

# Kadaknath Chicken Meat: Scope and Source of Animal Origin Nutrients for High-Altitude Regions

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## ABSTRACT

Leh-Ladakh falls in the category of a high-altitude region with low oxygen, low atmospheric pressure and lack of moisture in the air, thus rendering the climate harsh. Therefore, humans staying in this region need different diets, nutrient levels, and other health supplements compared to low-lander people to thrive under these stressful conditions. Chicken meat and eggs have high biological value proteins that play an important role in nutrient supply in human diets. Among them, Kadaknath chicken meat is very famous for its nutritious brown and greyish-black flesh. Its meat contains more protein, less cholesterol and less fat. Its flesh is also known for its various medicinal properties, so it is very popular among health-conscious people. However, fresh chicken production at high-altitude is very limited due to stressful conditions, making poultry rearing very difficult and uneconomical. Kadaknath is an Indian breed of chicken from the Jhabua region of Madhya Pradesh known for its hardy nature to thrive in any harsh environment. Therefore, the Kadaknath breed can be a good choice for high-altitude due to its hardy nature and disease-resistant ability. Hence, Kadaknath chicken meat can prove to be a superfood in high-altitude and such remote regions, especially during the acclimatization period. We have recently started working on the propagation of Kadaknath chicken among the farmers of Ladakh and evaluating their meat quality and medicinal value. The present review focuses on the scope of Kadaknath chicken at Leh-Ladakh under backyard farming, its acceptance, and the advantage of its meat in providing complete nutrition to human consumers.

**Keywords:** Kadaknath; High-altitude; Backyard poultry farming; Meat; Nutritional properties

## 1. INTRODUCTION

Hostile geographic and climatic conditions; sub-zero temperature (-40 to 40 °C), low atmospheric pressure (493-523 mm Hg), low relative humidity (27-45 %), higher UV exposure, higher light intensity, altitude >11000 ft AMSL, precipitation <100 mm, highest wind velocity (8-10 km/hr), etc. in the cold desert high-altitude of Ladakh<sup>1</sup>, causes various physiological, biochemical and hematological alterations in the body. These changes cause directly or indirectly impairment of immune and antioxidant systems that makes humans and animals more susceptible to various diseases in the high-altitude region.<sup>2,3</sup> Animal meat plays a very important role in human nutrition by contributing high quality proteins, essential trace elements, and a range of B-vitamins in bio-available forms.

The extreme climate of Ladakh serves as a big challenge for accessibility and supply of fresh food, including milk and meat from other parts of the nation, especially during the long winter period. Most of the population of Ladakh is non-vegetarian (>90%), so animal meat is the primary source of food. Interestingly, chicken

meat is highly preferred by Indian consumers due to its excellent flavor and palatability. However, due to the extreme climate of Ladakh, successful poultry farming in this region is a major constraint. At the same time, there is the unavailability of local indigenous chicken despite the high demand for fresh chicken meat and egg. Therefore, there is a need to identify a hardy and disease-resistant breed for high-altitude fresh chicken meat production. So far, studies have revealed that Kadaknath chicken meat has good nutritional and medicinal value. This is the only Indian chicken with a GI tag (Geographical Indication) since 30 July 2018.<sup>4</sup> So, the present review focuses on the scope of Kadaknath chickens rearing at Ladakh, a high-altitude region, and how Kadaknath chicken meat nutrients can benefit native people and other consumers in this remote region.

## 2. KADAKNATH CHICKEN BREED

Kadaknath chicken is popularly known as “Kalimasi” in Hindi<sup>5</sup>, and India’s only Black Meat Chicken (BMC), as its flesh is completely black or greyish-black in color.<sup>6</sup> These birds are native to the Jhabua and Dhar districts of Madhya Pradesh and some parts of Gujrat state, India. These are one of the only three varieties in the world of chickens that contain dark meat. The other two are

“Ayam Semani” in Indonesia and “Silki” in China. All these breeds of chicken share similar characteristics and traits. All of them have dark brown and black flesh. The meat color is due to high melanin pigment in these birds, making their color greyish-black. Due to the high melanin content, almost all the body parts of Kadaknath, such as beak, tongue, skin hair, muscles, feet, toes, and even their bones, are greyish-black in color. The cooked meat is also greyish-black in color, which may not give a pleasant and appealing look to our eyes; however, it has a delicious flavor.<sup>7</sup> The eggs of Kadaknath are brownish.

This chicken breed is well known for its resistant nature to extreme climatic conditions like hot summer and cold winter and easily surviving under adverse environments, poor housing, management, and feeding conditions.<sup>8,9</sup> Hence, this breed can be reared under backyard poultry farming and its growth and nutritive characteristics should be further studied at high-altitudes. Kadaknath has been associated with other economic traits like improved egg, meat, resistance to infectious disease,<sup>10</sup> and immune parameters that were distinct from commercial chickens.<sup>11</sup> It attains an average body weight of 865 gm at 20 weeks. Their eggs are small in size in the range of 42-45 gm and have 80 to 85 per cent, 83 to 90 per cent fertility, and hatchability percentage respectively.<sup>12</sup> These birds have been very active in nature since their birth and are very difficult to handle or restrain, which may be the reason for their lean, low-fat meat. Due to its high nutritional value, Kadaknath meat fetches high value in the local market, e.g., Rs 800-1000 per kg, whereas eggs are sold at Rs 20-35/egg. Still, despite the high economic value of

their meat and eggs, commercial farming is not popular because of poor growth and egg-laying.<sup>13</sup> However, Kadaknath will be a good choice for backyard farming in remote and extreme regions as they do not require much farm care and health management. Due to much popularity, there has been considerable interest in various aspects of Kadaknath breed, farm economics, and health value. However, there are limited publications on Kadaknath breed characteristics, meat, and health benefits. A literature review on Kadaknath chicken was conducted using the PUBMED citation database covering the last ten years (2011-2021) and presented in Table 1.

### 3. MEAT QUALITY OF KADAKNATH CHICKEN AND THEIR ROLE IN HUMAN HEALTH

Several studies indicated that Kadaknath meat has high protein and low-fat content than most chicken breeds meat. It is also widely recognized for its medicinal properties among the local tribes.<sup>23,24</sup> Further, tribals of Jhabua village use the meat and blood of Kadaknath to treat various diseases. However, not many scientific reports are available to support this public opinion. It is believed that it increases hemoglobin levels, so it might be useful in asthma and various other respiratory problems by improving tissue oxygenation. Hence, if these health benefits are evaluated, it may become good adaptogen food for high-altitude, where hypoxia is prevalent.

It has been found that the total protein content in Kadaknath meat is 25.47 per cent.<sup>25</sup> This could be due to better protein assimilation during digestion and absorption. Bora,<sup>26</sup> *et al.*, reported high serum total

**Table 1. List of research work in Kadaknath breed over the last ten years in PUBMED**

S. No.	Research	References
1.	Hyperpigmentation in native Indian Kadaknath	Arora <i>et al.</i> <sup>14</sup>
2.	Fertility and hatchability in Kadaknath	Haunshi <i>et al.</i> <sup>5</sup>
3.	Kadaknath breed characterization for production, egg, and semen quality.	Haunshi <i>et al.</i> <sup>13</sup>
4.	TLR mRNA expression in heterophils, serum nitric oxide level, and inducible nitric oxide synthase gene polymorphism	Ramasamy <i>et al.</i> <sup>15</sup>
5.	Th1 and Th2 response in PBMC of Kadaknath	Annamalai <i>et al.</i> <sup>16</sup>
6.	H5N1 virus susceptibility in Kadaknath	Suba <i>et al.</i> <sup>17</sup>
7.	Phylogenetic tree analysis on the basis of mtDNA D-loop	Sahu <i>et al.</i> <sup>18</sup>
8.	Reproductive toxicity of bisphenol-A in adult Kadaknath chicken	Singh <i>et al.</i> <sup>19</sup>
9.	Eimeria Populations sequencing collected from Kadaknath	Hinsu <i>et al.</i> <sup>20</sup>
10.	Semen attributes and fertility in exotic and indigenous breeds	Mavi <i>et al.</i> <sup>21</sup>
11.	Genetic diversity of Kadaknath poultry using amplified fragment length polymorphism markers	Tripathi <i>et al.</i> <sup>22</sup>

protein in Kadaknath as compared to other indigenous chicken breeds, e.g., Rajasri and Aseel. Sehrawat<sup>27</sup> *et al.*, observed higher protein content in Kadaknath meat as compared to Cobb broiler, i.e., average protein content in the breast meat was  $25.21 \pm 0.31$  g/100 g of wet weight,  $19.98 \pm 0.29$  g/100 g of wet weight in thigh meat, which was higher than the Cobb breast, i.e.,  $21.81 \pm 0.39$  and in thigh  $18.31 \pm 0.20$ . Kadaknath meat and eggs are rich in nutrients, vitamins, and protein; and have less fat and cholesterol.<sup>28</sup> In another report, fat content was 0.73-1.03 per cent in Kadaknath meat, 13-25 per cent in other chicken breeds, while cholesterol level was 184.75 mg/100 gm in Kadaknath meat and 218.12 mg/100 gm in other breeds.<sup>29</sup> It is reported that low cholesterol content in indigenous poultry breed makes these birds lean due to high metabolic activity.<sup>30</sup> Hence, a low cholesterol level in indigenous chicken meat helps optimize lipoprotein metabolism.<sup>31</sup> Low fat and high-protein diet are good for muscle development and other physiological processes. The Central Food Technological and Research Institute (CFTRI), Mysore, studied the medicinal properties of Kadaknath meat and found it suitable for heart patients as it increases blood supply to the heart.<sup>32</sup> A recent Nature Communications report suggests that black meat may positively treat atherosclerosis, as more linoleic acid and less cholesterol means protection against stroke, heart attack, and other essential heart conditions.<sup>33</sup> This could be due to improving hemoglobin synthesis and angiogenesis. Even the Chinese people have been using their dark meat chicken in a traditional way to treat various ailments for many years.<sup>34</sup> Other health benefits nutrients found in Kadaknath meat are listed in Table 2.

According to Pashudhan Praharee's report<sup>29</sup>, a brief comparison among the various nutrients and their quantities between Kadaknath and other white chicken meat are listed as follows:

Protein content in Kadaknath meat is 25.47 %, while it varies between 18-20 per cent in white chicken.

- (i) Less cholesterol (0.73-1.05 %) is found in Kadaknath meat than in white chicken (13-25 %).
- (ii) Kadaknath meat has the least fat among all the chicken breeds.
- (iii) High levels of 18 amino acids, 8 of which are essential for humans, are found in Kadaknath meat.
- (iv) Vitamin B1, B2, B6, B12, C, E, niacin, calcium, phosphorus, iron, nicotinic acid are found in the meat of Kadaknath.
- (v) Linoleic acid is found in 24 per cent compared to 21 % in white chicken.

Therefore, Kadaknath meat is no less than a superfood for meat consumers.

#### 4. PRODUCTION OF KADAKNATH CHICKEN MEAT IN THE HIGH-ALTITUDE REGION

Ladakh (11,480 feet above mean sea level) is a new Union Territory state of India, a high-altitude region in the north-western Himalayas, where to date, no commercial poultry farming occurs due to the unavailability of suitable high-altitude germplasm, poultry ration, better veterinary care, and housing managements.<sup>1</sup> The environment is extreme, especially during the winters when this region remains cut off from plain areas due to the closure of roads for at least six months. Therefore, transporting chicken meat and other resources from plain areas becomes more difficult. The most significant adverse effect on poultry health is observed during natural hatching, primarily due to hypobaric-hypoxia and low humidity. Such a climate is very challenging for successful poultry farming in the Ladakh region. Due to these reasons, indigenous chicken is almost extinct in Ladakh today, so no indigenous poultry breed is present. The rearing of exotic and low-altitude chicken breeds is tiresome and expensive due to poor growth, FCR 5-7 and low survivability,

**Table 2. List of nutrients found in Kadaknath meat**

S. No.	Nutrient Parameters	Kadaknath Meat	References
1.	Protein content	25.47%	Mohan et al. <sup>25</sup> ; Sehrawat <i>et al.</i> <sup>27</sup>
2.	Cholesterol level	0.73-1.05%	<a href="https://www.pashudhanpraharee.com/health-benefits-of-kadaknath-chicken/">https://www.pashudhanpraharee.com/health-benefits-of-kadaknath-chicken/</a> <sup>29</sup>
3.	Essential amino-acids	8 essential amino-acids	<a href="https://www.pashudhanpraharee.com/health-benefits-of-kadaknath-chicken/">https://www.pashudhanpraharee.com/health-benefits-of-kadaknath-chicken/</a> <sup>29</sup>
4.	Vitamins	B1, B2, B6, B12, C and E, niacin, calcium, phosphorus, iron, nicotinic acid	<a href="https://www.farmingx.in/kadaknath-chicken-complete-guide/">https://www.farmingx.in/kadaknath-chicken-complete-guide/</a> <sup>35</sup>
5.	Linoleic acid content	24%	<a href="https://www.pashudhanpraharee.com/health-benefits-of-kadaknath-chicken/">https://www.pashudhanpraharee.com/health-benefits-of-kadaknath-chicken/</a> <sup>29</sup>

i.e., 10-18% of mortality was observed, and it varies with time and batch. It was reported that the average body weight gain of parental chickens of exotic breeds like Red Cornish, White Rock, and Black Rock reared at high altitude has low compared to their weight gain in plain regions. Ascites is prevalent in poultry in Ladakh due to production and high-altitude stress. Hypobaric-hypoxia is the principal cause of ascites, which imposes greater metabolic demand and a further decrease in oxygen consumption increases the incidence of ascites.<sup>36</sup> Hence, backyard poultry farming with the Kadaknath chicken breed can be a good option in Ladakh to produce fresh chicken meat of high quality. Since this breed is hardy in nature and has good adaptability to adverse climates. Apart from these constraints, there are other challenges of high-altitude poultry farming such as:

- (i) Slow growth rate
- (ii) Higher Feed Conversion Ratio (FCR)
- (iii) High mortality rate
- (iv) High ascites incidence
- (v) Delayed egg laying and low productivity
- (vi) Negligible natural hatching
- (vii) Unavailability of native germplasm
- (viii) Unavailability of poultry ready-made ration and medicines

In such a situation, where the performance of exotic chicken breeds is not that favorable, rearing indigenous chicken breeds at high-altitude may be a good option for better survivability and consumer fresh chicken meat availability. The DIHAR, KVK, NGOs, and UT state poultry department are functioning together to boost fresh chicken meat availability in the Ladakh sector. The animal science research group of DIHAR is especially working on goat meat production (DIHAR-broiler goat lines) establishing different high-altitude adapted DIHAR-chicken lines, including Kadaknath chicken (Fig. 1). The body weight of day-old chicks (DOC) of the DIHAR-Kadaknath line was 30-35 gms, whereas the average body weight was 784 gms at the 10<sup>th</sup> week. These findings indicated that they are slow growers compared to the other DIHAR-chicken lines developed from exotic Red Cornish, White Rock, and Black Rock pure lines.



Kadaknath hen

Kadaknath rooster

Figure 1. Kadaknath hen and rooster in DIHAR poultry section.

Further, Kadaknath chicken has shown good survivability among the different chicken lines in different generations compared to other breeds. The incidence of ascites is almost negligible in Kadaknath. This could be due to a low metabolic state, as slow-growing birds tend to have slow energy demand.

The studies on meat quality, nutrient digestibility of Kadaknath meat in human consumers, and their medicinal properties need to be studied. Otherwise, folklore and unproven benefits of Kadaknath-meat are flooding in the society which led to extensive slaughter of the breed making it endangered. In one study on sarcoplasmic proteins, the profile of meat of different chicken breeds, including Kadaknath, showed ten bands of 12.4 kDa to 200 kDa. However, many such studies are required to identify their therapeutics role.<sup>37</sup>

Sehrawat, *et al.*<sup>27</sup> reported that Kadaknath meat had a higher antioxidant capacity than commercial broiler meat. These findings indicate that Kadaknath chicken meat is a better source of dietary antioxidants than other chicken meats and therefore, may benefit consumers health. So, this chicken meat can be utilized as an adaptogen food supplement for low-lander people and native highlanders for better acclimatization and health. However, more investigation is required before any of these points can further be claimed. As far the cost economic for rearing this chicken breed is minimal as they do not require any extra special interventions or medication, however the cost of pure Kadaknath chicken is higher than the other commercial breed. The cost of day old unsexed parent Kadaknath chick is Rs 70 whereas it cost Rs 60 of other unsexed parent chick.<sup>38</sup> At high-altitude, Kadaknath’s chicken consumption and probable benefits are summed up in (Fig. 2).

So, based on initial findings on the performance of Kadaknath chicken at high-altitude, this breed is suitable for backyard rearing. However, more studies are required to assess weight gain, production performances, and meat quality in different generations and rearing conditions.

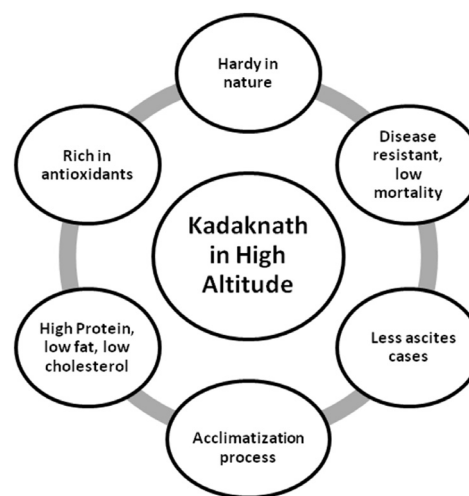


Figure 2. Benefits of Kadaknath at High Altitude.

Therefore, future research on Kadaknath chicken should include how they survive under high-altitude climate and hypoxia, production performance, meat quality, farm management, and economics. It should also explore the suitability of backyard farming. These studies will help establish a scientific basis of high meat quality and medicinal value of Kadaknath meat and may prove a “superfood” at high-altitude.

## 5. CONCLUSION

The various studies and technical reports revealed the high nutritional and medicinal value of Kadaknath chicken meat. So, it may become a “super-food” at high-altitude.

Since, Kadaknath chicken is hardy and disease resistant and therefore should be a choice of backyard poultry farming in all the remote localities and harsh climate, including Ladakh, for fresh meat production. However, the total pure population declined sharply due to the relatively high consumption of Kadaknath chicken meat and cross-breeding. Hence, government and some NGOs should work on breed popularization and developing sustainable breeding policies to conserve this indigenous poultry germplasm. Further, all the animal research institutes, UT state animal husbandry departments, and NGOs should promote the rearing of Kadaknath chicks among the farmers through various incentives, supports, and subsidies in Ladakh and similar localities.

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