# Nutrient Content and Organoleptic Quality of Traditional African Strain and Rhode Island Chickens and the Effect of Feed Rations

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## Abstract

**Pectoral and thigh muscles of African strain and Rhode Island chickens were characterised for their contents in moisture, proteins, lipids and phospholipids. Water retention capacity of the muscles was measured and the influence of enriched cotton cake feed on the muscle quality of Rhode Island race chicken was evaluated. The chicken stocks and their muscles were similar in terms of their water contents (73.6 - 74.9 g/100g). The muscles of the both chicken stocks showed excellent water retention capacity (up to 69%). The Rhode Island race were however, richer in lipids (2.74 - 3.46 g/100g) and phospholipids (0.34 - 0.57 g/100g). Feeding with cotton cake-enriched rations increased the lipid content further. On the other hand, muscles of the African strain chicken were richer in proteins (22.5 - 24.3 g/100g) than those of the Rhode Island race (19.5 - 22.5 g/100g). The nutritional, organoleptic and technological qualities of the chicken muscles are discussed with respect to these characteristics. Cultural consumption habits could explain preference of African Strain Chicken muscles by the local population.**

**Keywords**: chicken, feed, lipids, water retention capacity, proteins, quality.

## Introduction

The production of chicken as table birds has increased considerably in Cameroon over the past years. Although statistics from the relevant government ministry have been controversial, an order of magnitude of about 8 million birds in the year 1986, 10 millions in 1987, 13 millions in 1989 (Batimba and Mindjie, 1992) and even up to 22 millions from large scale poultry farms (Anon., 1995) could be retained. In 1988, traditional poultry production in Cameroon was estimated to account for 65 % of the national production of eggs and chicken (Agbede *et al.*, 1992). These values, which indicate an important revolution in poultry production, could be attributed to improved breeding practices (prophylactic treatments, feed, etc.) as well as to the population's interest in poultry as food and to improve cash earnings.

Poultry farmers have recently been indulging in feed production. This practice, which was common in the large-scale cattle breeding firms, contributes to valorising the waste products of some local industries. Indeed, significant progress has been recorded in terms of reduction of the production cycle: a maximum of 45 days to rear a 2-kg bird (of improved breed) as opposed to almost 6 months for traditional African breed (Jourdain, 1980). The improvement in growth rate notwithstanding, some consumers still consider birds of traditional breed to be of better taste, an appreciation that does not reflect the different aspects of quality. This study, on one hand, compares the nutritional and sensorial qualities of muscle from an improved breed and traditionally raised African breed chicken, and on the other examines the influence of feed type on the muscle quality of Rhode Island birds.

## Material and Methods

### Material

Experimental birds were of traditional African breed and the Rhode Island race, which represents the majority of imported poultry breeds in Cameroon. The birds were acquired as day old chicks from the local market. Samples were made of a total of 18 male birds separated into 3 stocks, one of the local breed and two of the Rhode Island race.

### Feeding

The two stocks of Rhode Island race birds were fed with the same starter and grower rations, but with different finishing rations. As finishing ration, the first stock ($RIC_1$) was fed with an enriched soybean cake diet while the second stock ($RIC_2$) was fed with an enriched cotton cake diet (**Table 1**).

### Muscle preparation

At slaughtering, the local breed and the Rhode Island race birds were respectively 6 months and 45 days old. These ages are habitually considered to be the optimum for their consumption.

**Table 1**.Composition in % (w/w) of the finishing rations fed to the Rhode Island race stocks

| Stock | Ground maize | Soybean cake | Cotton cake | Vitamins & minerals * |
|---|---|---|---|---|
| $RIC_1$ | 71 | 9 | 10 | 10 |
| $RIC_2$ | 71 | - | 19 | 10 |

* Commercial concentrate of vitamins and minerals (gift of ADER Yaoundé- Cameroon)
$RIC_1$: Rhode Island Chicken fed with an enriched soybean cake finishing diet
$RIC_2$: Rhode Island Chicken fed with an enriched cotton cake finishing diet

**Table 2.** Nutrient content and water retention capacity (WRC) of fresh chicken muscles from African strain chicken (ASC) and Rhode Island chicken *

| Stock | Muscle | Lipids (% w/w) | Phospholipids (% w/w) | Proteins (% w/w) | Moisture (% w/w) | Water Retention Capacity (% w/w) |
|---|---|---|---|---|---|---|
| African Strain Chicken (ASC) | Thigh | 2.38 ± 0.03 | 0.51 ± 0.002 | 22.5 ± 0.2 | 74.3 ± 0.5 | 69.4 ± 1.1 |
| | Pectoral | 1.71 ± 0.02 | 0.30 ± 0.003 | 24.3 ± 0.3 | 74.0 ± 0.7 | 66.2 ± 0.7 |
| Rhode Island Chicken, enriched soybean cake ration ($RIC_1$) | Thigh | 3.07 ± 0.17 | 0.57 ± 0.01 | 20.2 ± 0.2 | 73.9 ± 0.2 | 65.8 ± 0.4 |
| | Pectoral | 2.74 ± 0.09 | 0.35 ± 0.02 | 21.0 ± 0.3 | 73.6 ± 0.8 | 61.5 ± 1.1 |
| Rhode Island Chicken, enriched cotton cake ration ($RIC_2$) | Thigh | 3.46 ± 0.17 | 0.56 ± 0.005 | 19.5 ± 0.2 | 74.9 ± 0.9 | 63.5 ± 1.5 |
| | Pectoral | 2.89 ± 0.06 | 0.34 ± 0.002 | 22.5 ± 0.2 | 74.6 ± 0.9 | 61.4 ± 2.0 |

After slaughtering and disembowelling, carcasses were conditioned by refrigeration at 8°C for 24 hours. Skin, visible fat tissues and bones were removed from pectoral and thigh muscles and discarded. The muscles were cut into smaller pieces, mixed using a Warring Blender, wrapped tightly in dark impermeable polyethylene films and deep-frozen at -20°C until needed for analysis.

### Proximate analyses

Proximate analyses were conducted for moisture, proteins, lipids and phospholipid contents, as well as the water retention capacity.

The moisture content of the muscles was determined in conformity with the AOAC method (1980) by drying to constant weight of a 10-g portion in an air-ventilated oven at 105°C. The water retention capacity (WRC) was estimated using the method proposed by Goutefongea (1960). A 5-g muscle portion was placed between two filter paper disks (Whatman n° 3 MM) and pressed with a 2-kg piston for 1 hour. The WRC was calculated as the percentage ratio of the mass of the muscle portion after and before pressure. Lipids were quantitatively extracted from ground muscles by refluxing for 7 hours with hexane (Bourely, 1982).

The phospholipids were quantified using a different process described by Folch *et al.* (1957). The process involved cold extraction using a mixture of chloroforme/methanol (2/1, v/v). The total extracts were then washed with brine solution (0.9 %) to eliminate all inorganic compounds before fractionating the pure lipid extracts on a silicic acid column (Kates, 1982). Total nitrogen was determined using the Kjeldahl method and protein content estimated with 6,25 as conversion factor (AOAC, 1980). All results were expressed as percentage ratio to the mass of fresh muscle.

A panel of 10 trained persons visually appreciated the colour of the thigh and pectoral muscles of the chicken stocks. All analyses were performed in triplicate and student t-test was used (Marcel and Bernard, 1989).

## Results and Discussion

Results on the compositional analyses of the chicken muscles are presented in **Table 2**. The muscles of the Rhode Island race were richer in lipids and phospholipids ($P < 0.05$) than those of the local African breed chicken. Irrespective of the chicken stocks examined, thigh muscles were also richer in both compounds than pectoral muscles. The higher lipid content of the RIC muscle could be related not only to their inherent growth rate (genetic), but also to their lipid-rich diet. This is confirmed by the relatively higher lipid content of RIC chickens fed with enriched cotton cake diet (respectively 3.46 % and 2.89 % for thigh and pectoral muscles) compared to those fed with enriched soybean cake diet (respectively 3.07 % and 2.74 % for thigh and pectoral muscles). It should be noted that the ASC diet comprised essentially probably of insects, worms and vegetable debris picked up in the environment. The lipid content is often closely related to muscle quality as it contributes concurrently to its flavour, juiciness and tenderness. In effect, muscle lipids as a whole, and their phospholipids in particular, are rich in polyunsaturated fatty acids and lipid oxidation derivatives (Gandemer, 1990). Products derived from phospholipid oxidation could interact with other compounds like amino acids and reducing sugars, to produce flavour and aroma during cooking (Rhonda, 1994). The presence of lipids further improves the juiciness by lubricating muscular fibres during cooking, and tenderness by stimulating salivation during mastication (Sellier, 1988).

In terms of protein content, muscles of the local African breed chicken were richer than those of the Rhode Island race. Irrespective of the chicken stocks examined, pectoral muscles were also richer than thigh muscles. In effect, whereas the muscle protein content normally increases with the age of poultry birds (Grey *et al.*, 1983), as found in ASC birds, this parameter is not always influenced by breeding conditions (Bastiens *et al*, 1991).

In all cases, no significant difference

within stocks was observed in terms of muscle moisture content. On the other hand, the water retention capacity (WRC) of the thigh and pectoral muscles of African Strain Chicken (ASC) (respectively 69.4% and 66.2 %) were slightly higher than those of the Rhode Island race [respectively, ~ 66 % and ~ 62 % for those fed with soybean enriched cake ($RIC_1$) and ~ 64 and 61 % for those fed with cotton-enriched cake ($RIC_2$)]. These values, though slightly less, are comparable to those of pork muscle that have been found to be between 70 and 80 % (Goutefongea, 1969). This leads to suggest that chicken muscles could give similar yields in cooked, sterilised and canned products following emulsification and processing with some additives (Jacquet, 1982). The slightly higher WRC of ASC muscles does not solely account for its lesser tenderness. Proteins, in general, retain water favourably well. In effect, the density of the protein network intervenes as water loss during cooking has been associated with partial denaturation of this network. In addition, it is recognised that collagen polymerises during ageing, and as such contributes to the firmness of ASC muscles.

Visual appreciation showed conclusively (9 of 10 votes) that muscles of the African Strain Chicken (ASC) had a more reddish coloration than those of the Rhode Island chicken (RIC). This coloration was on the other hand, always well pronounced for thigh muscles (7/10) than pectoral ones (1/10). The reddish coloration of ASC muscles indicates high iron content, particularly myoglobine (Rhonda, 1994). The difference in myoglobine content could be attributed to ageing (ASC versus RIC birds) and physical exercise (thigh versus pectoral muscles). Unfortunately, the reddish coloration, which characterises good beef, is not usually a quality criterion of poultry muscle.

Indeed, the protein-rich diets of the Rhode Island Chickens gives their muscles a higher lipid content, which is translated as much tenderness in the mouth of the consumer. However, the local population seems to prefer the African Strain Chicken most probably because of culturally consumption habits with a stronger mouth feel. Furthermore, the high water retention capacity of the chicken muscles give an indication that they could be equally suitable as sterilised and canned products.

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