



Major Nutrient and Fatty Acid Compositions of Kadaknath Chicken Reared under the Eastern Himalayan Ecosystem

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ABSTRACT

Background: Kadaknath is an indigenous chicken breed known for its unique meat quality and adaptability to diverse environments. This study assessed the nutrient composition and fatty acid profile of Kadaknath chicken meat reared in the eastern Himalayan ecosystem.

Methods: Eighty Kadaknath chicks were reared under a deep litter system and at 32 weeks, eight birds were randomly selected for meat nutrient and fatty acid analysis.

Result: The live weight, carcass weight and dressing percentage were 1.83 ± 0.14 kg, 1.167 ± 0.11 kg and 63.19 ± 1.27 % respectively. The weight of liver, heart and gizzard was 21.64 ± 1.16 , 8.48 ± 0.29 and 33.28 ± 1.12 g individually, whereas the organ percentage of liver, heart and gizzard was 1.19 ± 0.02 , 0.47 ± 0.02 and 1.84 ± 0.08 % respectively. The moisture, crude protein, ether extract and total ash of the meat were 72.46 ± 0.43 , 23.31 ± 0.23 , 1.11 ± 0.06 and 0.50 ± 0.09 % respectively. Among saturated fatty acids, palmitic acid (32.120 ± 0.18) was the major fatty acid, followed by stearic acid (7.605 ± 0.12). Oleic Acid (43.661 ± 0.29) and palmitoleic Acid (1.677 ± 0.17) were the main monounsaturated fatty acids detected, while linoleic Acid (12.754 ± 0.13) was the chief polyunsaturated fatty acid in Kadaknath meat.

Key words: Fatty acids composition, Kadaknath chicken meat, Organ weight, Proximate composition.

INTRODUCTION

The growing demand for organic meat and eggs has boosted backyard poultry farming, with indigenous breeds preferred for their low input needs, disease resistance and higher market and cultural worth (Sokołowicz *et al.*, 2016). Indigenous chickens, often termed slow-growing (Haunshi and Prince, 2021; Haunshi *et al.*, 2022), are valued for their superior taste and nutrition (Fanatico *et al.*, 2007). Their growth and feed conversion rates are comparable to male layer-type chickens (Petkov *et al.*, 2013), supporting sustainable, high-quality meat production (Popova *et al.*, 2023). In recent years, there has been an increase in demand for meat from indigenous and local birds as consumers perceive that birds reared under extensive system are low in antibiotic and toxic residues (Bai *et al.*, 2022). Meat quality is strongly influenced by genetic factors like breed and strain (Jaturasitha *et al.*, 2004; Shahin and Elazeem, 2005).

Kadaknath is a dual-purpose indigenous breed from central India, mainly found in Madhya Pradesh and Chhattisgarh (Attri and Tyagi, 2010). Traditionally reared by tribal communities (Parmar, 2003), it is known for its dark plumage, distinct blood color and meat valued for taste and nutritional benefits (Parmar, 2003; Thakur *et al.*, 2006). The breed is highly profitable, fetching 2-3 times the price of regular chickens (Prakash *et al.*, 2023) and shows superior disease resistance and lower fat content compared to exotic breeds (Rao and Thomas, 1984). Kadaknath meat had a higher antioxidant capacity than the meat of commercial broiler (Sehrawat *et al.*, 2021). The growth performance and adaptability of Kadaknath chicken

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under the agroclimatic conditions of Meghalaya were satisfactory (Deori *et al.*, 2024). Tribals in Meghalaya typically slaughter them at around 7-8 months of age, often during festivals, religious ceremonies, or weddings. Today, the rising demand for poultry products from extensive production systems presents an opportunity to enhance the role of native chicken breeds, which are especially well-suited for free-range and organic farming due to their strong adaptation to local conditions (Sokołowicz *et al.*, 2016). The present investigation was conducted to assess the major nutrients composition and fatty acid fractions of the meat of Kadaknath chicken reared in a deep litter system under hilly region of Meghalaya.

MATERIALS AND METHODS

The study was conducted at the ICAR Research Complex for NEH Region, Umiam, Meghalaya, India in the Eastern Himalaya under standard housing system and

managemental practices. The farm is located at 21.5°N to 29.5° N latitude and 85.5°E to 97.5°E longitude with an altitude of 1010/ m altitude, the site experiences 2500-3000 mm annual rainfall, with temperatures ranging from 5.50°C in winter to 29.30°C in summer. All experimental protocols were approved by the Institutional Animal Ethics Committee, ICAR Research Complex for NEH Region, Umiam, Meghalaya.

A total of 80 Kadaknath chicks were raised in the farm in four separate pens following deep litter system (20 in each room) with proper ventilation (Deori *et al.*, 2024). Birds were fed age-appropriate rations ad libitum as per NRC (1994) standards (Table 1) and had access to clean water and 16 hours of light. Vaccination and deworming were done following standard farm protocols. At 32 weeks, eight birds were randomly selected, fasted overnight and slaughtered following Arumugam and Panda (1970). Meat samples (~150/ g) from breast, leg and wing (with skin) were pooled, packed and stored at -20°C. Liver, heart and gizzard were collected and weighed as a percentage of body weight.

Proximate analysis in triplicate was carried out within 24 hours of storage following the methods of the Association of Official Analytical Chemists (AOAC, 2007). Parameters investigated on a dry matter basis included crude protein (CP) by Kjeldahl method; nitrogen $\times$ 6.25, ether extract (EE) by ether extraction method and total ash by burning at 500°C for 3 h. The fatty acid profile of Kadaknath meat was evaluated in triplicate as described by O'Fallon *et al.* (2007) with a slight modification and expressed as a percentage. Meat samples were thawed and ground at room temperature using a standard grinder. Approximately 1.0 g samples were placed into a 16 $\times$ 125 mm screw-cap PYREX culture tube and 1.0 mL of the C13:0 internal standard (0.5 mg of C13:0/mL of methanol), 0.7 mL of 10 N potassium hydroxide in water and 5.3 mL of methanol were added. The tube was incubated in a 55°C water bath for 1.5 h with vigorous hand shaking for 5 s every 20 min to permeate, dissolve and hydrolyze the sample properly. After cooling below room temperature in a cold tap water bath, 0.58 mL of 24 N sulfuric acid in water was added. The tube was mixed by inversion and, with precipitated potassium sulfate present, was incubated again in a 55°C water bath for 1.5 h with hand-shaking for 5 s every 20 min. Subsequently, allowing the content for fatty acid methyl ester (FAME) synthesis, the tube was cooled in a cold tap water bath, 3 mL of hexane was added and the tube was mixed for 5 min on a multitube vortex mixer. The tube was then centrifuged for 5 min in a tabletop centrifuge and the hexane layer, comprising the FAME, was placed into a GC vial. The fatty acid composition of the FAME was determined by a GC Model 2010 Plus from Shimadzu. The standard used was obtained from Sigma-Aldrich, Supelco 37 Component FAME Mix (Product Code: CRM47885 with Lot No: LRAC6213).

Data obtained were statistically analyzed using SPSS version 23. The mean value, standard error and percentage attained were used to draw results and conclusions.

RESULTS AND DISCUSSION

The carcass yield and chemical compositions of the meat of Kadaknath chicken are given in Table 2. In the present study, Kadaknath chickens recorded a live weight of 1.83 $\pm$ 0.14 kg, carcass weight of 1.167 $\pm$ 0.11 kg and a dressing percentage of 63.19 $\pm$ 1.27%, similar to the values reported by Bhardwaj *et al.* (2006) and Haunshi *et al.* (2013).

Table 1: Rations provided to Kadaknath chicken during the growth trial.

Ingredients, kg	Starter	Grower	Breeder
Maize	43	44	45
GNC	15	18	16
SBM	23	20.9	17
RP	15.05	13	12.05
Lysine	0.5	0.45	0.4
Methionine	0.2	0.2	0.2
Salt	0.4	0.4	0.5
Toxin binder	0.05	0.05	0.05
Mineral mixture	1.6	1.4	1.3
DCP	1.2	1.6	1.5
Shell grit	-	-	6
Nutrient composition, % (on dry matter basis)			
ME, kcal/kg	2851	2800	2707
(calculated)			
CP	21.02	19.12	18.54
CF	5.1	5.3	5.7
EE	4.2	4.08	3.8

*- Nutritive value per kg: Vitamin A- 7,00,000 IU, Vitamin E- 250 mg, Vitamin D3- 70,000 IU, Cobalt- 150 mg, Iodine- 325 mg, Iron- 1500 mg, Nicotinamide- 1000 mg, Magnesium- 6000 mg, Potassium- 100 mg, Sodium- 5.9 mg, Copper- 1200 mg, Manganese- 1500 mg, Zinc- 9600 mg, Sulphur- 0.72%, Phosphorus- 12.75%, Calcium- 25%.

€- Nutritive value per kg: Phosphorus- Min. 9%, Iodine- Min. 0.01%, Moisture Max- 3%, Iron Min- 2000 ppm, Fluorine Max.- 0.05%, Calcium Min.- 30%, Acid insoluble ash max- 3%, Zinc Min.- 0.40%, Selenium Max- 3.5 ppm, Manganese min- 0.40%, Copper Min- 500 ppm.

Table 2: Carcass yield and meat chemical composition of kadaknath chicken.

Live weight (kg)	1.83 $\pm$ 0.14
Carcass weight (kg)	1.167 $\pm$ 0.11
Dressing %	63.19 $\pm$ 1.27
Liver (g)	21.64 $\pm$ 1.16
Heart (g)	8.48 $\pm$ 0.29
Gizzard (g)	33.28 $\pm$ 1.12
Liver yield % of live wt.	1.19 $\pm$ 0.02
Heart yield % of live wt.	0.47 $\pm$ 0.02
Gizzard yield % of live wt.	1.84 $\pm$ 0.08
Major nutrient composition of Kadaknath meat (pooled sample)	
Moisture %	72.46 $\pm$ 0.43
Crude protein %	23.31 $\pm$ 0.23
Ether extract %	1.11 $\pm$ 0.06
Total ash %	0.50 $\pm$ 0.09

Indigenous breeds like Kadaknath generally show lower dressing yields due to higher feather mass and a greater proportion of non-edible parts (head, shanks, feathers). Ekka *et al.* (2018) reported higher dressing yields (67.57% in males and 67.38% in females) at 20 weeks, while Haunshi *et al.* (2022) found 70.5% at 27 weeks. Variations in dressing percentage can be influenced by age, diet and rearing systems (Wattanachant *et al.*, 2002; Od-Ton *et al.*, 2004; Lawrie, 1991). Compared to commercial broilers, Kadaknath grows slower and has lower muscle mass. These values align with observations in other native breeds such as Aseel Peela and Ghagus (Arora *et al.*, 2011; Rajkumar *et al.*, 2016).

The moisture, crude protein, ether extract and total ash of the Kadaknath meat in the study were 72.46 ± 0.43 , 23.31 ± 0.23 , 1.11 ± 0.06 and 0.50 ± 0.09 % respectively. The moisture content of Kadaknath meat in the current work aligned with the moisture level in Kadaknath meat reported by other researchers. The protein and ether extract concentrations in the present study were comparable to the protein and ether extract % of Kadaknath meat reported by Haunshi *et al.*, (2022) and Balakumar *et al.* (2024). On the other hand, Kumar *et al.* (2018) and Gnanaraj *et al.* (2020) found a lower protein concentration than the current study, whereas Singh and Pathak (2017) found a higher protein concentration (27.25%). The amount of total ash in Kadaknath meat in the current work could be associated with that of the total ash in Kadaknath meat reported by Singh and Pathak (2017) and Kumar *et al.* (2018), while other researchers reported a slightly higher total ash content in the meat of Kadaknath (Gnanaraj *et al.*, 2020; Haunshi *et al.*, 2022).

The chemical composition of chicken meat is influenced by factors such as species, breed, age, muscle type and processing methods (Ding *et al.*, 1999; Lombardi-Boccia *et al.*, 2005; Wattanachant and Wattanachant, 2007). Slow-growing native chickens, like Thai indigenous birds, show higher protein and lower fat content than broilers (Wattanachant *et al.*, 2004). Fanatico *et al.* (2007) and Zotte *et al.* (2020) also reported similar trends in slow-growing breeds. These findings suggest that both genotype and growth rate significantly impact the nutritional profile of chicken meat, with native breeds generally offering leaner, protein-rich meat.

The organ weight and percent of organ weight are given in Table 2. The weight of liver, heart and gizzard were 21.64 ± 1.16 , 8.48 ± 0.29 and 33.28 ± 1.12 g respectively, while the percentage of liver, heart and gizzard of the live weight were 1.19 ± 0.02 , 0.47 ± 0.02 and 1.84 ± 0.08 % respectively. The organ findings in the present study could be associated with the organ weight of 20th and 27th week old Kadaknath chicken reported by Haunshi *et al.*, (2013) and Haunshi *et al.*, (2022), correspondingly. However, the liver and gizzard weight and their percentage of live weight of 10th week old Kadaknath reported by Haunshi *et al.* (2013) were superior to the current findings. The proportion of

internal organs' weight varies and is influenced by factors such as species, age, size and type of animal (Ressang, 1984). Auza *et al.* (2021) reported a similar percentage of liver and heart weight in 12-week-old native chickens (140 DOC), yet they found a superior percentage of gizzard weight.

Native chickens, due to their slower growth and lower feed intake, typically have smaller internal organs involved in digestion and metabolism compared to fast-growing broilers. Liver size reflects its detoxification role and metabolic activity, including bile secretion and protein breakdown (Price and Wilson, 1985; Auza *et al.*, 2021). Heart size is influenced by species, age and activity, adapting to physiological demands (Ressang, 1984). The gizzard, a muscular organ essential for feed grinding, increases in size with high-fiber diets (Amrullah, 2004). These organ variations are linked to genotype, diet and physiological needs of the bird.

The individual fatty acid fractions of Kadaknath meat have been given in Table 3. Among the saturated fatty acids, palmitic (32.120 ± 0.18) was the major saturated fatty acid, followed by stearic acid (7.605 ± 0.12). The concentration of monounsaturated fatty acids (MUFA) was higher, especially oleic acid (43.661 ± 0.29), whereas linoleic acid (12.754 ± 0.13) was the chief polyunsaturated fatty acid (PUFA).

Polyunsaturated fatty acids (PUFAs) like linoleic and α -linolenic acids cannot be synthesized by the body, making their tissue levels diet-dependent (Wood and Enser, 1997). In contrast, saturated and monounsaturated fatty acids are endogenously synthesized and remain stable. The present fatty acid profile of Kadaknath meat aligns with Gnanaraj *et al.* (2020) and varies among native breeds due to dietary differences (Cherian *et al.*, 2002). Lean meats, including

Table 3: Fatty acid compositions of Kadaknath meat (pooled sample).

Fatty acids fractions	g/100 g
Oleic acid (C18:1n9c)	43.661 ± 0.29
Linoleic acid (C18:2n6c)	12.754 ± 0.13
Palmitic acid (C16:0)	32.120 ± 0.18
Stearic acid (C18:0)	7.605 ± 0.12
A-Linolenic acid (C18:3n3)	0.390 ± 0.01
Myristic acid (C14:0)	0.927 ± 0.02
Palmitoleic acid (C16:1)	1.677 ± 0.17
Heptadecanoic acid (C17:0)	0.124 ± 0.02
Elaidic acid (C18:1,9t)	0.067 ± 0.01
Eicosatrienoic acid (C20:3n3)	0.095 ± 0.02
Heptadecanoic acid (C17:1)	0.149 ± 0.04
Arachidic acid (C20:0)	0.105 ± 0.02
Arachidonic acid (C20:4)	0.249 ± 0.01
Saturated fatty acids (SFA)	40.880 ± 0.26
Unsaturated fatty acids (USFA)	59.043 ± 0.27
Monounsaturated fatty acids (MUFA)	45.555 ± 0.36
Polyunsaturated fatty acids (PUFA)	13.489 ± 0.13
Trans fatty acids (TFA)	0.077 ± 0.01
Unsaturated: Saturated	1.445 ± 0.02

poultry, have low fat content and favorable P:S ratios, while meat from grazing ruminants naturally offers a beneficial n-6 to n-3 polyunsaturated fatty acid balance (Wood and Enser, 1997). Poultry respond rapidly to dietary changes in PUFA levels, especially n-3 fatty acids, which inversely affect n-6 levels (Tougan *et al.*, 2018).

Indigenous chickens are considered healthier due to lower fat, cholesterol and favorable fatty acid profiles (Jaturasitha *et al.*, 2008). Fat and triacylglycerol composition in muscle significantly influence meat quality, affecting flavor and tenderness (Miller, 1994). Despite similar diets, differences in fatty acid composition may arise from breed-specific feeding behaviors (Hunton, 1995). Indigenous chickens often show higher saturated and lower polyunsaturated fatty acids than broilers (Wattanachant *et al.*, 2004). In poultry, dietary fats are absorbed and deposited directly without modification (Wood and Enser, 1997). Fatty acid profiles are influenced by breed, anatomy and rearing practices (Žlender *et al.*, 2000).

CONCLUSION

Kadaknath chicken meat from the Eastern Himalayan region showed high protein, low fat and favorable fatty acid composition. The hilly ecosystem did not adversely affect meat quality, as the nutrient and fatty acid profiles were comparable to those reported in other Indian regions. Further research on amino acid, mineral content and muscle fiber characteristics of breast and thigh meat can provide a complete nutritional profile of Kadaknath chicken.

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Conflict of interest

The authors also declare that they have no conflict of interest in this study.

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