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Biochemical profiling of the cestode *Moniezia* sp. and its host *Capra hircus* in the Nanded region of Maharashtra

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Abstract
The present investigation was undertaken to evaluate the biochemical composition of the cestode parasite *Moniezia* sp. and the intestinal tissue of its host, *Capra hircus*. The concentrations of major biomolecules, namely protein, glycogen, and lipid, were estimated using standard biochemical methods. Protein content was recorded as 16.15 mg/g in the normal intestine, 13.17 mg/g in the infected intestine, and 12.64 mg/g in *Moniezia* sp. Glycogen content was 21.36 mg/100 ml in the normal intestine, 18.15 mg/100 ml in the infected intestine, and 16.38 mg/100 ml in the parasite. Similarly, lipid content was found to be 15.72 mg/g in the normal intestine, 12.57 mg/g in the infected intestine, and 11.78 mg/g in the parasite. A progressive decline in all biochemical constituents was observed from normal host tissue to infected tissue and further to the parasite. These findings indicate that *Moniezia* sp. depends largely on host-derived nutrients and causes significant biochemical alterations in the host intestine. The study provides valuable information regarding host–parasite metabolic interactions and contributes baseline data on the biochemical ecology of cestode infections in goats from the Nanded region of Maharashtra.

Keywords: *Moniezia* sp., *Capra hircus*, Biochemistry, Protein, Glycogen, Lipid, Host–parasite interaction

Introduction
Goats (*Capra hircus*) make up 26.40% of India's livestock, establishing it as a leading goat-rearing nation (Anonymous, 2012) [1]. Goat farming is crucial for the rural economy, offering income, nutrition, and livelihood for marginal farmers, landless workers, and nomadic groups (Singh, *et al*., 2018; Deshmukh and Shinde, 2020) [6, 30]. Gastrointestinal parasitic infections, especially cestodes, significantly reduce goat productivity (Patel, *et al*., 2019) [22]. Cestodes absorb nutrients from the host's intestine, causing malnutrition, stunted growth, anemia, and reduced productivity, impacting the health and economic value of animals (Gaikwad *et al*., 2017; Pawar and Hiware, 2020; Shinde *et al*., 2018; Bhosale *et al*., 2021) [3, 9, 24, 28]. Biochemistry, which studies biomolecules' composition and functions, offers insights into parasite physiology and host-parasite interactions, elucidating metabolic pathways and survival strategies of parasites. Cestodes, relying on host nutrients, are ideal for studying physiological and biochemical processes (Fairbairn *et al*., 1961; Smyth and McManus, 1989; Barratt, 1981) [7, 31]. They depend on glucose metabolism for energy, storing carbohydrates like glycogen as reserves (Mishra *et al*., 1945-1991; Markov, 1943; Read and Rothman, 1957; Kulkarni and Patil, 2017) [16, 20, 21, 26]. Proteins, comprising 20–40% of cestodes' dry weight, are crucial for structure, enzymatic activity, and metabolic regulation (Barrett, 1981; Shaikh, *et al*., 2020) [27]. Lipids, vital for reproduction and energy storage, are abundant in cestodes, which rely on host nutrients (Brand and Van T., 1952). The genus *Moniezia*, in the family Anoplocephalidae, commonly infects grazing ruminants like goats and sheep in tropical and subtropical regions. Several *Moniezia* species in Indian ruminants show taxonomic diversity and ecological adaptation, with many documented in Maharashtra's *Capra hircus*, highlighting cestode biodiversity (Jadhav and Ghogare, 2016; Mane *et al*., 2019) [12, 19].

Despite the significance of cestode infections, biochemical studies on cestodes in India remain limited. Previous investigations in Maharashtra's Marathwada region have documented significant variations in protein, glycogen, and lipid content among cestode parasites, reflecting adaptive metabolic strategies influenced by host nutritional status, parasite developmental stage, and environmental factors (Chavan *et al*., 2021; Ghorband and Pawar, 2018; Patil *et al*., 2021) [5, 10, 23]. These findings underscore the importance of biochemical profiling in understanding parasite physiology, host exploitation strategies, and potential therapeutic targets. However, no comprehensive biochemical investigation of *Moniezia* from the Nanded region of Maharashtra has been conducted. This study aims to evaluate the biochemical composition of *Moniezia* and its impact on the infected intestine of *Capra hircus* from the Nanded region of Maharashtra. The outcomes are expected to provide valuable insights into cestode metabolism, host–parasite relationships, and regional parasitic ecology, contributing meaningful baseline data for future research in parasitology, biochemistry, and disease management strategies.

Material and Methods
Collection of Material
The worms were removed from *Capra hircus* digestive tract and cleaned with distilled water. Collected worms were dried on blotting paper to eliminate excess water before being transferred to a watch glass and weighed using a

sensitive balance. The dry weight was also determined after 24 hours of 50-60 Co exposure.

Biochemical Estimation

The biochemical estimation followed by the following standard methods.

1. The estimation of protein content in the cestode parasites were carried out by Lowry's method (1951) [17]
2. The glycogen estimation was carried out by Kemp *et al*., (1954) [15] method.
3. The lipid estimation by Folch *et al*., (1957) [8] method.

Result and Discussion

The biochemical composition of the normal intestine, infected intestine of *Capra hircus*, and the cestode parasite *Moniezia* sp. is presented in Table 1 and Figure 1.

Table 1: Biochemical estimation of ruminant *Capra hircus* intestine and cestode i.e. *Moniezia*

Name of parameter	Host intestine (*Capra hircus*)	Host infected intestine (*Capra hircus*)	Cestode Parasite (*Moniezia)*
Protein	16.15 mg/ gm. wt. of tissue	13.17 mg/gm. wt. of tissue	12.64 mg/gm. wt. of tissue
Glycogen	21.36 mg/100 ml of solution	18.15 mg/100 ml of solution	16.38 mg/100 ml of solution
Lipid	15.72 mg/gm. of wt. of tissue	12.57 mg/gm. of wt. of tissue	11.78 mg/gm. of wt. of tissue

Protein content was highest in the normal intestine (16.15 mg/g tissue), followed by the infected intestine (13.17 mg/g tissue) and *Moniezia* sp. (12.64 mg/g tissue). The infected intestine showed an 18.45% reduction, whereas the parasite exhibited a 21.73% reduction relative to the normal intestine.

Glycogen content was recorded as 21.36 mg/100 ml in the normal intestine, 18.15 mg/100 ml in the infected intestine, and 16.38 mg/100 ml in *Moniezia* sp. The reduction was 15.03% in the infected intestine and 23.31% in the parasite when compared with normal tissue.

Similarly, lipid content was highest in the normal intestine (15.72 mg/g tissue), followed by the infected intestine (12.57 mg/g tissue) and the parasite (11.78 mg/g tissue). Lipid content decreased by 20.04% in infected tissue and by 25.06% in the parasite relative to the normal intestine.

The overall results indicate a progressive decrease in biochemical constituents from normal intestinal tissue to infected tissue and further to the parasite.

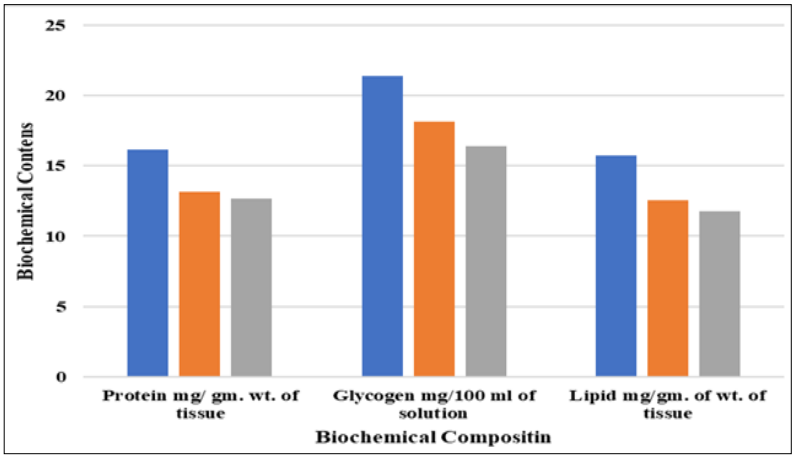

Fig 1: Biochemical estimation of ruminant *Capra hircus* intestine and cestode i.e. *Moniezia*

The present investigation revealed significant biochemical variations among normal intestine, infected intestine, and *Moniezia* sp. The reduction in protein, glycogen, and lipid content observed in infected intestinal tissue suggests metabolic stress imposed by parasitic infection and utilization of host nutrients by the parasite.

Protein is an essential structural and functional component involved in enzyme synthesis, tissue repair, and metabolic regulation. The observed reduction in protein content in infected tissues and the parasite may be attributed to continuous utilization of host-derived amino acids for parasite growth and maintenance. Similar observations have been reported by Ingle *et al*. (2022) [11] and Bhogil *et al*. (2022) [2].

Glycogen serves as the principal storage form of carbohydrate and represents an important energy reserve. The lower glycogen levels observed in infected tissues and the parasite indicate active utilization of carbohydrate reserves to meet energy requirements. Comparable findings were reported by Read and Rothman (1957) [26], who emphasized the importance of carbohydrate metabolism in cestode survival.

Lipids play a vital role in energy storage, membrane formation, and reproductive activities. The reduced lipid content recorded in *Moniezia* sp. and infected intestinal tissue suggests increased utilization of lipid reserves and dependence on host-derived nutrients. Similar findings have been documented by Makne (2021) [18] and Pawar *et al*. (2022) [25].

The gradual decline in biochemical constituents from normal intestine to infected intestine and parasite demonstrates the metabolic dependence of *Moniezia* sp. on the host. Since cestodes lack a digestive system, nutrient absorption occurs directly through the tegument, representing an efficient adaptation for survival within the host environment.

The present findings agree with previous studies on cestode parasites and support the concept that host nutrient exploitation and biochemical modulation constitute important adaptive mechanisms for parasite establishment, growth, and reproduction.

Conclusion

The present study demonstrated significant biochemical alterations associated with *Moniezia* sp. infection in *Capra hircus*. Protein, glycogen, and lipid contents were highest in normal intestinal tissue and progressively decreased in infected intestinal tissue and the parasite. These findings indicate that *Moniezia* sp. relies extensively on host-derived nutrients and exerts a considerable influence on host metabolism. The study contributes valuable baseline information on host–parasite biochemical interactions and may be useful for understanding cestode physiology and developing effective parasite management strategies in goats.

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