut cake.
The values in rows marked with the same letters are not statistically different at P > 0.05.

Table.6 Effect of apple bagasse and cashew nut cake on the internal physical qualities of quail eggs

Parameters (%)	Diet			P-value
	Témoin	25%	50%	
Weight of contents	8,53 ± 0,97 [a]	9,99 ± 1,09 [b]	9,88 ± 1,14 [b]	**2 x 10^{-16}**
Albumin length	45,32 ± 5,27 [a]	47,10 ± 5,16 [b]	45,23 ± 4,72 [a]	**3,4 x 10^{-5}**
Albumin height	2,99 ± 0,80 [a]	3,16 ± 0,65 [b]	3,04 ± 0,60 [ab]	**0,023**
Length of the yolk	27,04 ± 3,36 [a]	29,47 ± 3,38 [b]	29,39 ± 2,74 [b]	**2,2 x 10^{-16}**
Height of the yolk	6,31 ± 1,29 [a]	7,04 ± 1,48 [b]	6,78 ± 1,29 [b]	**3 x 10^{-8}**
Yolk index (%)	23,41 ± 4,63 [a]	24,29 ± 6,50 [a]	23,29 ± 5,11 [a]	0,285
Haugh unit	81,16 ± 5,03 [a]	81,13 ± 4,18 [a]	80,38 ± 4,11 [a]	0,097

At: control feed without bagasse or cashew nut cake; A25%: feed with 25% incorporation of apple bagasse and cashew nut cake; A50%: feed with 50% incorporation of apple bagasse and cashew nut cake.
The values in rows marked with the same letters are not statistically different at P > 0.05.

The proportions of breast and thigh meat were not influenced by bagasse and cashew meal. The proportions of breast and thigh meat obtained by Sharifi *et al.,* (2025) were 57.64 % and 35.74 % for all sexes in a cage rearing system. These values are higher than those obtained in our work, which range from 27.53 ± 3.79 % to 40.74 ± 22.17 %. This could be related to the quail phenotype used in our work, which is a light breed with a live weight not exceeding 250 g. Inci *et al.,* (2016) report breastbone proportions comparable to ours. These were 28.9 ± 1.5 %, 25.9 ± 2.1 % and 27.5 ± 1.4 % for male, female and mixed quails, respectively. Unlike the average wing proportions, which did not vary from one feed to another, the back proportion was negatively influenced by the 50 % treatment. Kouatcho *et al.,* (2015) made the same observations on quails subjected to increasing levels of protein in their feed. The latter observed a low proportion at an incorporation rate of 22 % in the feed. The proportions of gizzards were significantly higher at the 50 % treatment level. This could be explained by intense gizzard activity in the digestion of the fibres contained in the bagasse. According to Getahun and Yemane (2025), the incorporation of fibre into poultry feed promotes the development of digestive organs such as the crop, gizzard and intestines. Amerah *et al.,* (2009) found an increase in the relative weight of the gizzard in broiler chickens when they incorporated fine cellulose and wood chips at a rate of 6 %. The same findings were observed in ducklings, whose gizzard weight increased when the crude fibre content in their feed was increased from 3.09 % to 7.52 % (Han *et al.,* 2017). The proportion of gizzard obtained in our work is comparable to that obtained by Coelho *et al.,* (2021), with values ranging from 2.1 7 % to 2.29 % in quails hatched from eggs incubated under different light colours. Contrary to the increase in gizzard weight with increasing fibre incorporation, the liver weight of chickens decreases with a diet rich in neutral detergent fibre (Han *et al.,* 2023). These results corroborate those observed in our work, where the proportion of liver is significantly lower in the control diet with a lower crude fibre content.

The eggs from the first and last weeks of laying had significantly higher average weights at the A25% and A50% levels. This shows that apple bagasse and cashew nut meal have a positive effect on the weight of quail eggs. The weights recorded in week 8 for treatments

A25% and A50% are higher than those recorded by Coelho *et al.,* (2021) and N'Guessan (2020), which ranged from 10.5 to 10.8 g at 60 days of laying and 10.35 g to 10.96 g at 6 months of laying, respectively. On the other hand, the weights obtained in the experimental batches are similar to those observed by Kouatcho *et al.,* (2025), which ranged from 11.11 ± 1.1 g to 12.05 ± 0.97 g.

The shape index is used to measure the mechanical strength of eggs (Hassan, 2010). The results showed that the combination of apple bagasse and cashew nut meal significantly influenced the shape index. The highest value was obtained in the control batch, at 79.66 ± 4.91 %. This value is well above the reference values, which should be between 70 % and 77 % (Nedeljka, 2006). This reflects the high calcium content in the control feed. These eggs would be suitable for consumption as they are resistant to transport shocks. However, their use for reproduction could result in a low hatch rate

Although outside the reference range, the shape indices obtained with the 25 % and 50 % feeds are close to the upper values (77 %). These eggs have lower mechanical resistance than those from the control feed. They can therefore withstand the jolts of handling for table eggs but can also be used for reproduction. Our results differ from those of N'Guesssan (2020), who obtained values ranging from 76.03 % to 77.41 % in quails fed diets containing different protein sources. Coffi (2025), evaluating the effect of combining apple bagasse and cashew nut cake in laying hens, obtained condition scores of 77.79 % and 77.83 % respectively at incorporation rates of 25 % and 50 % of these inputs. Conversely, our results corroborate those of Kouatcho *et al.,* (2022), who obtained condition scores of 78.82 ± 2.80 % and 78.60 ± 3.03 % respectively in white and spotted white quails. Similarly, Kouatcho *et al.,* (2025), incorporating Figuil limestone as a source of calcium at different rates in the diet, obtained shape index values of up to 80.19 %.

The yolk index is an indicator used to determine the freshness of an egg. According to DSM (2016), an egg is extra fresh when this index is above 0.38, fresh when it is between 0.28 and 0.38, and regular, i.e. of poorer quality, when it is 0.28. The yolk index of eggs from all three types of treatment was below 0.38 %. This could be explained by the storage time observed before measurements were taken. The eggs were collected over a week and stored at room temperature, which could reach up to 30°C, before measurements were taken. According to the work of DSM (2016), eggs stored for seven days at a temperature of 22°C gave a yolk index of approximately 0.37 %. Previous work carried out on quails gave yolk indexes of between 47.75 ± 3.0 % and 48.33 ± 4.1 % (Çetin, 2025), 40.97 ± 4.16 % (Kouatcho *et al.,* 2022) and between 42.66 ± 3.18 % and 45.15 ± 4.60 % (Kouatcho *et al.,* 2025).

The Haugh unit obtained in our work was 80. These results show that the combination of apple bagasse and cashew nut meal does not negatively affect the protein quality of quail eggs. Previous studies conducted by Coffi (2025) on the influence of combining apple bagasse and cashew nut meal on laying hen eggs have yielded the same results. Northcutt *et al.,* (2022) noted Haugh unit values above 80 in quail eggs stored for 0 to 90 days at 4°C.

In conclusion, we note that combining cashew nut meal and cashew apple bagasse in feed produced similar effects to commercial feed in terms of carcass yield and the proportions of breast, thigh and wing. Feeds containing 25 % and 50 % apple pomace and cashew nut cake resulted in higher proportions of gizzard and liver. These same feeds produced heavier, more solid eggs with good protein quality. These qualities are important parameters for farmers whose primary objective is financial profitability.

References

Akande, T. O., Akinwumi, A. O. and Abegunde, T. O. (2015). Cashew reject meal in diets of laying chickens: Nutritional and economic suitability. *Journal of Animal Science and Technology*, 57(17), 1-6. https://doi.org/10.1186/s40781-015-0051-7

Amerah, A. M., Ravindran, V. and Lentle R. G. (2009). Influence of insoluble fibre and whole wheat inclusion on the performance, digestive tract development and ileal microbiota profile of broiler chickens. *British Poultry Science*, 50(3), 366-375. https://doi.org/10.1080/00071660902865901

Awan, F. N., Shah, A. H., Soomro, A. H., Barahm, G. S. and Tunio, S. G. (2017). Carcass yield and physico-chemical characteristics of Japanese quail meat. *Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences*, 33(1), 111-120.

Berto, D. A., Garcia, E. A., Mori, C., Faitarone, A. B. G., Pelicia, K. and Molino A. B. (2007). Performance of Japanese quails fed feeds

containing different corn and limestone particle sizes. *Brazilian Journal of Poultry Science*, 9(3), 167-171. https://doi.org/10.1590/S1516-635X2007000300004

Boko-Koiadia, A. N. N., Guéladio, C., Brama, K. and Dedy, S. (2016). Variabilité Climatique Et Changements Dans L'environnement À Korhogo En Côte D'ivoire: Mythes Ou Réalité ? *European Scientific*, 12(5), 158-176. https://doi.org/10.19044/esj.2016.v12n5p158

Çetin, M. 2015. Utilization of soft pistachio hulls in Japanese quail diets for enhanced egg quality and yolk pigmentation. *PeerJ*, https://doi.org/10.7717/peerj.20204

Coelho, L. M., Leão, A. P. A., Bernardes, L. F., Alves, V. V., Martins, B. G., Peixoto, J. V., Pereira, L. J., Fassani, E. J., Alvarenga, R. R. and Zangeronimo, M. G. (2021). Reproductive aspects of Japanese quails (*Coturnix coturnix japonica*) hatched from eggs incubated under different light colors. *Theriogenology*, 170, 67-76. https://doi.org/10.1016/j.theriogenology.2021.04.025

Coffi, G. M. M. (2025). Effet du tourteau amélioré d'amandes de cajou déclassées (*Anacardium occidentale* L., 1753) associé à la bagasse de pomme de cajou sur les paramètres zootechniques et la santé de la poule pondeuse (*Gallus gallus domesticus* L., 1758). Thèse de doctorat, Université Félix HOUPHOUËT BOIGNY, Abidjan, Côte d'ivoire, 208 p.

Dembélé, D. O., Amani, N. S.-C., Kouato, F., Loukou, G. A., Ouattara, H. and Octoumou, A. (2025). Effect of incorporating cashew nut meal into diet on feed efficiency, growth performance and mortality of meat-type quails (*Coturnix japonica*, Temminck and Schlegel, 1849). *Journal of Chemical, Biological and Physical Sciences*, 15(4), 774-784.

DSM, (2016). Egg quality manual: A practical guide to the efficient evaluation of egg quality at farm level. https://www.dsm.com/content/dam/dsm/anh/en/documents/dsm-egg-quality-manual.pdf

Duymus, M., Demiraslan, Y., Akbulut, Y., Orman, G., Aslan, K. and Ozcan, S. (2013). The Statistical Analysis of Some Volumetric Measurements in the Japanese Quails' Head with Different Feather Color: A Computed Tomography Study. *Kafkas Universitesi Veteriner Fakultesi Dergisi*, 19(4), 681-686. https://doi.org/10.9775/kvfd.2012.7923

Genchev, A. and Mihaylov, R. (2008). Slaughter analysis protocol in experiments using Japanese quails (*coturnix japonica*). *Trakia Journal of Sciences*, 6(4), 66-71.

Genchev, A. (2012). Quality and composition of Japanese quail eggs (*Coturnix japonica*). *Trakia Journal of Sciences*, 10, 91-101.

Getahun, A. and Yemane, N. (2025). Review on impact of dietary fiber on poultry performance. *South Asian Journal of Life Sciences*, 13, 41-49. https://doi.org/10.17582/journal.sajls/2025/13.41.49

Han, G. P., Kim, D. Y., Kim, K. H., Kim, J. H., and Kil, D. Y. (2023). Effect of dietary concentrations of metabolizable energy and neutral detergent fiber on productive performance, egg quality, fatty liver incidence, and hepatic fatty acid metabolism in aged laying hens. *Poultry Science*, 102, 1-10. https://doi.org/10.1016/j.psj.2022.102417

Han, H. Y., Zhang, K. Y., Ding, X. M., Bai, S. P., Luo, Y. H., Wang, J. P. and Zeng, Q. F. (2017). Effect of dietary fiber levels on performance, gizzard development, intestinal morphology, and nutrient utilization in meat ducks from 1 to 21 days of age. *Poultry Science*, 96(12), 4333-4341. https://doi.org/10.3382/ps/pex225

Hassan, H. A. (2010). Variations in egg performance and plasma constituents at different ages of females Japanese quail. *Egyptian Poultry Science*, 16, 565–581.

Haugh, H. (1937). A new method for determining the quality of an egg. *US Poultry Magazine*, 39, 27-49.

Inci, H., Ozdemir, G., Sogut, B., Sengul, A. Y., Sengul, T., Taysi, M. R. (2016). Comparison of growth performance and carcass traits of Japanese quails reared in conventional, pasture, and organic conditions. *Revista Brasileira de Zootecnia,* 45(1), 8-15. https://doi.org/10.1590/S1806-92902016000100002

Kokoszynski, D., Zochowska-Kujawska, J., Kotowicz, M., Wegner, M., Arpášová, H., Wlodarczyk, K., Saleh, M. and Cebulska A. (2024). Carcass characteristics, physicochemical traits, texture and microstructure of young and spent quails meat. *Poultry Science*, 103, 1-7. https://doi.org/10.1016/j.psj.2024.103294

Kouatcho, F. D., Kana, J. R., Ngoula, F., Nana, N. F. C. et Teguia, A. (2015). 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.

Kouatcho, F. D., Miégoué, E., Watsop, H. M., Nai, R., Panzaru, C., Radu-Rusu, R., Smiz, E. and Yanou, N. N. (2025). Figuil limestone as a calcium source for Japanese quail: effects on growth, carcass, egg production, and blood biochemical parameters. *Acta Scientiarum*, 48, 1-14. https://doi.org/10.4025/actascianimsci.v48i1.69321

Kouatcho, F. D, Mamoudou S., Mweugang, N., Watsop, H. M, Kepawo, S., Radu-Rusu, R. M., and Usturoi M. G. (2022). Growth performance and egg characteristics of some phenotypes of quail (*coturnix* sp.) raised in the Sudano-guinean zone of Cameroon. *Czech Journal of Food Sciences*. 77(1), 280-289. https://doi.org/10.17221/280/2021-CJFS

Lukanov, H., Pavlova, I. and Genchev, A. (2013). Effect of Fattening Period Duration on Meat Productivity of Domestic Quails from Different Productive Types. *Poultry Science Journal*, 11(2), 223-231.

Lukanov, H., Pavlova, I. and Genchev, A. (2021). Effect of different fattening period duration on meat productivity of domestic quails. *Agricultural Science and Technology*, 13(4), 370-377. https://doi.org/10.15547/ast.2021.04.062

Mondry, R. (2016). Élevage des cailles en milieux tropical, Collection PRO-AGRO, 32 p.

N'Guessan, A. R. (2020). Utilisation des farines de graines de *Cajanus cajan* et des feuilles de *Moringa oleifera* dans l'alimentation des cailles (*Coturnix japonica*, Temminck & Schlegel, 1849): effets sur les performances zootechniques, la santé, la qualité de la viande et des œufs. Thèse de doctorat, Université Nangui ABROGOUA, Abidjan, Côte d'Ivoire, 147 p.

Nedeljka, N. et Kocevski, D. (2006). Forming egg shape index as influenced by ambient tempertaures and age of hens. *Biotechnology in Animal Husbandry*, 22(1-2), 119–125.

Northcutt, J. K., Buyukyavuz, A. and Dawson, P. L. (2022). Quality of Japanese quail (Coturnix coturnix japonica) eggs after extended refrigerated storage. *Journal of Applied Poultry Research*, 31(3), 1-8. https://doi.org/10.1016/j.japr.2022.100292

Panaite, T. D., Criste, R. D., Ropota, M., Olteanu, M., Mitoi, M., Varzaru, I., and Untea, A. (2017). Effect of using nuts meal in diet formulations on layer performance and egg quality. *Lucrări Ştiinţifice-Universitatea de Ştiinţe Agricole şi Medicină Veterinară, Seria Zootehnie*, 67(22): 156-160.

Prommajak, T., Leksawasdi, N. and Rattanapanone, N. (2014). Biotechnological Valorization of Cashew Apple: a Review. *Chiang Mai University Journal of Natural Sciences*, 13(2), 159-182. https://doi.org/10.12982/CMUJNS.2014.0015

Sharifi, S. D., Rahimi, A., Rouhanipour, H. and Zanussi, H. P. (2025). Raising systems and diet type in Japanese quails production: Effects on growth performance, carcass characteristics, fatty acid profiles and meat quality. Poultry Science 104, 1-10. https://doi.org/10.1016/j.psj.2025.104032

Yao, I. (2023). Poultry Voluntary Report. Rapport United States Department of Agriculture, Côte d'Ivoire, 8p.

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