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Effect Of Prebiotic Supplementation On The Quality Characteristics Of Rabbit Meat

Shahzad Ahmed[1], Allah Bux Kachiwal[1], Jahanzaib Khaliq[1]*, Ghulam Shabir Barham[2], Tayyab Ahmad[3], Muhammad Bilal Khan[4], Lubna Kandhro[5], Imtiaz Ali Panhwar[6], Muhammad Arif[1], Fateh Muhammad Gad[7], Muhammad Umar Farooq[2], Hamza Faiz[8], Imam Bakhsh Kandhro[9], and Ehsan Ullah[10]

[1]*Department of Veterinary Physiology and Biochemistry, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, 70060 Tandojam, Pakistan.*
[2]*Department of Animal Products and Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan.*
[3]*Institute of Pharmacy,Physiology,and Pharmacology of Veterinary Sciences, Agriculture University Faisalabad, Pakistan.*
[4]*Departmant of Livestock and Dairy Development,Quetta,Balochistan*
[5]*Department of Livestock and Management, Faculty of Animal Husbandry and Veterinary Sciences,Sindh Agriculture University, Tandojam, Pakistan.*
[6]*Shaheed Benazir Bhutto University of Animal Sciences, Sakrand, Sindh.*
[7]*Department of Surgery and Obstetrics, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan.*
[8]*Department of Veterinary Surgery, Faculty of Veterinary Sciences, University of Veterinary and Animal Sciences, Lahore, Pakistan.*
[9]*Department of Veterinary Microbiology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan.*
[10]*Institute of Chemistry,University of Sargodha, Pakistan.*

* ***Corresponding author***: *jahanzaib Khaliq*
**Department of Veterinary Physiology and Biochemistry, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University ,70060 Tandojam, Pakistan.Email:* jahanzaibvet@gmail.com

Abstract

This randomized controlled trial aimed to evaluate the effects of prebiotic supplementation on the meat quality of rabbits. A total of 12 rabbits were divided into two groups (n=6 each). Group A served as the control, while Group B was supplemented with prebiotics in their regular diet over a period of 45 days. The results revealed that Group B showed significant improvements in meat quality compared to Group A. Cooking loss was reduced to(29.21%) in Group B, compared to (35.30%) in Group A. Drip loss in Group B was significantly reduced to (6.75%), compared to Group A (3.02%). Additionally, the pH level in Group B was significantly higher (5.75), compared to Group A (6.18). Water holding capacity was significantly higher in Group B at (65.62%), compared to (51.65%) in Group A. Ash content in Group B was slightly higher (1.20%) than in Group A (1.06%), while carbohydrate level was significantly reduced in Group B (1.61%) compared to Group A (0.99%). Moisture content was also significantly reduced in Group B (73.23%) compared to Group A (75.68%). Protein content in Group B was reduced to (21.42%) than in Group A (19.60%).Fat content in Group B was lower (2.52%), compared to Group A (2.65%) Furthermore, the total soluble content was significantly reduced in Group B (26.76%) compared to Group A (24.31%). These findings indicate that prebiotic supplementation may improve meat quality by reducing cooking loss, drip loss, and improving water holding capacity in rabbits.

Keywords: Prebiotic, Rabbit Meat

INTRODUCTION

Rabbit breeding and production is an important agricultural activity in Pakistan, particularly in rural areas where it provides a source of income and nutrition. The most raised rabbit breeds in Pakistan are the New Zealand White, California, and Chinchilla breeds (Sahota*et al*., 2018).New Zealand White rabbits are a popular breed for meat production due to their rapid growth rates and high feed conversion efficiency (Hussain*et al*., 2017). The breed is known for its large size, with adult rabbits weighing between 3-5 kg, and its white fur, which is easy to clean and process (Sahota et al., 2018). California rabbits are also commonly raised for meat production in Pakistan. They are slightly smaller than New Zealand White rabbits, with adult rabbits weighing between 2.5-4 kg (Hussain*et al*., 2017). California rabbits are known for their efficient feed conversion and good meat quality (Sahota*et al*., 2018). Chinchilla rabbits are a dual-purpose breed, suitable for both meat and fur production. They have a distinctive grey fur with black tipping, which is highly valued in the fur industry (Hussain*et al*., 2017). Chinchilla rabbits have a moderate growth rate and reach an adult weight of around 3 kg (Sahota*et al*., 2018).In addition to these breeds, other breeds such as the Flemish Giant, Dutch, and Rex are also present in Pakistan, although they are less common (Sahota*et al*., 2018). Overall, rabbit breeding and production in Pakistan is an important sector that contributes to food security and rural livelihoods. The New Zealand White, California, and Chinchilla breeds are the most raised breeds, due to their suitability for meat and fur production.According to a report by the Food and Agriculture Organization (FAO) of the United Nations, the total number of rabbits in Pakistan was estimated at 1.23 million in 2020, with an annual production of 2,460 tons of rabbit meat. This is a relatively small contribution compared to other livestock industries such as poultry, cattle, and goats, but it is a growing industry with potential for further development. Rabbit meat is considered a healthy and nutritious source of protein and has the potential to meet the growing demand for high-quality protein in Pakistan. To attempt the demand for the modern consumers' desire for a healthy lifestyle, rabbit meat can be an interesting source of high contents of polyunsaturated fatty acids, proteins, and essential amino acids (Li *et al*., 2018). Rabbit meat products have been rapidly developed during the last two decades, with an increase in the global rabbit meat production by 16% between 2010-2015 and have become increasingly popular worldwide (Li *et al*., 2018).The demand for high-quality and nutritious meat has led to increased research into various factors that influence the quality and composition of meat in livestock animals. Among these factors, nutrition plays a pivotal role, with dietary interventions having the potential to significantly impact meat characteristics (Evans *et al*., 2020). The production of high-quality meat is a key objective in modern animal husbandry, driven by consumer demands for nutritious, flavorful, and sustainable food sources. The quality and composition of meat are influenced by a complex interplay of genetic, environmental, and nutritional factors. Among these factors, nutrition has emerged as a powerful tool for optimizing meat characteristics (Guarino*et al*., 2017). Recent advances in animal nutrition have led to the exploration of novel dietary additives, such as prebiotics, which have the potential to enhance both animal health and meat quality (Miranda *et al*., 2019).Rabbit meat has gained attention as a valuable source of high-quality protein with low fat content and good nutritional value. In recent years, there has been a growing interest in improving the nutritional quality of rabbit meat through dietary interventions. Rabbit meat is recognized for its excellent nutritional profile, offering a lean source of high-quality protein, essential amino acids, and minimal levels of saturated fat (Combes*et al*., 2015; Dalle&Cullere, 2019). As global dietary preferences shift towards healthier and more sustainable options, rabbit meat has garnered increased attention as a valuable component of human diets. However, with the growing demand for nutritious and wholesome meat, researchers and producers are continuously exploring innovative strategies to enhance the nutritional attributes of rabbit meat. Prebiotics are non-digestible compounds that selectively stimulate the growth and activity of beneficial gut microbiota, which in turn can influence nutrient digestion, absorption, and metabolism in the host. This interaction between prebiotics and gut microbiota has the potential to impact the nutrient composition of rabbit meat (Gidenne*et al*., 2015; Siddiqui*et al*., 2023).Prebiotics, classified as non-digestible compounds, hold promise as functional feed additives that promote the growth and activity of beneficial microorganisms in the gut. These microorganisms, collectively referred to as the gut microbiota, play a critical role in nutrient metabolism, immune function, and overall gut health (Roto*et al*., 2015; Dittoe*et al*., 2018). The gut microbiota has been increasingly recognized as a regulator of various physiological processes, extending its influence beyond the gastrointestinal tract. The effects of prebiotic supplementation on the quality and composition of meat of rabbits (Sanders *et al*., 2019). Rabbits are valued for their lean and protein-rich meat, making them a favorable choice for health-conscious consumers. The mechanisms underlying the effects of prebiotics on meat quality are multifaceted. Prebiotics provide a substrate for beneficial gut microorganisms to thrive, leading to enhanced fermentation processes that produce short-chain fatty acids (SCFAs). SCFAs serve as an energy source for gut epithelial cells, supporting gut barrier integrity and immune function (Leblanc *et al*., 2017; Blaak*et al*., 2020). The modulation of gut inflammation and improved nutrient absorption can collectively contribute to the animal's overall well-being, which in turn might be reflected in meat quality attributes. As the global demand for high-quality protein sources continues to rise, exploring innovative strategies to improve meat quality becomes paramount. The potential of prebiotics to positively influence rabbit meat quality aligns with the broader goals of sustainable agriculture and animal welfare (Hassoun et al., 2022; Soumati*et al*., 2023). By deciphering the intricate interactions between prebiotics, gut microbiota, and meat quality, researchers can pave the way for targeted nutritional interventions that enhance the value and desirability of rabbit meat. The gut microbiota's intricate connection with host health and performance underscores its significance in meat production. A balanced gut microbiota is associated with efficient nutrient digestion and absorption, which can directly influence the development of muscle tissue and subsequently impact meat yield and composition. Furthermore, the gut microbiota contributes to the synthesis of certain vitamins and bioactive compounds that can indirectly influence meat quality attributes such as color, flavor, and oxidative stability (Mitrea*et al*., 2022). Prebiotics, a category of dietary additives, have garnered attention for their potential to positively influence both animal health and meat quality. Prebiotics are non-digestible compounds that selectively stimulate the growth and activity of beneficial gut microorganisms, thereby fostering a healthy gut microbiota. Enhancing the quality and nutritional profile of rabbit meat through dietary strategies aligns with consumer preferences for wholesome and sustainable food sources (Roto*et al*., 2015; Saini et al., 2022). Probiotics has been largely reported in cattle, chicken and pigs (Abdou*et al*., 2018). Generally, the probiotics mechanisms of action are reduction of metabolic reactions which produce toxic substances, stimulation of host enzymes, production of vitamins or antimicrobial substances, competition for adhesion to epithelial cells and an increased resistance to colonization, and stimulation of the immune system of the host (Falcão-e-Cunha *et al*., 2007)The utilization of prebiotics, which are non-digestible dietary compounds known for their ability to selectively stimulate the growth and activity of beneficial gut microbiota. The complex interplay between gut microbiota and host health is well-established, with an emerging understanding of its profound impact on nutrient digestion, absorption, and metabolism (Gibson *et al*., 2017). Prebiotics, by promoting the growth of beneficial microbes, have the potential to influence various physiological processes within the gastrointestinal tract, ultimately affecting the nutritional composition of meat derived from these animals (Plaizier et al., 2017; Beaumont *et al*., 2022). Despite extensive the effects of prebiotic supplementation on rabbit health, growth performance, and intestinal function, there remains a noteworthy knowledge gap regarding the specific influence of prebiotics on the nutrient composition of rabbit meat (Bosco*et al*., 2019). By focusing on changes in protein content, fat content, mineral profiles, and other relevant nutrients, this study seeks to provide comprehensive insights into the potential benefits and limitations of using prebiotics as a tool for improving the nutritional quality of rabbit meat (Pinheiro*et al*., 2020; Xie*et al*., 2023). The effects of prebiotic supplementation on the growth performance, intestinal health, and meat quality of rabbits. However, there is limited comprehensive research that specifically examines how prebiotic supplementation might alter the nutrient composition of rabbit meat. This study aims to review and analyze the existing literature on the impact of prebiotic supplementation on the nutrient composition of rabbit meat, focusing on changes in protein, fat, minerals, and other relevant nutrients (Yang *et al*., 2021; Trocino*et al*., 2022).One potential strategy to mitigate the negative effects of EHS on rabbits is the use of prebiotics. Prebiotics are non-digestible dietary fibers that selectively stimulate the growth and activity of beneficial gut bacteria (Gibson and Roberfroid, 1995). They have been shown to improve gut health, reduce inflammation, and enhance immune function in various animal species (Yang *et al*., 2019; Wang *et al*., 2020). Prebiotics are non-digestible food ingredients that can stimulate the growth and activity of beneficial bacteria in the gut, improving digestive health and overall performance. In the context of environmental heat stress in rabbits, prebiotics have been investigated as a potential solution for mitigating the negative impacts of heat stress on rabbit health and productivity.Several types of prebiotics have been used in studies on heat-stressed rabbits, including fructooligosaccharides (FOS), mannanoligosaccharides (MOS), and inulin. For example, Shakoor*et al*. (2018) used a prebiotic blend containing FOS and MOS in their study on heat-stressed rabbits, while Sattar*et al*. (2020) used a prebiotic blend containing inulin.Studies have reported positive effects of prebiotic supplementation on the growth performance, feed intake, and feed conversion efficiency of heat-stressed rabbits. For example, Shakoor*et al.* (2018) reported that prebiotic supplementation improved growth performance, feed intake, and feed conversion efficiency in heat-stressed rabbits. Similarly, Sattar*et al*. (2020) found that prebiotic supplementation improved feed intake, weight gain, and carcass characteristics in heat-stressed rabbits.Overall, prebiotics show promise as a potential solution for mitigating the negative effects of environmental heat stress on rabbit health and productivity. Therefore, this research is planned to determine the effect of prebiotic supplementation on quality and composition of meat in rabbit.

MATERIALS AND METHODS

Experimental Design

This study utilized a randomized controlled trial design with two cohorts of rabbits, as outlined in Table I. Each cohort consisted of n=6 animals, totaling 12 rabbits. The first group (Group A) served as the control and did not receive any prebiotic supplementation. The second group (Group B) was provided with prebiotic supplementation in addition to their regular dietary intake. The experimental duration was 45 days.

Table I: Experimental Group Allocation

Group	Treatment	Number of Animals
A	Control (no prebiotic)	6
B	Prebiotic supplementation	6

Animal Care

All rabbits were housed individually in enclosures with unrestricted access to water and commercial pellet feed. The environmental conditions of the housing facility were carefully controlled, with a temperature maintained at 25 ± 2°C, a relative humidity of 50 ± 5%, and a 12-hour light/dark cycle.

Prebiotic Supplementation

The prebiotic supplement used in this study included Fructooligosaccharides (FOS) and Mannanoligosaccharides (MOS). The prebiotic supplement was dissolved in drinking water and provided ad libitum to the rabbits in Group B throughout the study period.

Measurements

At the end of the 45-day study period, all rabbits were humanely slaughtered following ethical guidelines and standard procedures. The following measurements were taken to assess meat quality:

Chemical Test Parameters

- ***Protein***: The protein content was determined by the Kjeldahl method, which measures total nitrogen content (Benedict, 1987).
- ***Carbohydrates***: The carbohydrate content was calculated by subtracting the percentages of protein, fat, moisture, and ash from 100%.
- ***Fat***: The fat content was determined using the Soxhlet extraction method, where fat was extracted using a solvent, and the solvent was evaporated to calculate the fat percentage (Bohrer, 2019).
- ***Ash***: Ash content was determined by dry ashing for proximate composition and wet ashing for mineral analysis (Jones, 2001; Enders and Lehmann, 2012).
- ***Moisture***: Moisture content was measured using the Karl Fischer titration method, which quantifies water content based on the reduction of iodine by sulfur dioxide (Fischer, 1935). Protein, fat, carbohydrates, ash, and moisture content were determined according to AOAC procedures (AOAC, 2016).

Physical Test Parameters

- ***pH***: The pH of the meat was measured using a pH meter, either directly on the meat or by creating a slurry with water (Trout, 1989).
- ***Drip Loss***: Drip loss was calculated by weighing the meat sample before and after storage under controlled conditions, with the difference in weight representing the drip loss (Barton-Gade *et al*., 1993; Kim et al., 2013).
- ***Cooking Loss***: Cooking loss was measured by weighing the meat before and after cooking, typically using grilling or baking methods, with the weight difference indicating cooking loss (Kim *et al*., 2013).
- ***Water Holding Capacity***: Water holding capacity was assessed by measuring the amount of water released from the meat sample under pressure using methods such as the filter paper press method (Kristensen & Purslow, 2001).

Sensory Test Parameters
Sensory quality of the rabbit meat was evaluated using a 6-point hedonic scale. Parameters such as color, aroma, odor intensity, flavor, tenderness, and firmness were rated, where 1 represented "disliked extremely" and 6 represented "liked extremely" (Larmond, 1982).

STATISTIC ANALYSIS

The data was statistically analyzed using the "Student Edition of Statistics" computer program. Correlation and regression analyses were performed to examine the relationship between different parameters. Results were considered statistically significant at ($P < 0.05$).

RESULTS

Live body weight of Rabbits
The live body weight of rabbits was measured over a period of six weeks, with results indicating a significant difference between the control and supplemented groups. The rabbits in the supplemented group exhibited a consistently higher live weight compared to the control group ($P<0.05$). For the control group, the mean live weight started at 800±0.39 g and increased gradually to 1100±0.33 g by the fourth week before slightly declining to 1015±0.45 g by the sixth week. In contrast, the supplemented group started at 1180±0.47 g and steadily increased, reaching 1520±0.49 g by the fourth week, and remained higher (1370±0.76 g to 1410±0.39 g) throughout the study. These results suggest that supplementation with prebiotics positively affected the rabbits' live weight during heat stress conditions.

Table II: Live Body Weight of Rabbits

Weeks	Control (Mean±SEM)	Treated Group (Mean±SEM)
1	$800±0.39^{b}$	$1180±0.47^{a}$
2	$1000±0.22^{a}$	$1200±0.38^{a}$
3	$1100±0.12^{b}$	$1500±0.26^{a}$
4	$1100±0.33^{a}$	$1520±0.49^{a}$
5	$1015±0.45^{a}$	$1370±0.76^{a}$
6	$1035±0.72^{a}$	$1410±0.39^{a}$

Respiration Rate of Rabbits
The respiratory rate was measured over six weeks, revealing that the supplemented group had a significantly lower respiratory rate compared to the control group ($P<0.05$). The control group started with a respiratory rate of 39±0.15 breaths per minute and increased to 47±0.30 by the sixth week. In comparison, the supplemented group started at 30±0.25 breaths per minute and ended with 31±0.17 breaths per minute, indicating a beneficial effect of supplementation on reducing respiratory stress during heat exposure.

Table III: Respiratory Rate (Breaths per Minute) in Rabbits

Weeks	Control (Mean±SEM)	Treated Group (Mean±SEM)
1	$39±0.15^{a}$	$30±0.25^{b}$
2	$45±0.24^{a}$	$35±0.30^{b}$
3	$40±0.22^{a}$	$25±0.42^{b}$
4	$47±0.30^{a}$	$33±0.46^{b}$
5	$48±0.40^{a}$	$34±0.15^{b}$
6	$47±0.30^{a}$	$31±0.17^{b}$

Rectal Temperature of Rabbits
Rectal temperature measurements showed that the supplemented group had a lower average temperature compared to the control group. The control group's temperature started at 102.3±0.12°F and fluctuated, reaching 103.4±0.31°F by the sixth week. Conversely, the supplemented group maintained a lower average rectal temperature, starting at 101.9±0.01°F and peaking at 102.7±0.43°F. However, the difference in rectal temperature between the groups was not statistically significant ($P>0.05$).

Table IV: Rectal Temperature (°F) in Rabbits

Weeks	Control (Mean±SEM)	Treated Group (Mean±SEM)
1	102.3±0.12[a]	101.9±0.01[b]
2	102.9±0.32[a]	100.2±0.21[b]
3	102.8±0.02[a]	102.2±0.23[b]
4	102.6±0.21[a]	101.8±0.41[b]
5	101.9±0.36[a]	103.4±0.25[b]
6	103.4±0.31[a]	102.7±0.43[b]

Heart Rate of Rabbits

Heart rate measurements showed that the control group consistently exhibited higher heart rates than the supplemented group. The control group started with a heart rate of 150±0.14 beats per minute and decreased to 149±0.41 by the end of the study. In comparison, the supplemented group had lower initial heart rates (130±0.20 beats per minute) and remained consistently lower (120±0.41 beats per minute at week 4 to 130±0.23 at week 6). The differences in heart rates between the two groups were statistically significant (P>0.05).

Table V: Heart Rate (Beats per Minute) in Rabbits

Weeks	Control (Mean±SEM)	Treated Group (Mean±SEM)
1	150±0.14[a]	130±0.20[b]
2	145±0.23[a]	135±0.32[b]
3	160±0.02[a]	125±0.44[b]
4	151±0.31[a]	120±0.41[b]
5	150±0.71[a]	127±0.41[a]
6	149±0.41[a]	130±0.23[a]

Effect of Prebiotics on Meat Quality in Rabbit

Cooking Loss (%)

Figure-I illustrates the reduction in cooking loss percentage in rabbits from the supplemented group (Group B) as compared to the control group (Group A), with Group B showing a significantly lower cooking loss percentage (29.21% vs. 35.30%, P<0.05).

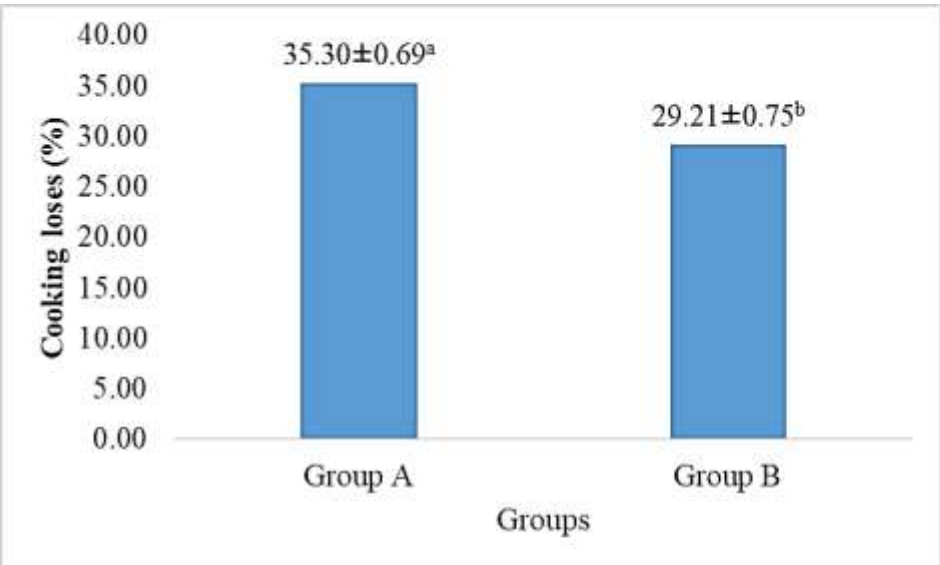

Figure I. Cooking loses (%) of meat of rabbit

Drip Loss (%)

Drip loss was lower in Group B (6.75%) compared to Group A (3.20%), but the difference was not statistically significant (P>0.05).

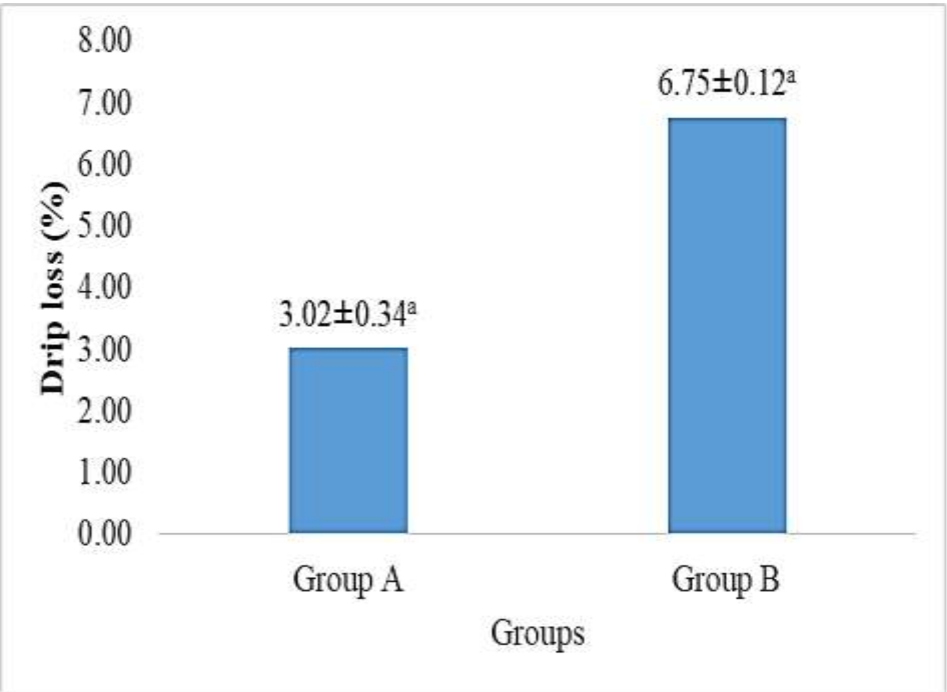

Figure II. Drip loses (%) of meat of rabbit

pH of Meat
The pH of meat from rabbits in Group B was significantly higher (5.75) than in Group A (6.18), indicating that the prebiotic supplementation influenced meat pH levels ($P<0.05$).

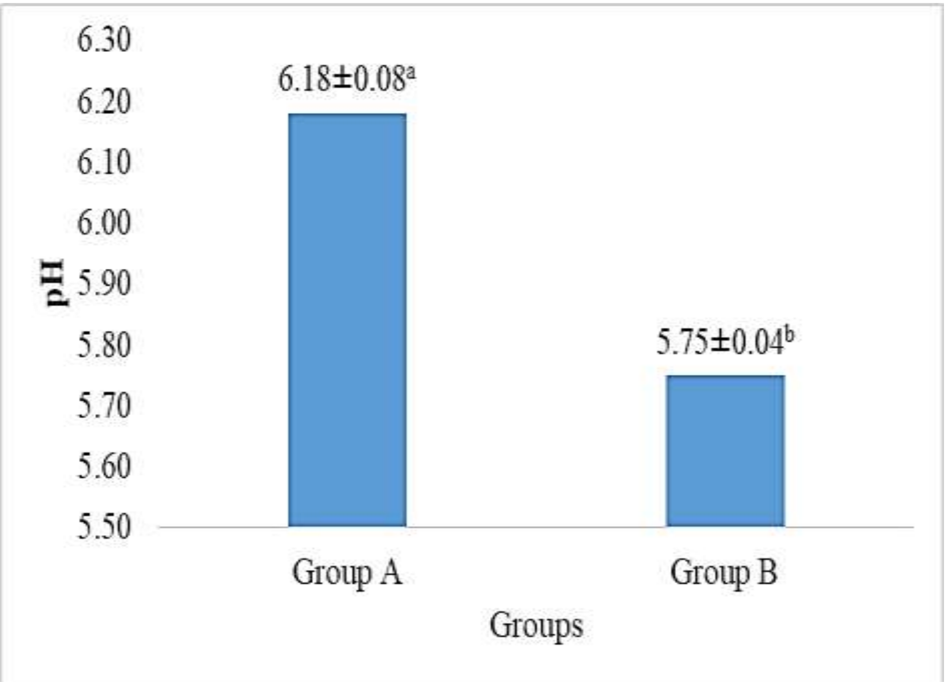

Figure III. pH of meat of rabbit

Water Holding Capacity (%)
The water holding capacity of rabbit meat was significantly higher in Group B (65.62%) compared to Group A (51.65%), with statistical significance confirmed by ANOVA ($P<0.05$).

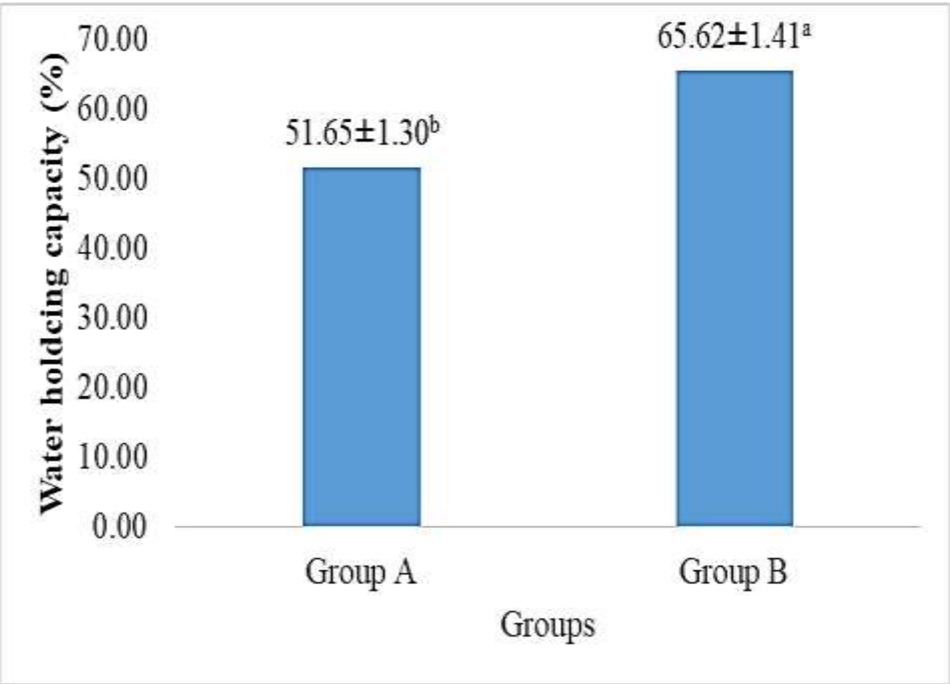

Figure IV. Water Holding Capacity (%) of meat of rabbit

Color of Meat

No significant difference in meat color was found between the groups, with Group A showing a color score of 2.28 and Group B a score of 3.60 (P>0.05).

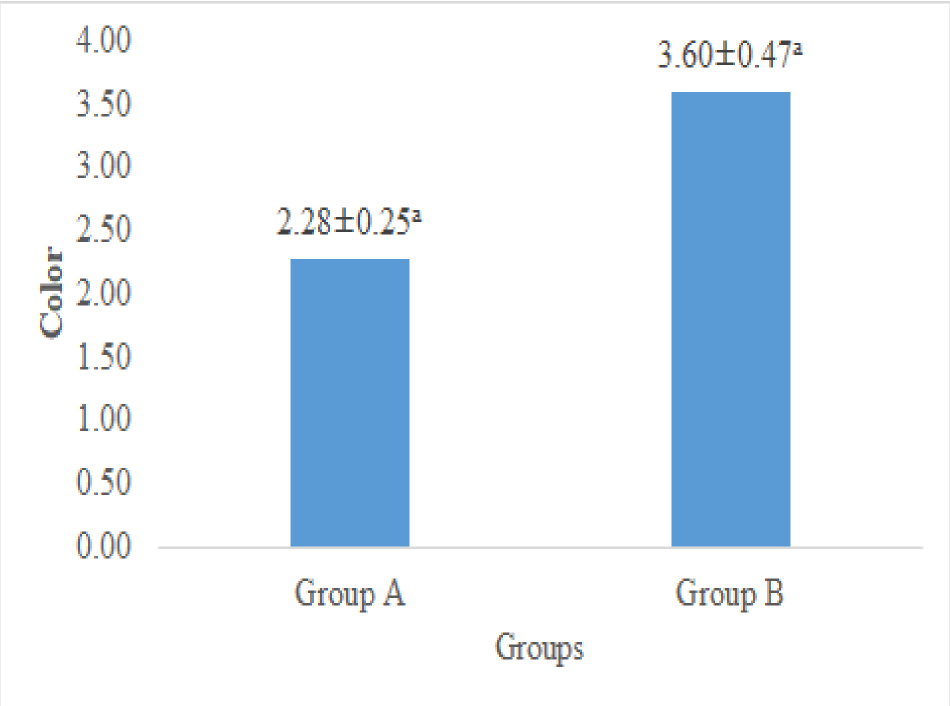

Figure V. Color of meat of rabbit

Aroma of Meat

No significant difference in aroma was observed, with Group A having a score of 2.17 and Group B scoring 3.89 (P>0.05).

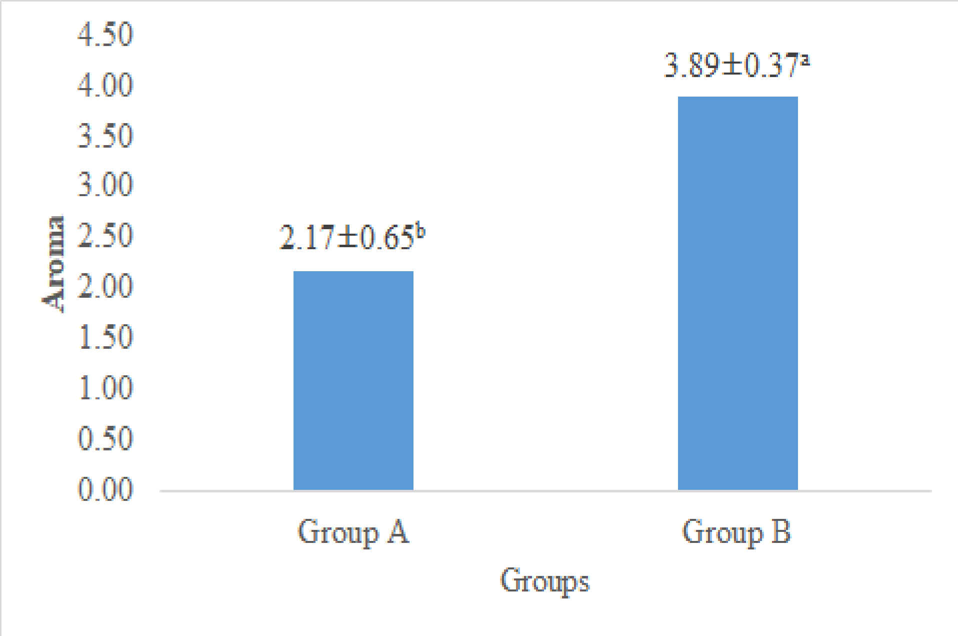

Figure VI. Aroma of meat of rabbit

Odor Intensity

Similarly, odor intensity was not significantly different between groups (Group A: 2.48, Group B: 3.89, P>0.05).

Figure VII. Odour intensity ofmeat of rabbit

Flavor of Meat

Flavor intensity also showed no significant difference (Group A: 2.16, Group B: 3.12, P>0.05).

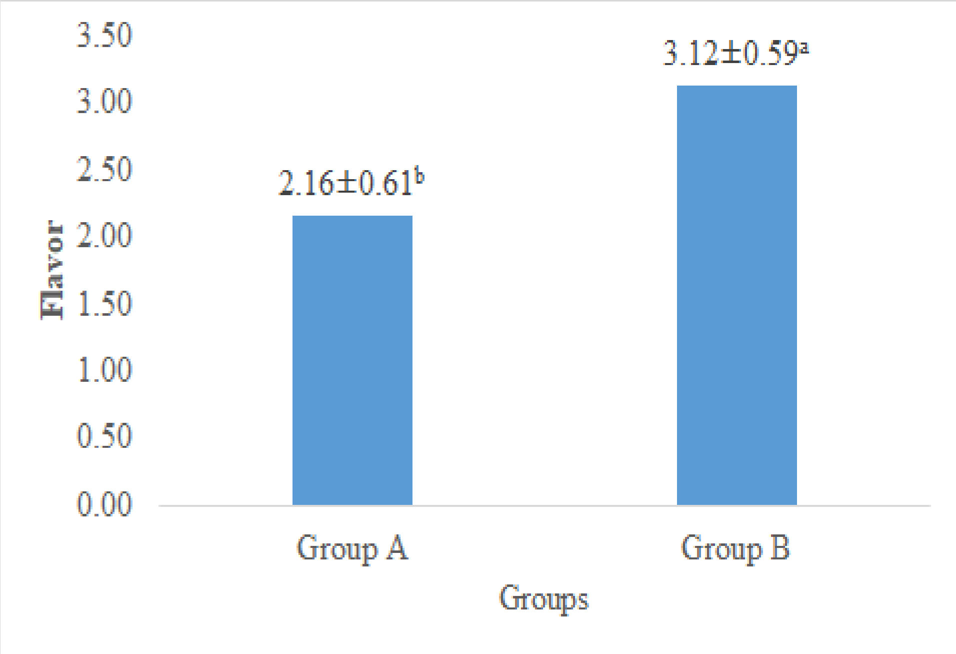

Figure VIII. Flavor of meat of rabbit

Tenderness of Meat

Tenderness scores were higher for Group B (3.65) compared to Group A (2.70), but the difference between groups was not statistically significant (P>0.05).

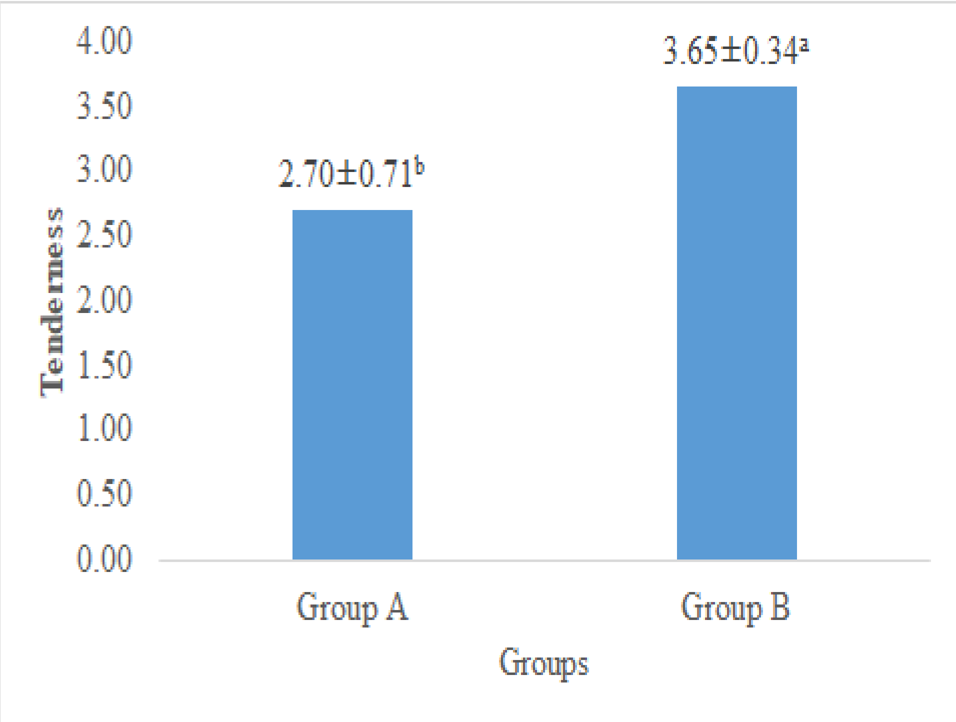

Figure IX. Tenderness of meat of rabbit

Firmness of Meat

Firmness was slightly higher in Group B (3.15) compared to Group A (2.64), but the difference was not statistically significant (P>0.05).

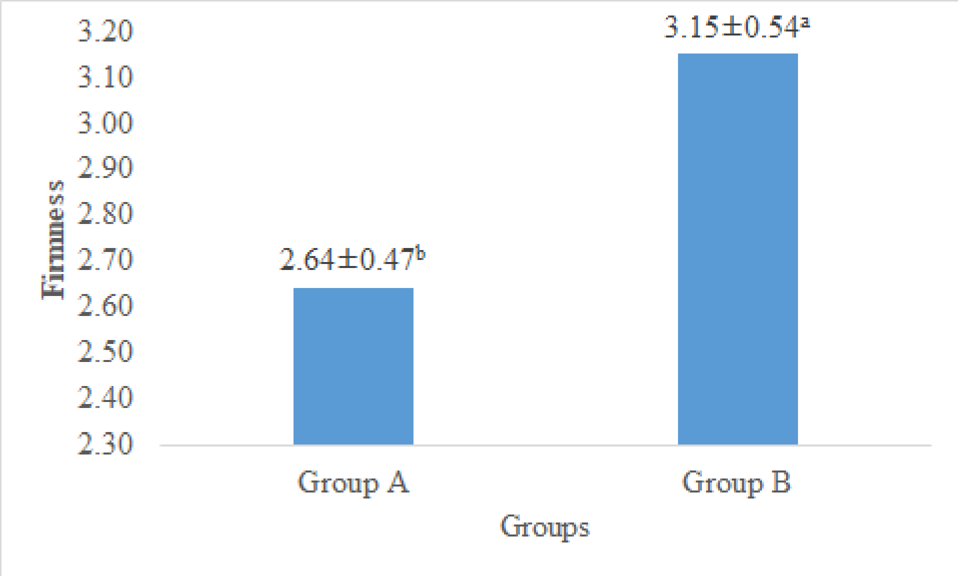

Figure X. Firmness ofmeat of rabbit

Impacts of Prebiotic on Nutrient Composition of Rabbit Meat

Carbohydrate (%)
Carbohydrate content was significantly reduced in Group B (1.61%) compared to Group A (0.99%), with statistical significance confirmed by ANOVA (P<0.05).

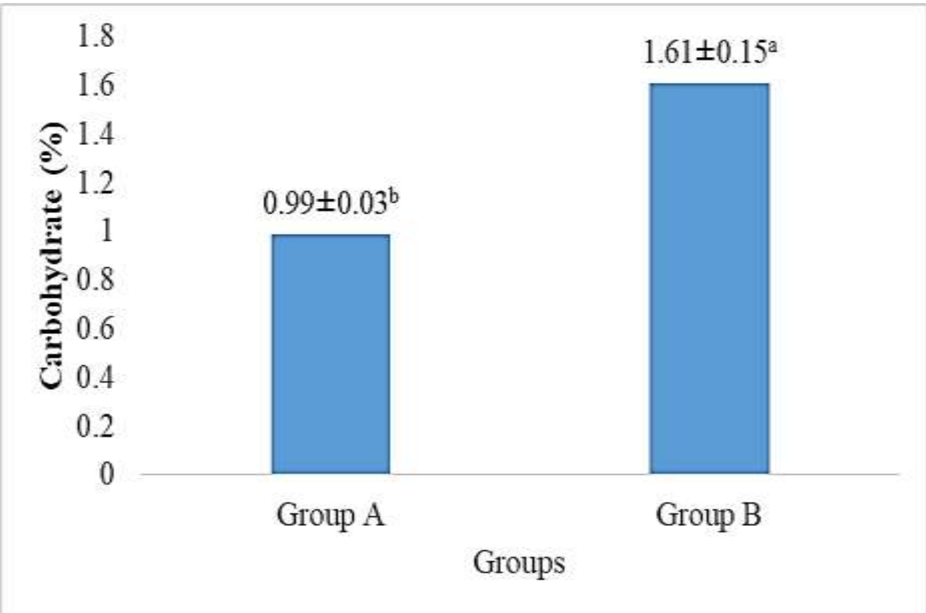

Figure XI. Carbohydrate (%) of meat of rabbit

Ash (%)
Ash content showed a minor increase in Group B (1.20%) compared to Group A (1.06%), but no statistically significant difference was found (P>0.05).

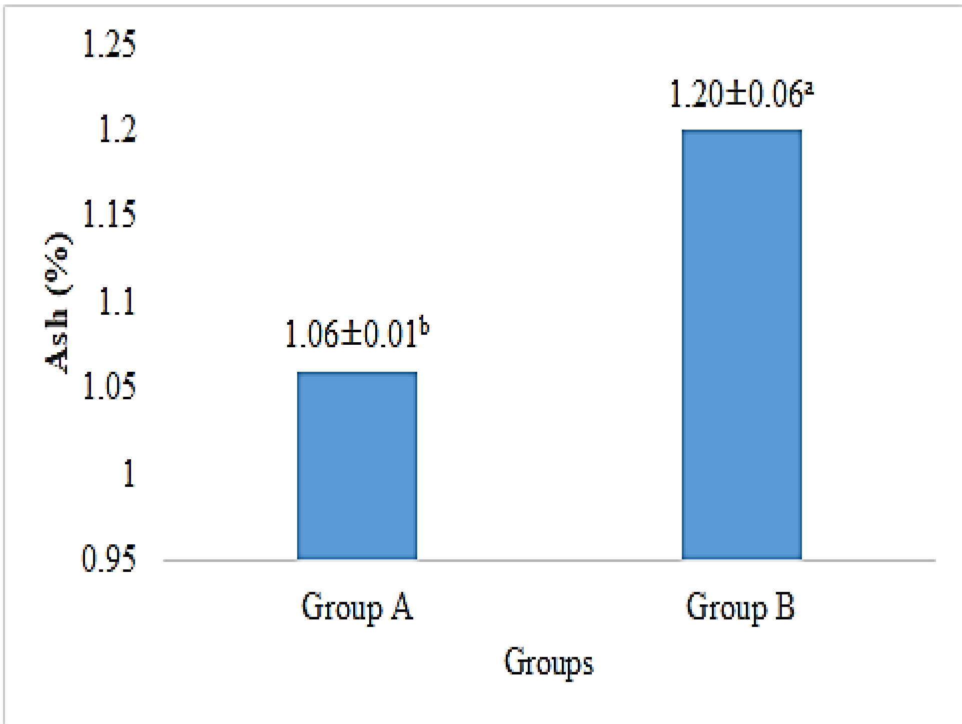

Figure XII. Ash (%) of meat of rabbitFat (%) of meat of rabbit

Fat (%)

Fat content showed a small reduction in Group B (2.52%) compared to Group A (2.65%), but this difference was not statistically significant (P>0.05).

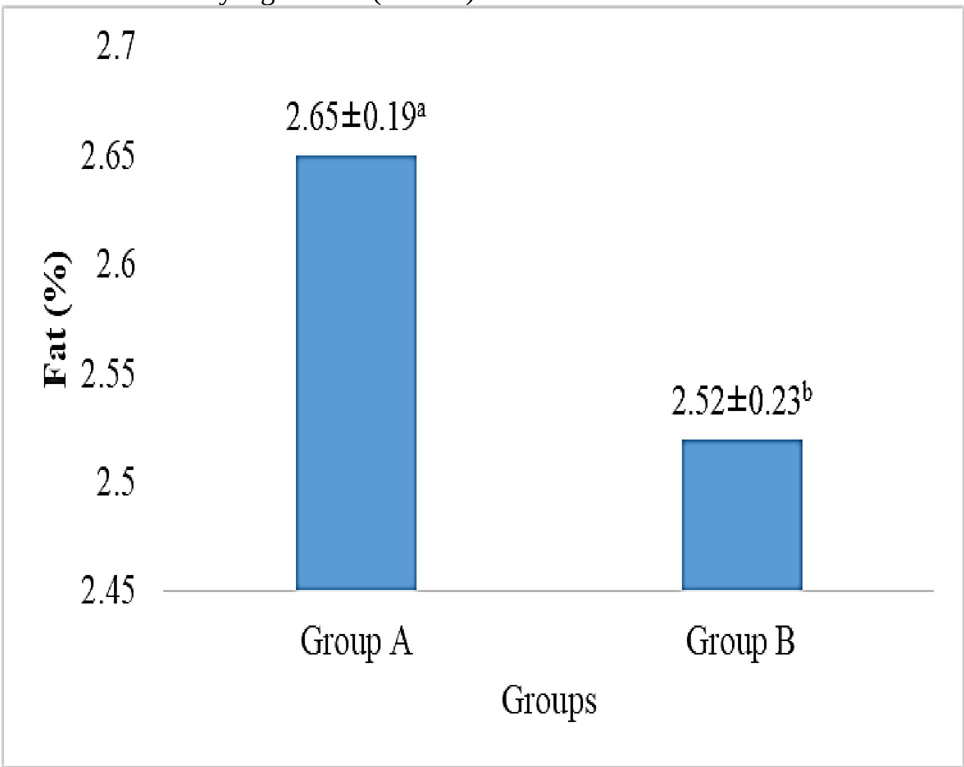

Figure XIII. Fat (%) of meat of rabbit

Moisture (%)

Moisture content was significantly lower in Group B (73.23%) compared to Group A (75.68%), with statistical significance confirmed (P<0.05).

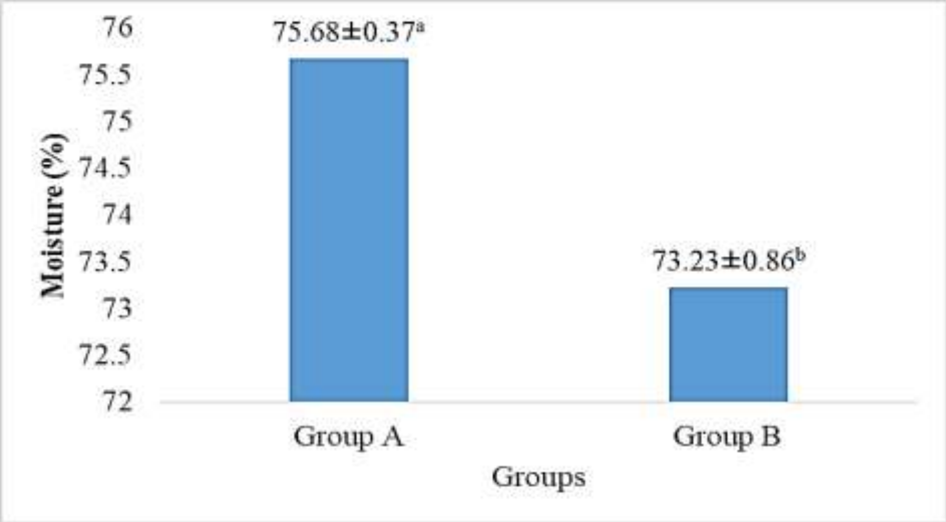

Figure XIV. Moisture (%) of meat of rabbit

Protein (%)

Protein content was significantly reduced in Group B (21.42%) compared to Group A (19.60%), with statistical significance (P<0.05) confirmed.

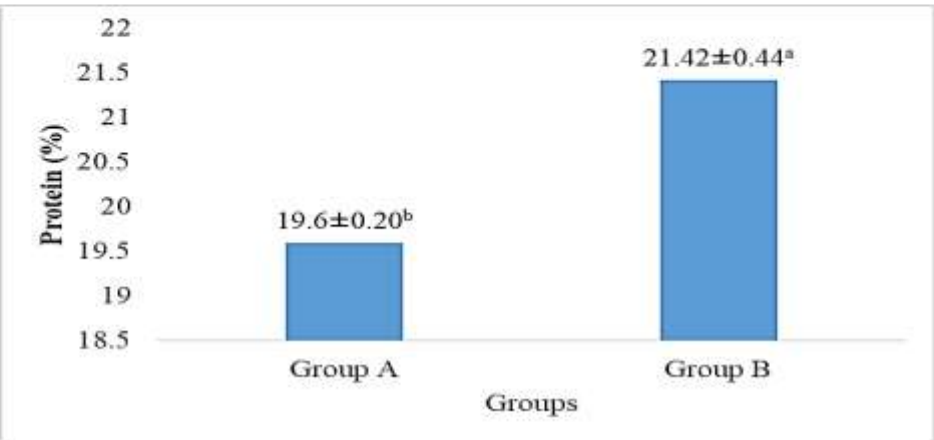

Figure XV. Protein (%) of meat of rabbit

Total Soluble (%)

Total soluble content was significantly reduced in Group B (26.76%) compared to Group A (24.31%), with statistical significance confirmed (P<0.05).

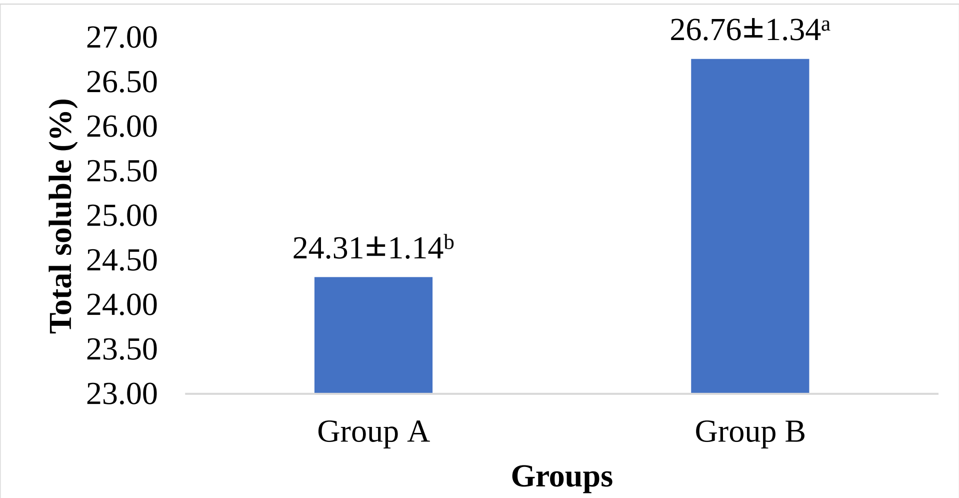

Figure XVI. Total soluble (%) of meat of rabbit

DISCUSSION

The present study investigated the effects of dietary supplementation with prebiotics on various meat quality parameters in rabbits. A significant difference in cooking loss, drip loss, pH, water holding capacity, and nutritional content was observed between the two groups, which were supplemented with different prebiotic strains.

The results show that Group B, which received prebiotic supplementation, exhibited a lower cooking loss (29.21%) compared to Group A (35.30%). This suggests that the prebiotics might improve the meat's ability to retain water during cooking, thus enhancing its quality and reducing nutrient loss. Similarly, the drip loss was significantly reduced in Group B (6.75%) as compared to Group A (3.02%), indicating that prebiotics may improve the moisture retention in rabbit meat, which is an important factor for maintaining meat tenderness and juiciness. These findings are consistent with the study by Park & Kim (2016), who reported an increase in drip loss with dietary prebiotic supplementation, although the mechanisms remain unclear.

The pH levels of rabbit meat in Group A were significantly lower (6.18%) than in Group B (5.75%). A lower pH can be indicative of meat that is more prone to spoilage, while a higher pH can lead to better meat quality and storage properties. Our findings align with previous studies, such as that of Bonai *et al*. (2008), which reported a similar pH range in rabbit meat when supplemented with prebiotics. The pH reduction in Group A may be attributed to the natural processes occurring without prebiotic intervention, where the meat could become more acidic post-slaughter.

In terms of water holding capacity, Group B showed a significant improvement (65.62%) compared to Group A (51.65%). This result is supported by Pelicano *et al*. (2004), who found that prebiotic supplementation in rabbit diets positively influenced meat quality, including pH and tenderness. A higher water holding capacity suggests that prebiotics may enhance the meat's ability to retain moisture, which can improve the texture and tenderness of the meat, thus influencing its overall sensory qualities.

The nutritional analysis revealed a significant decreased in carbohydrate in Group B (1.61%) compared to Group A (0.99%), and a significant decreased in protein content in Group B (21.42%) as compared to Group A (19.60%). These changes could be attributed to the influence of prebiotics on the metabolic processes of the rabbits. Previous studies have suggested that prebiotics may alter nutrient absorption, which could result in variations in the nutritional profile of the meat.

Ash content, however, showed no significant difference between the two groups, with values of (1.20%) in Group A and (1.06%) in Group B. This suggests that while prebiotics may influence other quality parameters, they do not have a substantial impact on the mineral composition of the meat.

Regarding fat content, no significant difference was found between the two groups, with values of (2.65%) in Group A and (2.52%) in Group B. This outcome is in contrast to the study by Olorunsanya*et al*. (1999), which noted changes in fat content in domesticated rabbits. The minor variation in fat content could be a result of dietary manipulation or prebiotic strain variations, which were not significant in the current study.

Moisture content was significantly higher in Group A (75.68%) compared to Group B (73.23%), indicating that prebiotics may slightly reduce moisture retention in rabbit meat. This result could be due to differences in dietary composition and prebiotic supplementation, as suggested by Castillo *et al*. (2008), who observed changes in moisture levels associated with prebiotic supplementation.

Finally, the total soluble content was significantly reduced in Group B (26.76%), compared to Group A (24.31%). This decrease might be related to changes in the solubility of proteins and other solubles due to the effects of prebiotics on digestion and metabolism.

In summary, the current study demonstrates that prebiotic supplementation has a significant effect on the quality parameters of rabbit meat, including cooking loss, drip loss, pH, water holding capacity, and nutritional composition. While the changes observed in some parameters were statistically significant, others, such as fat content and ash levels, showed no considerable variation. The findings corroborate previous studies and suggest that the inclusion of prebiotics in rabbit diets may improve meat quality, although further research is needed to fully understand the underlying mechanisms.

CONCLUSION

In conclusion, the present study highlights significant differences between the prebiotic supplementation and control groups in various quality and nutritional parameters of rabbit meat. Rabbits supplemented with prebiotics exhibited improved organoleptic properties, including better moisture retention, lower pH levels, and reduced cooking and drip loss. Additionally, the prebiotic-supplemented group showed lower carbohydrate and protein content, along with a decrease in total soluble content. These findings suggest that prebiotic supplementation can positively influence the quality and nutritional profile of rabbit meat, enhancing its overall desirability and storage properties. Further studies are recommended to explore the mechanisms behind these changes and optimize prebiotic supplementation for improved meat quality.

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Statement of Conflict of Interest
The authors declare that there is no conflict of interest regarding the publication of this research.

CONTRIBUTION

SA, ABK, IK and GSB conceived and designed the experiments .SA performed the experiments. TA, MBK, LK and IAP analyzed the data. MA, FMG, MUF and HF revised the manuscript IBK, and EU wrote the manuscript.

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