Scientific Research Publishing

Open Journal of Animal Sciences, 2024, 14, 1-13
https://www.scirp.org/journal/ojas
ISSN Online: 2161-7627
ISSN Print: 2161-7597

Technical-Economic Performance, Carcass and Meat Quality of COBB500 Broilers Fed Rations Incorporating Mango By-Product Feeds in Ivory Coast (West Africa)

Timbilfou Kiendrébéogo[1,2,3], Alidjata Traoré[4], Etienne Sodre[1,2], Drissa Barry[5], Isidor Ouedraogo[5], Marcelle Grace Koidja[4], Vianney Tarpaga[1,2]

[1]Centre National de la Recherche Scientifique et Technologique, Institut de l'Environnement et de Recherches Agricoles, Laboratoire de Recherches en Production et Santé Animales (LAREPSA), Bobo-Dioulasso, Burkina Faso
[2]Centre National de la Recherche Scientifique et Technologique, Institut de l'Environnement et de Recherches Agricoles, Laboratoire Central d'Horticulture (LCH), Bobo-Dioulasso, Burkina Faso
[3]Laboratoire d'Etude des Ressources Naturelles et des Sciences de l'Environnement (LERNSE), Ecole Doctorale Sciences Naturelles et Agronomie (ED-SNA), Université Nazi BONI, Bobo-Dioulasso, Burkina Faso
[4]Université Catholique de l'Afrique de l'Ouest (UCAO) Section du Burkina Faso, Bobo-Dioulasso, Burkina Faso
[5]Direction Régionale de l'Agriculture, des Ressources Animales et Halieutiques de l'Est, Fada, Burkina Faso
Email: timbilfou@gmail.com

How to cite this paper: Kiendrébéogo, T., Traoré, A., Sodre, E., Barry, D., Ouedraogo, I., Koidja, M.G. and Tarpaga, V. (2024) Technical-Economic Performance, Carcass and Meat Quality of COBB500 Broilers Fed Rations Incorporating Mango By-Product Feeds in Ivory Coast (West Africa). *Open Journal of Animal Sciences*, **14**, 1-13.
https://doi.org/10.4236/ojas.2024.141001

Received: October 26, 2023
Accepted: December 3, 2023
Published: December 6, 2023

Abstract

The study evaluated the growth performance and carcass quality of COBB500 broilers fed two experimental rations incorporating feed and mango fine ED_{10} for a batch of 83 birds, ED_{20} (batch of 83 birds) in comparison with a commercial control ration CCD (84 birds). For this purpose, 250 day-old chicks of this breed were purchased in Korhogo and transported to Tengréla in Ivory Coast for rearing. The results show that substituting mango provender ans and mango seed flour for maize resulted in rations with costs per kgMS of 215.35FCFA, 2016.93FCFA and 320FCFA for the ED_{10}, ED_{20} and CCD rations respectively. The production costs per kg of chicken (FCPkgLW) of the CCD ration were significantly higher than those of the ED10 and ED_{20} ($p < 0.05$). ADGs were significantly different and decreasing from CCD, ED_{20} to ED_{10} ($p < 0.05$). Average weights at 42nd day for ED_{20} and CCD were homogeneous ($p > 0.05$) and significantly higher than for ED_{10} ($p < 0.05$). By day 49th the average weight of ED_{20} had reached and exceeded that of CCD by day 42nd. PSLW, HCW and CCW were significantly different and decreasing from CCW, ED_{20} to ED_{10} ($p < 0.05$). Average hot (HCY) and cooled (CCY) carcass yields of ED_{20} and CCD rations were comparable ($p > 0.05$) and significantly higher than those of ED_{10} ration ($p = 0.009$) and 0.003). Average drumstick

and neck weights were significantly higher and lower for CCD, ED_{20} and ED_{10} ($p < 0.05$). For all other parts of the cut, the average weights of the CCD ration were significantly higher ($p < 0.05$) than those of the ED_{20} and ED_{10} rations, which were homogeneous ($p < 0.05$). The incorporation of mango provender and mango seed flour in broiler rations offers the prospect of reduced production costs, less competition between man and animals over cereals, and lean meat production that is more appreciated than that of chickens fed conventional feed. As it stands, the ED_{20} ration can be recommended as a growth diet for broilers. It would be necessary to determine the levels of anti-nutritional substances in mango feeds and to assess the *in vivo* digestibility of mango ingredients and the diets incorporating them.

Keywords

Broiler, COOB 500 Chickens, Mango Feed, Carcass Characteristics, Tengrela, Ivory Coast

1. Introduction

In African countries south of the Sahara, the need to substantially increase production in order to satisfy an ever-increasing demand for food is becoming an imperative. This need fits in well with the prospects of a 14% increase in global livestock production between 2020 and 2029 [1]. Within this dynamic, poultry remains the fastest-growing meat type, accounting for around half of the projected increase in total meat production. Many authors recognize that feed is the main constraint on livestock production in West Africa. In monogastric livestock production, particularly pigs and poultry, the food constraint is exacerbated by competition between animal species for the most widely used agricultural products (maize, millet, etc.) [2]. The cost of feed represents 55% - 60% of the production cost of poultry products, and the energy fraction represents 70% of the cost of feed [3]. Food savings can therefore make a substantial contribution to production efficiency. That's why it is so important to use the good feed, at the lowest possible cost and in the right quantities, in the poultry ration. It is also important to know what feeds are available and how they should be used in poultry diets [1]. Also, non-conventional feeds are increasingly being used to reduce the financial burden of feed in production. Their use as partial or total substitutes for cereals reduces the competition between humans and animals for these conventional food sources. The possibility of producing feeds-based mango by-products [4] and use them in the rationing of monogastric pigs undergoing finishing growth [5], laying chickens [6] and "bicycle" chickens [7] mixed-breed "*Poulet du Faso*" broiler chicken [8] has been successfully proven in Burkina Faso. On the strength of these results, a technology transfer agreement for the production of feed based on mango residues in Ivory Coast was draw up between the Fond Interprofessionnel pour la Recherche et le Conseil Agricoles

(FIRCA) and the Institut de l'Environnement et de Recherche Agricole (INERA) in Burkina Faso. This is in view of the development and, above all, the processing of mangoes in Ivory Coast which are potential sources of production and processing residues that can be used as animal feed, including poultry feed. Indeed, despite the importance of the poultry sector, with its 44% contribution to meat production in Ivory Coast, this activity encounters nutritional and technical constraints, as seen from the angle of the frequent shortage of raw materials (maize, fish meal, cotton cake) and the poor quality of available feed [9]. The present study was carried out on the occasion of the transfer of mango by-product-based feed production technology. It also evaluated, for demonstration purposes, the effects of mango feed-based rations on growth parameters, carcass quality and organoleptic quality of COBB500 broiler meat in Ivory Coast.

2. Materials and Methods

2.1. Study Site

The study was carried out on 2020 at Tengréla in Ivory Coast. Tengréla is a town located in the Savannas region in the extreme north of the country. Tengréla has a very dry, hot Sudanese climate. The vegetation is dominated by wooded savannah. The area produces mangoes and is ideal for livestock farming [10].

2.2. The Broiler Housing

The building used for the trial consists of a hangar topped with sheet metal and open on the west side. The other three sides are built of fixed masonry. It is subdivided into 3 pens of 10 m^2 each, each large enough to house a batch of 85 chickens from chick to sale. The screened enclosure provides good natural ventilation. It should also be noted that an electrical system was installed in the building to regulate temperature during the cool season. The flour of the henhouse was covered with litter at the recommended rate of 4.5 to 7.2 kg/m^2 depending on the raw material used [11]. The litter was changed every two weeks.

2.3. Animal Materials

The animal material consisted of 255 COBB500 broiler chickens purchased at 01 day of age in Korhogo from Abidjan and transported to Tengréla. On arrival, the chickens were fed sugar water. A commercial starter feed was fed to all chicks without distinction for 01 week, before being replaced by the experimental rations once the batches had been formed. Three batches of 83, 83 and 84 chicks were formed, each receiving 01 control ration (CCD), an experimental ration with 10% mango seed floor (ED_{10}) and a second experimental ration incorporating 20% mango fines (ED_{20}).

2.4. Formulation of Distributed Rations

Three rations, including two experimental ones (ED_{10} and ED_{20}), were formu-

lated to be fed chickens per batch. These rations were formulated to reduce the incorporation rate of maize, the main source of energy in intensive and/or industrial rearing, by incorporating feed and mango seed floor. Their centesimal compositions and nutritional contributions are given in Table 1. The two experimental rations were compared with a control ration, which is a commercial broiler growth feed usually sold on the Ivorian market. Feeding was carried out in 2 phases. A start-up phase (from 1st to 10th day) during which the chicks were fed a starter diet purchased on the market, and a growth-finishing phase during which the chickens were fed ED_{10}, ED_{20} and RTC rations.

2.5. Data Collection and Calculation of Analysis Parameters

- **Zootechnical parameters:** the zootechnical parameters studied concerned:
  - Weight evolution was assessed by weekly weighing of the chickens in the morning from 6 hours before the ration was served;
  - Growth rate was measured by Average Daily Gain (ADG) calculated according to the formula: ADG (g) = FW − IW where PF (g) = final weight and PI (g) = initial weight;
  - Daily food consumption (DFC) is calculated using the formula DFC (g) = (QFD − RF) where QDF (g) = amount of feed distributed the previous day and RF (g) = feed refusal measured the following day;
  - The consumption index (CI) was calculated using the formula: CI = DFC (g)/(ADG) (g)
- **Carcass parameters:** To assess carcass characteristics, chickens were first fasted for 24 hours and weighed before slaughter. The chickens were slaughtered and the carcasses cut according to the methods recommended by [12]. After plucking, warm carcasses were weighed and then chilled at 5˚C for 24 hours. The chilled carcasses were then weighed. Each piece of the cut and each organ were weighed. The data collected from the weighting's were used to calculate:

Table 1. Centesimal composition of the distributed diets.

Ingredients	Distributed diets		
	ED_{10}	ED_{20}	CCD
Corn	35	33	-
Mango food	26.75	25	0
Mango almond	10	20	0
Vegetable oil	2	0	-
Fish	7	2.75	-
KLC	19.25	19.25	-
Total	100	100	-

ED_{10} = experimental ration incorporating mango by-products including 10% mango seed flour; ED_{20} = experimental Ration incorporating mango by-products including 20% mango seed floor; CCD = commercial control ration without mango by-products.

- Hot carcass yield (HCY) according to the formula: HCY (%) = (HCW/PSLW) × 100 were HCW = hot carcass weight and PSLW = pre-slaughter live weight;
- Cold carcass yield (CCY) according to the formula: CCY (%) = (CCW/PSLW) × 100 were CCW = cold carcass weight and PSLW = pre-slaughter live weight;
- Abdominal fat rate (AF) according to the formula: AF (%) = (AFW/CCW) × 100 were AFW = total weight of abdominal fat and CCW = cold carcass weight;

➢ Organoleptic quality of the meat: organoleptic qualities were determined by evaluating the tenderness and succulence of the meat, by tasting the salted meat fried in oil. A panel of twenty-five (25) people (men and women) carried out the tasting. The meat was served in two dishes, one identified by pink wallpaper and the other blue, containing respectively meat from the CCD ration and meat from the ED_{10} and ED_{20} rations. It should be noted that only the organizers could differentiate between the meats served. The carcasses were cut to ensure uniformity in the size of the pieces of meat served. After tasting, we recorded each participant's appreciation in an event notebook for analysis.

The data collected were entered using Excel 2016 software, and the analysis was carried out with XLSTAT 2016 software using an ANOVA for the separation of means at the 5% threshold by Fisher LSD test.

3. Results

3.1. Influence of Mango Feed Incorporation on Ration Characteristics and Costs

The energy and nutritional composition of the rations is shown in Table 2. The levels of incorporation of mango seed floor in ED_{10} (10%) and ED_{20} (20%) rations resulted in a higher level of fish incorporation in the experimental diets ED_{10} which were higher than those ED_{20}. The ED_{10} and ED_{20} rations were iso-energetic and iso-proteinic. The Crude Fiber (CF) contents of the RD_{10} and ED_{20} rations were virtually equal and higher than those of the commercial CD ration. The cost per kg of the ED_{10} and ED_{20} rations was lower than that of the CD ration.

3.2. Weight Trends during the Growth Phase

Figure 1 shows that growth was continuous for all three rations from D1 to D35. The results in Table 3 show that, apart from the weights at D1 and D7, all other average weekly weights were significantly different ($p < 0.05$). From D7 to D35, the CCD ration was on average significantly higher than the ED_{10} ration, which was in turn significantly higher than ED_{20} ($p = 0.000$). At the seventh weighing (D49), the average weight of ED_{20} was significantly higher ($p = 0.000$) than those of CCD and ED_{10}, which were homogeneous ($p = 0.000$).

Table 2. Feed values of rations distributed.

Ingredients (%)	Rations distributed		
	ED_{10}	ED_{20}	CCD
ED (kcal/kg)	2906	2925	3146
Protein (%)	17.13	17.26	18.99
Lysine (%)	1.41	1.51	-
Methionine (%)	0.67	0.75	-
Calcium (%)	1.5	2.67	8.3
Phosphorus (%)	0.37	0.27	6.25
CB (%)	10.57	10.06	5.12
Costs (FCFA/kgMS)	215.35	216.93	320

ED_{10} = experimental ration 1 incorporating mango by-products including 10% mango kernel; ED_{20} = experimental; Ration incorporating mango by-products including 20% mango kernel; CCD = commercial control ration without mango by-products.

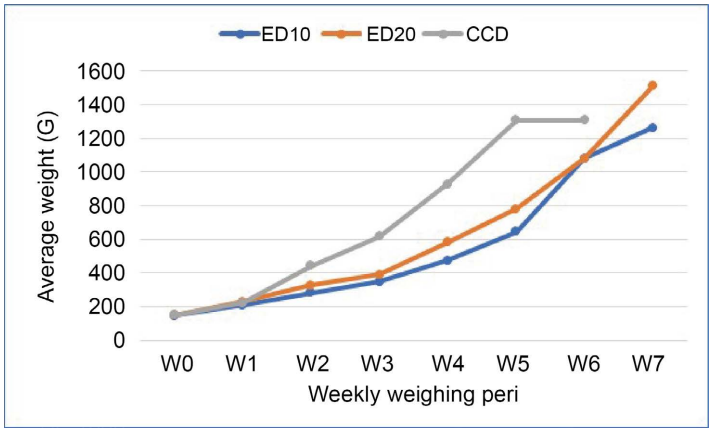

Figure 1. Weight evolution of broilers according to rations distributed.

Table 3. Average weekly chicken weights according to rations.

Period	Diets distributed			Pr > F	Sig.
	ED_{10}	ED_{20}	CCD		
W0	148 ± 30[a]	150 ± 35[a]	152 ± 29[a]	0.806	No
W1	211 ± 45[a]	231 ± 54[a]	223 ± 51[a]	0.183	No
W2	282 ± 51[a]	327 ± 70[b]	445 ± 111[c]	0.000	Yes
W3	351 ± 62[a]	390 ± 76[b]	618 ± 150[b]	0.000	Yes
W4	476 ± 72[a]	582 ± 130[b]	929 ± 206[c]	0.000	Yes
W5	646 ± 103[a]	781 ± 191[b]	1308 ± 251[c]	0.000	Yes
W6	1081 ± 163[a]	1080 ± 189[b]	1308 ± 251[b]	0.000	Yes
W7	1261 ± 140[b]	1510 ± 180[a]	-	0.000	Yes

ED_{10} = experimental ration incorporating 10% of mango seed flour; ED_{20}: experimental ration incorporating 20% of mango seed floor; CCD = commercial control ration without mango. Averages on the same line bearing the same letter are not significantly different at the significance levels indicated.

3.3. Growth, Conversion and Production Costs for Live Chickens

The results in Table 4 shows that ADG were significantly different and decreasing from CCD, ED_{20} to ED_{10} ($p = 0.000$). No significant difference was observed in average daily feed intake between diets. The CI for the ED_{10} ration was significantly higher than that for CCD ($p = 0.039$). The average FCkgLW of the ED_{10} and ED_{20} experimental rations was significantly lower than that of the CCD ration ($p = 0.027$).

3.4. Characteristics of Broiler Carcasses

The results in Table 5 shows that average pre-slaughter live weights (PSLW), hot carcass weights (HCW) and cooled carcass weights (CCW) were significantly higher and decreased from CCD, ED_{20} to ED_{10} rations ($p = 0.000$). The average

Table 4. Growth (ADG) and conversion index (CI) parameters and feed cost of 01 kg of live weight of chicken (FCkgLW).

Parameters	Diets distributed			Pr > F	Sig.
	ED_{10} (n = 43)	ED_{20} (n = 43)	CCD (n = 84)		
DFC	71.07 ± 17.57	71.95 ± 19.11	71.47 ± 19.03	0.976	No
ADG	22.72 ± 2.96^{c}	27.75 ± 3.69^{b}	33.03 ± 6.95^{a}	0.000	Yes
CI	3.44.56^{a}	2.82 ± 0.54^{ab}	2.69 ± 2.14^{b}	0.039	Yes
FCPkgLW	739 ± 121^{ab}	612 ± 117^{b}	859 ± 686^{a}	0.027	Yes

ADG = average daily gain; CI = conversion index; FCPkgLW = feed cost of 01 kg chicken live weight production; DFC = daily feed consumption per subject; ED_{10} = experimental ration with 10% mango seed flour; ED_{20}: experimental ration with 20% mango seed floor; CCD = commercial control ration without mango. Average means in the same line bearing the same letter are not significantly different at the significance levels in the table.

Table 5. Comparative average characteristics of broiler carcasses.

Parameters	Diets distributed			Pr > F	Sig.
	ED_{10} (n = 43)	ED_{20} (n = 43)	CCD (n = 84)		
PSLW (g)	1013 ± 255^{a}	1206 ± 116^{b}	1707 ± 159^{c}	0.000	Yes
HCW (g)	712 ± 194^{a}	921 ± 105^{b}	1286 ± 127^{c}	0.000	Yes
CCW (g)	616 ± 178^{a}	829 ± 129^{b}	1176 ± 78^{c}	0.000	Yes
HCY (%)	70 ± 4^{a}	76 ± 6^{b}	75 ± 3^{b}	0.009	Yes
CCY (%)	60 ± 4^{a}	69 ± 7^{b}	69 ± 6^{b}	0.003	Yes
AF (%)	3 ± 1^{a}	2 ± 1^{b}	2 ± 0.4^{b}	0.004	Yes

ED_{10} = experimental ration with 10% mango seed flour; ED_{20}: experimental ration with 20% mango seed floor; CCD = commercial control ration without mango. PSLW = pre-slaughter live weight of chicken, HCW = hot carcass weight, CCW = weight of chicken after slaughter, HCY = hot carcass yield, CCY = cold carcass yield. Average means in the same line bearing the same letter are not significantly different at the significance levels in the table.

hot carcass yield (HCY) and cold carcass yields (CCY) of rations ED_{20} and CCD were comparable ($p > 0.05$) and significantly higher than those of ration ED_{10} ($p = 0.009$ and $p = 0.003$). Conversely, the mean abdominal fat content (AF) of ED_{10} was significantly higher than that of rations ED_{20} and CCD ($p = 0.004$), which were comparable with each other ($p > 0.05$).

3.5. Characteristics of Carcass Cuts

Our results for carcass cuts (Table 6) show that:

- The average weights of the whole thigh, wings, chest and back of the CCD were significantly higher than those of the ED_{10} and ED_{20} rations ($p = 0.000$), which were comparable to each other;
- Mean drumstick and neck weights were significantly different and decreased from CCD, ED_{20} to ED_{10} ($p = 0.000$).

3.6. Organs' Characteristics

The results presented in Table 7 shows the offal and organ weights of COOB 500 broilers after slaughter, according to ration. Average total offal and gizzard weights of the RT ration were significantly higher than those of the ED_{10} ($p = 0.000$) and ED_{20} ($p = 0.001$) rations, which were homogeneous between them. Average gutted gizzard weights of RT and ED_{20} were comparable and significantly higher than those of the ED_{10} ration ($p = 0.004$). Average leg and head weights were significantly different and decreased from RT and ED_{20} to ED_{10} ($p = 0.000$).

3.7. Organoleptic Quality of Broiler Meat

The results of the taste test showed that the tenderness of the meat from chickens on the mango diet was tenderer for 60% of consumers, compared with

Table 6. Characteristics of carcass cuts.

Parameters	Diets distributed			Pr > F	Sig.
	ED_{10} (n = 43)	ED_{20} (n = 43)	CCD (n = 84)		
Whole legs	361.5[a]	254.5[b]	206.5[b]	0.000	Yes
Pestle (g)	163.5[a]	117.5[b]	90.5[c]	0.000	Yes
Thigh (g)	196.5[a]	134[b]	114[b]	0.000	Yes
Wing (g)	146[a]	99[b]	80[b]	0.000	Yes
Neck (g)	60[a]	50[b]	39.5[c]	0.000	Yes
Breast (g)	331[a]	245[b]	183.5[b]	0.000	Yes
Dos (g)	222.5[a]	159[b]	134.5[b]	0.000	Yes

ED_{10} = experimental ration with 10% mango seed floor; ED_{20}: experimental ration with 20% mango seed floor; CCD = commercial control ration without mango; Average means in the same line bearing the same letter are not significantly different at the significance levels in the table.

Table 7. Offal and organ weights for COBB500 broilers.

Parameters	Distributed diets			Pr > F	Sig.
	ED_{10} (n = 43)	ED_{20} (n = 43)	CCD (n = 84)		
Total offal (g)	93.5[a]	73[b]	67.5[b]	0.000	Yes
Full gizzard (g)	56[a]	41.5[b]	39[b]	0.001	Yes
Empty gizzard (g)	32[a]	29.5[a]	23[b]	0.004	Yes
Liver (g)	26.5[a]	25[a]	22.5[a]	0.275	No
Heart (g)	8[a]	7.5[a]	6.5[a]	0.418	No
Leg (g)	77.5[a]	60[b]	40.5[c]	0.000	Yes
Head (g)	49.5[a]	40.5[b]	34.5[c]	0.000	Yes

ED_{10} = experimental ration with 10% of mango seed flour; ED_{20}: experimental ration with 20% of mango seed flour; CCD = commercial control ration without mango; Average means in the same line bearing the same letter are not significantly different at the significance levels in the table.

40% on the CCD diet. The succulence of meat from diets incorporating mango was also judged more succulent by 76% of consumers, compared with 24% for the CCD diet.

4. Discussion

4.1. Effects of Rations Incorporating Feed and Mango Fines on the Technical and Economic Growth Performance of Broilers

Our results on broiler weight development showed continuous growth from the beginning to the end of the trial. However, the growth rate of the commercial control ration (CCD) was higher than that of the ED_{10} and ED_{20} experimental rations. These results confirm our expectations on these two parameters. They corroborate results reported by other authors such as [6] and [7] who tested rations based on mango by-products respectively in the feed of growing Isa Brown layers and growing-finishing local breed chickens respectively. Since mango by-products are rich in fiber, they have certainly had an upward influence on the fiber content of rations, which is not conducive to good digestibility and therefore good availability of nutrients, especially energy. The consequence of this situation is that after 42 days of rearing, the CCD subjects had reached an average weight (1308 ± 251 g) acceptable for sale. On the other hand, ED_{10} and ED_{20} subjects waited a week longer to reach average weights of over 1200 g. At 42 days of age, the average weights of all our ED_{10} (1081 ± 16 g), ED_{20} (1080 ± 19 g) and CCD (1308 ± 25 g) rations are lower than those reported by [13] for 2 experimental rations based on maize *espoir* variety (1743.8 ± 248.0 g) and SR21 (1721.3 ± 250.2 g) compared with a commercial ration (1610.3 ± 244.9 g). In addition, the CI of the ED_{20} ration was significantly comparable to that of the CCD, meaning that these two rations were the most highly valued compared with the experimental ED_{10} ration. These results show that the mango by-product feeds

(mango meal and mango seed flour) used in the ED_{10} (36.75%) and ED_{20} (45%) rations can be a good substitute for maize, which is recognized as a major source of energy. The effects of rationing trials based on maize (60.23%) as the main source of energy and groundnut meal (25.49%) as the main source of protein [14] showed the same growth rate for control rations in both cases, and double that of our experimental rations. However, the conversion levels (CI) measured weekly in the trial were close to those of our ED_{20} ration. This performance of the ED_{20}, ration, which also doubled its weight gain compared with the ED_{10} ration between W6 and W7, could be explained by the influence of the additional rate (10%) of incorporation of mango seed flour Contrary to weight performance, feed production costs of per kg live chicken (FCPkgLW) were lower for the ED_{10} and ED_{20} rations than for the CCD ration.

4.2. Influence of Rations Incorporating Mango Provender and Mango Seed Flour on Carcass Characteristics and Organoleptic Quality of Meat

Our results on the average characteristics of broiler carcasses (**Table 5**) show the same levels of abdominal fat rate (AF) between the ED_{20} and CCD rations, which are significantly lower than that of ED_{10}. The opposite is true for carcass yields (HCY and CCY), which are comparable for the ED_{20} and CCD rations, but significantly higher than that of ED_{10}. These results run counter to the average of PSLW, HCW and CCW, which are significantly higher and decreasing for CCD, ED_{20} and ED_{10} rations. This demonstrates the ability of the ED_{20} ration to produce more meat than the ED_{10} ration and as much lean meat as the CCD ration. In monogastric animals, fibrous feeds favor the production of lean meat, which in principle weighs more than fatty meat. The evaluation of mango-fed pig carcasses by [15] and [5] demonstrated this assertion. Note that according to [16] mango kernels have antioxidant properties that reduce fat formation in carcasses. Our results obtained for the CCD and ED_{20} are very close to the abdominal fat levels reported by [16] for broilers fed increasing levels of caterpillar meal and fish meal, for which it had been concluded that they were capable of producing lean meat. The significant difference in live weight at slaughter (LWS) depends on the final weights, which differed between the 3 rations. However, we note that the ED_{20} has the same carcass yield as the CCD. As the aim of rearing chickens is to gain meat, the almost equal yields between the CCD and the ED_{20} show that the latter, based on mango by-products, makes up for the chickens' growth deficit through meat yield. This may be explained by the higher fat content of CCD carcasses compared with experimental rations. If we add to these good yield performances the lower production feed cost of the ED_{20} ration than that of the CCD, we can conclude that it is technically and economically competitive with the control ration.

Meat from rations incorporating mango feed received the highest ratings for both tenderness and succulence, compared with that from the CCD mango-free control diet. This shows that, in addition to good carcass yield, the mango-based

ration provides lean, tender and succulent meat, qualities that most consumers are looking for. If we add to these good organoleptic performances, good yields and low production costs, we can encourage the use of feed based on eating by-products in broiler diets.

5. Conclusion

At the end of this study, it emerged that the incorporation of feed and mango kernels in broiler rations offers an interesting prospect in terms of production feed costs and carcass quality. The results of the experiment show that good carcass performance and appreciable organoleptic qualities make it technically and economically possible to make up for the growth lag experienced in the ED_{20} experimental ration. These results show that feed and mango kernel can partially replace cereals and other ingredients in broiler rations. This not only limits competition between man and beast in the use of cereals, but also makes it possible to use large quantities of mango by-products, which used to be bulky and thrown away in nature. As it stands, the ED_{20} ration can be recommended as a growth diet for broilers. In the future, it will be necessary to determine the exact composition of mango kernels for better use in modern poultry feed, and also for other animal species. Also, to encourage the transfer of technology to other mango-producing countries, and to promote the technology among mango processors and breeders in order to increase their income.

Acknowledgements

We would like to thank the Fond Interprofessionnel pour la Recherche et le Conseils Agricoles (FIRCA) for funding the technology transfer to Côte d'Ivoire, and the Institut de l'Environnement et de Recherches Agricoles (INERA) of CNRST (Burkina Faso) for facilitating it by sending a team of experts for the successful implementation of the activities.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] FAO (2020) Rising Uncertainties from COVID-19 Cloud Medium-Term Agricultural Prospects. OECD-FAO Agricultural Outlook 2020-2029. https://www.fao.org/news/story/en/item/1298333/icode/

[2] Zagré, H., Kiendrébéogo, T., Ouédraogo, S., Barry, D., Ouédraogo, I.Z., Mopaté, Y.L. and Kaboré Zoungrana, C.-Y. (2019) Effects of Pineapple Waste Based-Diet on the Growth and Quality of Carcasses Mixed Pig (Large White X Pietrain) in Burkina Faso. *Asian Journal of Applied Science and Technology*, **3**, 142-150. http://ajast.net/volume-3-issue-4.html

[3] Maliboungou, J.C., Lessire, M. and Hallouis, J.M. (1998) Composition chimique et teneur en énergie métabolisable des matières premières produites en République

centrafricaine et utilisables chez les volailles. *Revue d'élevage et de Médecine Vétérinaire des Pays Tropicaux*, **51**, 55-61. https://doi.org/10.19182/remvt.9653 https://revues.cirad.fr/index.php/REMVT/article/view/9653

[4] Kiendrebeogo, T., Logtene, Y.M., Ido, G. and Kabore, C.Y. (2013) Procédés de production d'aliments non conventionnels pour porcs à base de déchets de mangues et détermination de leurs valeurs alimentaires au Burkina Faso. *Journal of Applied Biosciences*, **67**, 5261. https://doi.org/10.4314/jab.v67i0.95047

[5] Kiendrebeogo, T., Mopaté Logténé, Y. and Kaboré-Zoungrana, C.Y. (2018) Effets derations à base de déchets de mangue sur les performances pondérales et la qualité dela carcasse de porcs Korhogo en croissance au Burkina Faso. *Journal of Applied Biosciences*, **129**, 13039-13049. https://doi.org/10.4314/jab.v129i1.7

[6] Barry, D., Kiendrebeogo, T., Sere, M., Combari, A., Logténé, Y.M. and Kaboré-Zoungrana, C.Y. (2019) Effects of Mango Wastes-Based Diets on the Growing Parameters of Laying Hens and Biometric Parameters of the Eggs. *OALib*, **6**, 1-13. https://doi.org/10.4236/oalib.1105868

[7] Kiendrebeogo, T., Sawadogo, C., Soudre, A., Combari, A., Mopate Logtene, Y. and Kabore-Zoungrana, C.Y. (2020) Effects of Mango Waste-Based Rations on the Technical-Economic Performance of Local Growing-Finishing Chickens in Burkina Faso. *International Journal of Innovation and Applied Studies*, **29**, 97-103. http://www.ijias.issr-journals.org/abstract.php?article=IJIAS-19-322-03

[8] Ouédraogo, Z.I. (2021) Weight Performance and Carcass Quality of "Poulet du Faso" Broilers Fed Mango Provendes and Maggot Concentrate in Partial Substitution for Corn and Total Substitution for Fish. Master II Thesis, Nazi BONI, Bobo-Dioulasso.

[9] Kouakou, E.K., Kreman, K., Bamba L.K. and Kouadja, S.G. (2019) Effet de la farine d'épluchures de manioc sur les performances zootechniques et économiques du poulet de chair au démarrage en Côte d'Ivoire. *Journal of Animal & Plant Sciences*, **42**, 7237-7244. https://doi.org/10.35759/JAnmPlSci.v42-2.5

[10] Infodrone (2019) Filière mangue: La Côte d'Ivoire 3è fournisseur du marché européen, 40% de la production pourris. http://www.linfodrome.com/economie/44924-filiere-mangue-la-cote-d-ivoire.

[11] Dennery, G., Dezat, E. and Rousset, N. (2012) Vers une gestion efficace des litières, de l'approvisionnement aux techniques d'élevage avicole. 48 p. https://pays-de-la-loire.chambres-agriculture.fr/fileadmin/user_upload/National/FAL_commun/publications/Pays_de_la_Loire/2012/brochure_12_litiere_volaille.pdf

[12] MAF (Ministère de l'Agriculture Française) (2010) Guide des bonnes pratiques d'hygiène et d'application des principes HACCP relatif à l'abattage et à la découpe des volailles maigres (toutes espèces). 105 p. https://agriculture.gouv.fr/sites/default/files/documents/pdf/GBPH_5945_valid_jo_cle89dc17.pdf

[13] Ouédraogo, A. (2017) Contribution à l'étude de l'élevage de poulets de chairdans la ville de Bobo-Dioulasso. Mémoire d'Ingénieur du développement Rural, option Élevage. Institut du Développement Rural (IDR), Université é Nazi Boni (UNB), Bobo-Dioulasso, 88 p. https://bibliovirtuelle.u-naziboni.bf/biblio/opac_css/docnume/idr/environnement2/IDR-2017-OUE-CON.pdf

[14] Mouhadou, K. (1980) Les effets du maïs grain entieroubroyé en alimentation séquentielle ou mélangée sur les performances zootechniques des poulets de chair de senegal (périodefroide). Ph.D. Thesis, Université Cheikh Anta Diop de Dakar, Dakar.

[15] Silga, V. (2017) Effects of mango waste-based rations on weight and carcass performance of mixed-breed pigs. Mémoire d'Ingénieur de Développement Rural, Option élevage, Université Polytechnique de Bobo-Dioulasso (UPB), Bobo-Dioulasso, 51 p.

[16] Diomande, M., Beugre, M.G.A., Kouame, B.K. and Bohoua, L.G. (2018) Effects of Caterpillar Meal (Imbrasiaoyemensis) on Growth Performance and Organ Yield of Broilers in Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, **12**, 716-727. https://doi.org/10.4314/ijbcs.v12i2.9