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Carcass Quality and Organoleptic Properties of the Meat of Layers (Warren) Fed with a Laying Feed Enriched with Soybean Oil and Sprouted Sorghum

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Abstract: The Ivorian poultry sector is experiencing very significant growth, in proportion to consumer demand. This requires the players in this sector to produce products with better nutritional and marketable qualities. This present work aims to evaluate the effects of ingestion of a laying feed on the quality of the carcass and the organoleptic quality of the meat of Warren layers. The laying feed used for this study was fortified with soybean oil (2%) and sprouted sorghum powder (0.8%). This formulation was used to feed 50 Warren pullets to 20 week old. After 48 weeks of the experiment, 10 layers which had reached the end of the laying period were slaughtered. Physical and sensory tests were carried out, respectively on the carcass and on the meat of the layers. The results obtained showed that the carcass yield was 73.43% with a fat index of 0.06. For the organoleptic tests of the meat, the average values of tenderness, flavor, aroma, juiciness and texture were, respectively 4.55; 5.13; 6.13; 5.15 and 4.45. The layer meat is found to be low in fat and of average organoleptic quality.

INTRODUCTION

The poultry sector has undergone ever-increasing development over the past 15 years. This development is believed to be due to a drop in demand for red meats, due on the one hand to the significant increase in the price of this meat in relation to the purchasing power of the majority of consumers[1] and on the other share of their impact on health. This situation has pushed poultry farmers in the constant search for better zootechnical productivity and a reduction in production costs[1], thus, prompting the control of zootechnical performance as well as feed which occupies >70% the cost of production[2].

Feeding has a huge influence on the quality of the end products of poultry farming (meat and eggs), thus, a contribution of elements such as vegetable oils (soybean oils, palm oils, etc.) and cereals (sorghum, ground peas, millet, etc.) could have an impact on the quality of the carcass and the meat.

Poultry meat is important in the human diet, since, it provides an interesting protein intake for a low-fat content[3]. They are appreciated by consumers and the medical profession because they have the reputation of being low in lipids if we consider the muscles mainly consumed (fillets and thighs) and are also a source of fatty acids with health value[4].

The present study therefore proposes to evaluate the effects of a laying feed enriched with soybean oil and sprouted sorghum powder on the quality of the carcass and the organoleptic properties of the meat of layers (Warren).

MATERIALS AND METHODS

Biological materials: Our biological material consists of 20 layers of the Warren strain of 68 weeks of age. The average slaughter weight of individuals was around 1750±50 g for Experimental Layers (EL) and 1500±59 g for Control Layers (CL).

Technical materials: Our technical equipment is made up of:

- A global brand scale of 20 kg capacity; 0.1g precision
- A refrigerator
- A pH meter
- A DSM chicken colorimetric fan

Ethical aspect: The study took place at the "LABOGRAIN" experimental farm of the Nangui Abrogoua University (formerly the University of Abobo-Adjamé) in Abidjan (Ivory Coast). The animal experimentation and the slaughtering procedure within the framework of this study complied with Council Directive 1999/74/CE of July 19, 1999 establishing minimum standards for the protection of laying hens and Directive 93/119/CE of the Council of December 22, 1993 (Regulation (CE) n° 1099/2009 of the Council of September 24, 2009) on the protection of animals at the time of their killing or slaughter. The study also complied with national regulations by respecting the Ivorian penal code in its articles 433 and 434. It should be noted that at the time of the study, the Ethics Committee of Côte d'Ivoire did not had no standards regulating the use of farm animals.

Diet: The hens in our study were fed two lay feeds from week 20 until the end of lay. The first of these foods is the standard or control food, the second is the experimental food which has been fortified with 2% soybean oil and 0.8% sorghum powder. Layers were fed daily at 8 a.m., 3 p.m. and 9 p.m. for the duration of the experiment.

After 48 weeks of laying, (10) layers from each of the 2 batches were slaughtered to allow the determination of certain physical and organoleptic parameters.

Physical parameters

The slaughter yield: Slaughter efficiency (S) indicates the ratio of Dead Weight (DW) to Live Weight (LW). It is given by the following formula:

$$\%S = DW \times 100/LW$$

Where:
DW = (Whole carcass-whole offal)
LW = Live chicken weight

The weight of the carcass: The weight of the carcass is determined after slaughter of the subject and its plumage. The slaughter is done after a 12 h fasting. The different parts of the layer are cut and then weighed in turn. These weighing will make it possible to determine the weight of the whole carcass (carcass without feathers) and single (carcass free of the head, neck, legs and offal (intestines, gizzard, heart and liver).

The fat index (abdominal fat): The determination of the Fat Index (FI) or quantity of abdominal fat is carried out on 10 layers of each batch. The slaughtered layer is stripped of its terminal parts (legs, head and neck) and then eviscerated. The simple carcass is obtained. The isolation of the fat is facilitated by the preliminary storage of the carcass at -5°C for 24 h which allows the fat to be separated from the flesh[5]. The formula is as follows:

$$FI = WAF/WSC$$

Where:
WAF = Weight of abdominal fat
WSC = Weight of the single carcass

The pH: The pH of the meat is determined using a pH meter by directly inserting the probe into the meat. It is measured 15 min and 24 h after slaughter.

The color: The color of the meat is evaluated by direct comparison (visual notation) of it with the DSM chicken color fan (DSM broiler skin color fan) (Fig. 1). This range makes it possible to determine the different shades of yellow or white color of the meat.

Sensory parameters

Organoleptic tests: Tests on the tenderness, aroma, flavor, juiciness and texture of layer meat were carried out. The organoleptic analysis is carried out according to the method of Touraille[6].

Constitution of the tasting panel: The tasters are made up of 12 people including 6 women and 6 men chosen at random from the population. The age of these people varies between 25 and 45 years. They are informed consumers of the dishes to evaluate. However, they received explanations as to the correct understanding of the test.

Fig. 1: DSM chicken color fan

Preparation and presentation of samples: The layer should be well cleaned and cut into quarters. The pieces chosen for tasting (fillet, thigh) are soaked in a salt solution (20 g of ordinary salt in 0.5 L of water) for 24 h. The pieces are then drained and cooked in water (boiled) and oil (fried) for 10 min. The evaluation tests were carried out in a ventilated room protected from all odors as well as from auditory and visual distractions. The samples are coded with 3-digit numbers and presented to the tasters. Tasters should rinse their mouth with water before and between two samples. They should not communicate with each other during the evaluation. All samples are presented to the tasters at the same time in order to allow them to evaluate them a second time if necessary.

Scorecard: The grading criteria are explained to the assessors before the start of the test. The scores to be assigned are between 0 and 10. To do this, each taster has a score sheet established according to the model of Linda *et al*.[7] which is a scale ranging from 0-10 cm. Each centimeter corresponds to a difference in sensitivity.

The taster is instructed for this purpose to mark his assessment of the organoleptic quality of the meat with a cross on the scale[8, 9]. The distance from the origin (0) to the cross is measured. These different measurements are compiled for all the subjects to form the data to which the appropriate statistical test will be applied (Newman Keuls comparison test). Data processing was performed using the STATISTICA program (StatSoft, version 6.0, 2009). This experiment focuses on 5 characteristics which can be defined as follows:

Tenderness: Property for the piece to be more or less resistant to chewing.

Flavor: General property for a sample to be good or bad.

Aroma: Property for the piece to be tasted to be bland or to present more or less the taste that people are used to giving to good chicken.

Juiciness: Property of being juicy or dry.

Texture: Property linked to the fineness of the "grain", that is to say fine or coarse of the piece, causing a pleasant or unpleasant physical sensation on contact with the oral mucous membranes.

Statistic study: The results are analyzed by the STASTISTICA software: ANOVA test with $\alpha = 0.05$. It is a comparative analysis which makes it possible to know whether the values obtained are at the threshold of 5% statistically equal or not.

RESULTS AND DISCUSSION

Determination of the carcass quality of laying hens at the end of laying: The various parameters measured making it possible to determine the quality of the carcass are given in Table 1. The average live weight value of the Experimental Layers (EL) is significantly higher than that of the live weight of the Control Layers (CL) (1750±50 g against 1500±59 g). The same significant difference is observed in the values of single carcasses, whole offal and fat indices. These values for the Experimental Layers (EL) are, respectively 1125±50 g, 315±10 g and 0.06± 0.005 against 905±70, 290±28 and 0.07±0.01 for the Control Layers (CL). On the other hand, no significant difference was observed for the abdominal fat values of the two types of layers (70±5 g vs. 60±7 g).

Organoleptic tests on layer meats: The meats from the prepared layers (experimental and control) (fillet/thigh) were assessed on the basis of the criteria of tenderness, flavor, aroma, juiciness and texture by a panel of tasters (Fig. 2 and 3). Tenderness scores for fillets and thighs from Experimental Layers (EL) range from 4-5 and are higher (without significant difference ($p>0.05$)) than those from Control Layers (CL) (4-4.5). As for the flavor of the meat of the Experimental Layers (EL), it received marks ranging from 4-6. The annotations of the tasters concerning the aroma, the juiciness and the texture of the meat of the Experimental Layers (EL) range from 3-7. The scores thus assigned are all statistically ($p<0.05$) higher than those of the meat of the Control Layers (CL) [(3-4.5) and (3-5)].

Society is increasingly sensitive to the composition of food products and their nutritional values. As meats are no exception to this phenomenon, consumers are waiting for clear, demonstrative and detailed information to reassure them about their "health" advantages (protein intake, low lipid content and fatty acid intake. polyunsaturated omega 3 type)[10].

The evaluation of the quality of the layer meat for this study made it possible to know the values of carcass yield and fat index. The fat index is 0.06 for a carcass yield of

Table 1: Evaluation of the carcass quality of laying hens at the end of lay

Settings	Experimental layers	Control layers
Live weight (g)	1750±50	1500±59
Whole carcass (g)	1600±100	1350±63
Single carcass (g)	1125±50	905±70
Whole giblets (g)	315±10	290±28
Slaughter yield (S) (%)	73.43±0.03	70.67±0.09
Abdominal fat (g)	70±5	60±7
Fat Index (FI)	0.06±0.005	0.07±0.01
Color	104±0.6	102±0.4
pH		
15 min	6.6±0.1	6.4±0.1
24 h	5.84±0.06	5.75±0.01

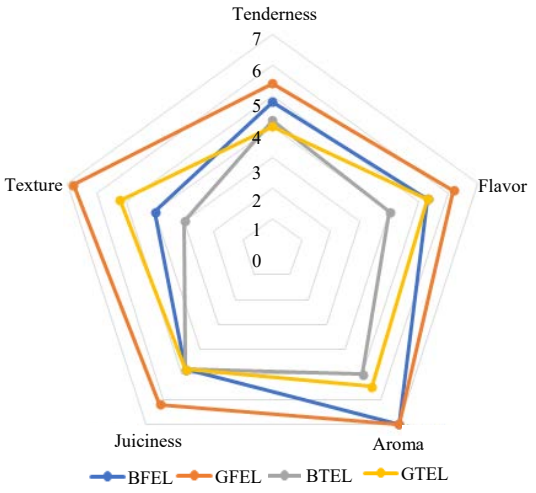

Fig. 2: Sensory profile of pieces of experimental layer meat; BFEL: Boiled Fillet Experimental Layer; GFEL: Grilled Filet Experimental Layer; BTEL: Boiled Thigh Experimental Layer; GTEL: Grilled Thigh Experimental Layer

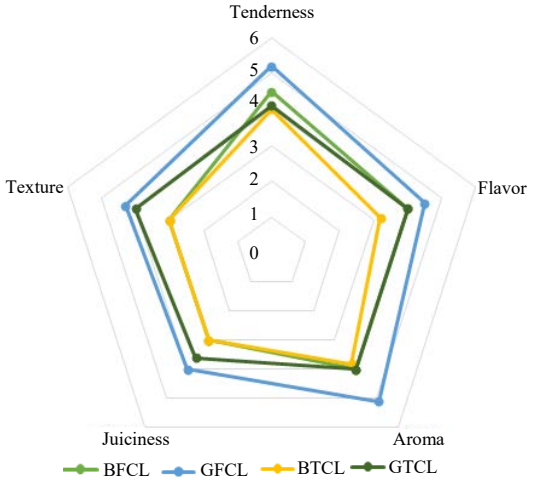

Fig. 3: Sensory profile of pieces of control layer meat; BFCL: Boiled Fillet Control Layer; GFCL: Grilled Filet Control Layer; BTCL: Boiled Thigh Control Layer; GTCL: Grilled Thigh Control Layer

73.43%. The yield result is somewhat similar to that of Eugene *et al.*[11] (72.78%) obtained during previous work. However, it turns out to be superior to the yields obtained by Eugene *et al.*[11] (67.17%) in Ivory Coast, Ouattara *et al.*[12] (61.5%) in Burkina Faso but lower than those of Bello[13] (74.89, 76.48, 76.98 and 77.20%) and Ayssiwede *et al.*[14] (75.20, 75.50, 77.13 and 77.30%) in Senegal. These variations could be explained by differences in breeding and feeding conditions.

The final pH of the meat constitutes a major element, among the criteria of the sensory and technological quality of poultry meat[15]. Also, for this study the final pH (24 h after slaughter) was 5.84 for the Experimental Layers (EL) and 5.75 for the Control Layers (CL). These pH values are close to the pH stabilization framework of poultry meat. Indeed, the final pH value always stabilizes at a minimum value which is normally between 5.6 and 5.8[16]. They are somewhat consistent with the pH value of Meda *et al.*[17] who in his study reported an average pH value of 5.82. The pH values observed in the present study (5.75 and 5.84) are in the pH range 5.7-6.1. This range is that of acceptable pHs suitable for the preservation and processing of meat[18].

The organoleptic tests on the meat of the Experimental Layers (EL) showed that of the four pieces tested the most appreciated is the grilled fillet (GFEL) and the least appreciated the boiled thigh (BTEL). Overall, sensory analysis of meat from Experimental Layers (EL) gave low results on average. Indeed, tenderness received ratings ranging from 4-5. Flavor, aroma, juiciness and texture had ratings varying from 3-7. These results can be corroborated by those of the work of Beugre[19] on hybrid chickens. For the Control Layers (CL), it turns out that of the four pieces tested the most popular is also the grilled fillet (GFCL) and the least popular is also the boiled thigh (BTCL).

In summary, the meat of the Experimental Layers (EL) appears on the visual as having a yellow color (104), low in fat and with good slice retention. The meat of the Control Layers (CL) that has it is visually a very pale yellow (102), moderately fatty with an acceptable slice behavior. Both are in the category of meat of good technological quality.

The meat of the Experimental Layers (EL) of this study can be qualified as not very tender, moderately tasty, juicy and flavored and with a texture that is noticeably pleasant in the mouth.

CONCLUSION

At the end of our analysis, it emerges that the meat of the experimental layers has an appreciable quality profile and a certain organoleptic behavior. The lay feed administered turned out to be good considering the profile it confers on the meat of the layers at the end of lay.

This study could be continued by determining the nutritional profile of layer meats and their impact on consumer health. The results of this study could allow a real increase in productivity in poultry farms and by extension a substantial increase in the income of poultry farmers.

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