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Analysing the Impact of Processing and Preservation Techniques on Quality of Meat (Buffalo Meat, Chicken and Sheep/Goat Meat)

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Abstract: Technical, microbiological, and nutritional characteristics of the completed product are frequently prioritized while choosing the technique for cooking beef. But when choosing a processing or preservation method, it's critical to consider more than just how the technology will impact the product's quality; instead, it's essential to adopt a holistic and global approach that takes into account changes to the product's sensory qualities, nutritional value, and consumer appeal. This category includes physical, chemical, and biological activities including fermentation, smoking, curing, marinating, and reformulation. Refrigeration is the sole method that will retain the beef product's intrinsic quality. But physicochemical, microbiological, and sensory quality changes need to happen gradually. Meat can potentially have a variety of impacts, such as a decrease in surface moisture due to drying, an increase in its ability to retain both moisture and fat, and an enhancement of the protein's functional properties due to the inclusion of additives. Learn how various processing techniques impact a meat sample's ability to be preserved, to be pathogen-free, to maintain its functional physiochemical quality, and to have a shelf life.
Keywords: Food Processing , Functional Quality , Shelf Life , and Proteolytic Enzymes

I. INTRODUCTION

It is anticipated that India would produce 8.6 million tons of meat in 2019–20, which will place the country in sixth place globally in terms of meat production. It is responsible for the production of 4.26 million tons of red meat and 4.34 million tons of poultry meat. As a result of shifts in how people live their lives in today's society, there is a chance that certain timehonored products could become obsolete. In general, the modifications to the meat's physiology and chemistry that occur as a result of its being subjected to a variety of processing, preservation, and technical procedures may be broken down into two distinct classes. modifications to the tissue's internal organization are what are referred to as physical modifications. These alterations have an effect on the product's sensory properties, such as its volume, appearance, color, texture, aroma, and taste. Meat may undergo a variety of transformations, some of which include a reduction in surface moisture as a consequence of dehydration, an increase in the amount of moisture and fat that is retained as a consequence of denaturation of proteins, and an improvement in the functional features of proteins as a consequence of the addition of additives.

The concept of "quality" can be understood in a variety of ways by various individuals on the basis of their individual needs and the degree to which the use of a particular thing lives up to the expectations they have for it. To give one example, you may think of a daily necessity such as shaving cream or hand soap. There are hundreds of brands available, but you select one based on the price and features that are tailored to your requirements. Despite this, there are a lot of people who do not like the same brand since their requirements are different. As a consequence of this, quality is not static and is never absolute; as a consequence of this, different people give various interpretations to the term. The primary actors involved in the farming, processing, wholesaling, and retailing of meat are consumers, wholesalers, and retailers, respectively. Because of this, the attributes of meat that are referred to as "meat quality" are the qualities of meat that satisfy the needs of the user groups outlined before.

The natural quality of the beef product must be preserved by refrigeration in order to avoid deterioration.

The natural quality of the beef product being sold needs to be protected, and the only way to achieve this is to store it in a refrigerator. However, changes in the physicochemical, microbiological, and sensory quality must occur gradually over time.

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According to the findings of Papadima and Bloukas (1999), the conditions of storage did not have any impact on the characteristics of traditionally processed Greek sausages including their composition, color, or sensory qualities. On the other side, it was discovered that the pH, weight loss, and water activity were all affected. In the year 2000, Karthikeyan and colleagues undertook a study to investigate the physicochemical, microbiological, and sensory aspects of hurdle-treated chevon keema. In spite of the fact that it had been exposed to germs, they found that it may remain edible at room temperature for up to five days. According to Boles and Swan (2002), age and gender had a substantial influence on processing features, but storage conditions had an impact on the sensory qualities of beef roasts. Boles and Swan also found that storage circumstances had an influence on the sensory qualities of beef roasts. On the other hand, age and gender both had an effect on the processing characteristics..

A. Properties Quality of meat

As was said earlier, yield is extremely important for both farmers and wholesalers since it indicates the amount of marketable meat that can be obtained from an animal. This is the factor that dictates the economics behind the production of meat. In addition to the amount of meat produced, the amount of muscle, bone, and fat accumulated is also very important. Because most individuals are reluctant to purchase fatty meat, a larger ratio of lean to fat is typically selected for consumption nowadays for reasons related to one's health. Functional properties such as pH and WHC are extremely important for processors, since they are used in the creation of processed meat products for the consumer market. The chemical make-up of the meat, in addition to its practical applications, is a major factor in the juiciness, texture, and flavor of processed meals, as well as to some extent their appearance.

B. Technologies For Processing And Preserving Meat: Effects On Meat Quality

1) •Dry Aging

Under carefully controlled conditions, a method known as dry aging causes the maturation of meat. A refrigerator set to a temperature between 0 and 4 degrees Celsius and a relative humidity of 75–80% is used to hang the beef carcasses or primal slices for 28–55 days. To this moment, research has only been conducted on foods derived from bovine and porcine sources. The procedure has a somewhat high cost because of the requirement for high-quality meat cuts, the loss of meat due to shrinkage (six to fifteen percent), the loss of meat due to trimming (three to four percent), and the large risk of open-air infection to meat. It is possible to reduce the risk of open-air infection by packaging the meat in containers that are extremely porous to moisture.

The effect that dry aging has on the flavor and texture of the meat Dry-aged beef possesses an unrivaled flavor and palatability as a direct result of the proteolysis, lipolysis, and concentration of flavor components that occur as a direct result of the loss of water. The flavor of bovine flesh is described as having notes of brown roasting, meatiness, butteriness, roasted nuts, nuttiness, and sweetness. The distinctive flavor of umami can be attributed to the high quantities of glutamate found in dry-aged pork and beef. When dry-aged meat was compared to vacuumaged meat, it was discovered that dry-aged meat had more prominent umami and butter-fried tastes. This was discovered through study that compared the two methods of aging meat.

2) •Dry Curing

Dehydration is a method that reduces the amount of moisture that is present in meat in order to lengthen the period of time that the meat may be stored. Drying chambers that are fully automated and equipped with programmable logic controllers and real-time monitoring are typically seen in contemporary meat processing operations. These chambers make it possible to exercise exact control over the airflow rate, temperature, relative humidity, and flow distribution in respect to the product's size, shape, and structure as well as its moisture content. The capacity of the dried meat to store water, the state of the muscle proteins, and the microscopic structure all play a role in determining whether or not the meat can be rehydrated after being dried. Both the diameter of the muscle fibers and the spacing between the groups of fibers are reduced as a result of dehydration. When compared to raw meat, the pace at which the moisture content of precooked meat is reduced throughout the dehydration process is at a much faster rate. The flavor of char, the flesh's firm texture, and the grittiness are the distinguishing qualities of heat-damaged meat. It is feasible to conceive the distribution of water in meat while it is being dehydrated by making use of cutting-edge, non-destructive techniques such as hyperspectral imaging. This will allow for the operation to be improved.

3) •High Pressure Processing

High pressure processing, often known as HPP, is a method of non-thermal minimum processing that entails subjecting the meat to pressures ranging from 350 to 600 MPa for a condensed amount of time in order to lengthen its shelf life and reduce the risk of contamination by harmful microorganisms. The pressure is supplied in a static manner, and as the pressure increases, the volume of the product decreases. High-pressure processing (HPP) has the potential to alter the flavor and nutritional profile of meat products.

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A change in the protein's quaternary structure is the first step in the process of denaturing the protein, which occurs when high pressure causes weaker ionic and hydrogen connections to break. This is followed by a change in the protein's tertiary structure at higher pressure levels. The high-pressure processing has just a little effect on the meat's nutritious content.

II. OBJECTIVES OF THE STUDY

1) To research how meat quality is affected by processing and preservation technologies.
2) Research the value of chilled preservation in preserving beef products' natural quality.

III. RESEARCH METHOD

The White Leghorn breed, cull birds aged 63 weeks, and broiler chicks aged 6 weeks were all procured from the farm at the Ranchi Veterinary College. Desi chickens that were 32 weeks old and had no special characteristics were obtained from a market in the area. The weight of the birds ranged from 1.1 to 1.6 kg each. These 36 birds were divided into two subgroups: the control group and the treatment group; both of these subgroups had six birds apiece. Culled birds, desi birds, and broiler birds made up the three categories.

1) Isolation of IVRIN

IVRIN, a plant proteolytic enzyme, was said to have been isolated from unripe fresh fruits of the Cucumis pubescens W plant by Yadava (1982). Lyophilization, performed in a TBP centrifuges lyopholizer model FD-6000, was used to preserve the isolated enzyme so that it could be used in the experiment.

2) Treatment of IVRIN

IVRIN, an enzyme, was applied to the meat in the experimental groups in order to treat it. This procedure was carried out in accordance with Herring et al.'s (1967) instructions. In order to create an incubation medium with a volume of 250 milliliters, we combined 50 grams of whole breast or thigh meat from a number of different groups, 32.5 milligrams of enzyme protein, 200 milliliters of phosphate buffer with a pH of 7.0, and 50 milliliters of 0.9% sodium chloride. The mixture was kept warm in an incubator set at 60 degrees Celsius for twenty minutes. Both fresh meat and meat that had been treated with enzymes were used in the experiment. The fresh meat served as the control.

Sensorial and bacteriological analysis of the meat was undertaken in order to assess the ammonia content of 67 samples of retail sliced meat (40 samples of chicken breasts without skin, also known as "fillet," and 27 samples of chicken legs). This was done in order to determine the quantity of ammonia in the meat.

The meat was acquired from young male buffaloes (about 18 months old), older or spent male buffaloes (culled buffalo bullock), and mother buffaloes (>10 years) at a meat market located in Bareilly, Uttar Pradesh, India. Samples of meat were extracted from car-cases that had longissimus dorsi muscles that were almost similar in form to one another. Each herd of buffaloes was slaughtered using a method that is traditionally considered halal. Within six hours of the animal's passing, the flesh was removed from the carcass, placed in bags made of low density polyethylene (LDPE), and chilled in a Godrej Cold Gold refrigerator in India for twentyfour hours at a temperature of 4.1 degrees Celsius. The subsequent excision of the fatty tissue and connective tissue separately. The beef was cut into parts, packed in LDPE bags, and then transferred to a freezer (Vest Frost, Denmark) where the temperature was maintained at 18 degrees Celsius. This step occurred prior to the processing of the meat. The beef meat was allowed to thaw at a temperature of 41 degrees Celsius for a period of twelve hours before being utilized to produce keema. At the local market, we got the ingredients for the spice mix, including the vegetables and refined mustard oil (Dhara, Dhara Vegetable Oil and Foods Co. Ltd., Anand, India). Tata Chemicals Ltd. in Mumbai, India supplied us with the refined salt that we ordered. Tomato, onion, garlic, ginger, and green chile were all ground up into a fine paste and used as a flavoring in this dish. Spice components that were devoid of any other ingredients were placed in an oven with hot air and heated to 50 degrees for a period of four hours. In a home mixer manufactured in India by Remi Equipments, the constituents were mixed together before being screened through an extremely fine mesh. The powders were mixed together in the required proportions in order to develop a spice blend for the buffalo meat keema. Coriander powder (also known as dhania), cumin seeds (also known as zeera), dried ginger (also known as sont), aniseed (also known as soanf), black pepper (also known as kali mirch), capsicum (mirch powder), degi mirch, turmeric (also known as haldi), caraway seed (also known as ajowain), cardamom (also known as bada elaichi), cin

3) Microbiological quality

In accordance with the protocols specified by APHA (2001), an investigation into the microbiological properties of keema made from buffalo flesh was carried out. Ready-made medium purchased from Hi-medium Laboratories (P) Ltd. in Mumbai, India was used in the process of counting the various types of microorganisms.

Samples were made in a horizontal laminar flow unit (Model YSI-188, Yarco Sales (P) Ltd., New Delhi, India), and buffalo meat keema was serially diluted in close proximity to a flame. It was made ready for use by sterilizing it using ultraviolet light and according to all of the appropriate aseptic protocols. As the diluent, sterile peptone water with a concentration of 0.1 percent was used for the process of creating serial dilutions. After multiplying the number of colonies by the reciprocal of the dilution, the result was represented as log10 cfu per gram.

Plate count agar (M091) was utilized in order to accomplish the task of tallying the total number of plates. The plates were incubated at 37 degrees Celsius for a period of 48 hours. Plates were produced in the same manner as before and then placed in an incubator at 41 degrees Celsius for a period of 14 days. Between thirty and three hundred different colonies were found on each plate. Using anaerobic agar (M 228) and violet red bile agar (VRBA, M049A), we were able to assess both the coliform count as well as the overall anaerobic count. The plates were incubated at 37 degrees Celsius for a period of 48 hours. Coliforms were counted in VRBA as several colors of colonies: red, purple, and pink. On the other hand, only the colonies on the anaerobic agar that were white were considered to be complete anaerobes.

4) Statistical analysis

A two-way analysis of variance (ANOVA), the least significant difference test, and the Duncan's multiple range test were performed on the data (Steel and Torris, 1981). These statistical approaches made it possible to do a comparison of means as well as to identify disparities between groups, storage periods, and the interactions between those parameters and other variables. According to the data, even the smallest difference (D5%) that occurred between the two means was statistically significant (P 0.05). This was the case despite the fact that the two means were quite close to one another.

IV. DATA ANALYSIS

The information that can be found in Table 1 pertains to the influence that proteolytic enzyme has on the physicochemical properties of poultry meat. The pH of meat has a considerable impact in determining how well it can be preserved. The firmness of the flesh is maintained even at low pH levels. It was shown that the pH level in the breast muscle dropped more rapidly in the treatment group compared to the thigh muscle than it did in the control group. According to Khan and Nakamura (1970), a final pH of around 5.7 is required for the chicken breast meat to maintain its high level of quality throughout time. IVRIN was administered to the breast muscles of broiler, desi, and culled chickens, and the results indicated that IVRIN is an effective tendarizer. This value is in line with the data that were obtained after the treatment, therefore it is compatible with those findings. In spite of this, the difference did not constitute a statistically significant departure. The pH of the thigh muscle was found to be higher than that of the breast muscle. According to Rao and Reddy (1990), the pH value of thigh muscle was much greater than the pH value of breast muscle. Following IVRIN treatment, both the total pH and the water holding capacity (WHC) were found to be lower. In their research from 1988, Singh and Bhatia found that papain had a similar effect on chicken meat. The WHC content of broiler meat is the highest, followed by that of desi and culled bird. According to Panday and Shyam Sunder's research from 1990, the proteolytic enzyme papain had no effect on the wet-heat capacity (WHC) of the breast and thigh muscles of White Leghorn birds that were killed, and there was also no correlation between age and WHC in White Leghorn cockerels. Goll et al. (1977) discovered that connective tissue protein had a direct influence on WHC, despite the fact that muscle protein underwent structural changes during post-mortem preservation and comprised charged amino acids. These findings provide credence to the ongoing study that indicates a lower WHC in aged hens that have been culled, in comparison to broilers; the extent to which connective tissue plays a role in this difference. In the groups that served as controls, there were no differences in the types of muscles present, but after treatment, the levels of WHC in breast muscle were much greater than those in thigh muscle. The high WHC is evidence of the effect that an enzyme had, which resulted in the protein contents of the thigh muscle being degraded into charged amino acids of varying concentrations (Lawrie, 1968).

In the study of different breeds, comparisons of muscle fiber diameter (MFD) found variations. On the other hand, there was no evidence of any age-related differences in various breeds, in contrast to what was discovered in the case of broilers that were culled. Some investigations observed no variations in MFD linked to sex or muscle type in rabbits (Nath and Narayan Rao, 1983). However, differences were discovered owing to age and the kind of food (Joubert, 1956).

The findings of Hammond (1932) and Joubert (1956), who demonstrated that MFD differs among various muscles, species, breeds, and sexes as reported in the case of pigs, are compatible with the current conclusion. However, the current result is consistent with the findings of Hammond (1932) and Joubert (1956). According to Dumont's research from 1978, it was shown that the muscular fibers in the thigh muscles were much bigger than those in the breast muscles of the same group. This finding may be connected to the type of exercise and the muscles that were employed.

Table 1. leg and breast muscle lipid profiles of desi, broiler, and cull chickens in the control and proteolytic enzyme-treated groups.

	Group	Control			Treatment		Control & treatment		Anova significanc
		Thigh muscle	Breast muscle	pooled	Thigh muscle	Breast muscle	pooled	pooled	Treatment Muscle Groups
Total lipid (mg/g wet mass)	Culled(6) Desi(6) Broiler(6)	119.63* 1-6.36	123.83 * ±3.50	121.73 ±3.52	109.37* ±5.57	112.26* ±3.80	110.81 ±3.25	116.27^{B} ±3.05	NS
		56.70' ±7.08	57.06' ±5.17		48.29' ±6.91	45.00' ±5.68	46.65 ±4.29	51.76^{A} ±3.03	
	Overall Culled(6) Desi(6) Broiler(6)	113.07* ±7.10		56.88 ±4.19	102.62* ±0.41	10337* ±7.29	102.99 ±4 82	108.14^{B} ±2.97	NS
			113.49 * ±7.94						
		97.30 +12.89		113.28 ±5.08	**86.82 ±12.80**	**2.22^{aba} ±0.10**		**198^{A} ±0.92**	
Total Cholesterol (mg/g wet mass)		**6.09^{1} ±0.82**	**2.68^{abcd} ±0.20**		**4.94^{-1} ±0.80**	**3.31a^{b}e^{d} a ±0.44**			
		4.50^{d}e^{1} ±0.86	4.03^{0d}e **±0.58**	**4.39 ±0.65** 4.27 **±0.50**	3.61^{13-d}e **±0.78**	**52a ±0.19**		**3.81^{A} ±0.30**	NS **
	Overall Culled(6) Desi(6)	**3.87^{0d}e ±0.36**		**2.79**	**3.07a^{t}a^{l}a ±0.29**			**2.54^{s}**	

a,b,c,d,e,f or A, B, x, y, Means bearing same superscript did not differ significantly
Figures in parenthesis are number of observation, * $p<0.05$ ** $p<0.01$ significant

The thigh muscle of a desi, on the other hand, was discovered to have an abnormally large muscle fiber diameter (Goldspink, 1962; Dumont, 1978). This may be because of the breed, the kind of muscle, or the training (Goldspink, 1962; Dumont, 1978). After being subjected to incubation at a temperature of 60 degrees Celsius, the effect of the enzyme treatment did not disclose any changes in the MFD of the control for each respective muscle in the groups. This corroborates the findings of Price and Schweigert (1971), who discovered that the length of the longissimus dorsi muscle did not change noticeably as a result of the cooking process.

There is information presented in Table 1 on the effects of IVRIN on the total lipid, phospholipid, and cholesterol levels in the thigh and breast muscles of broiler, desi, and culled chickens. There was no noticeable difference in appearance at all between the muscle, the culled hens, and the broilers. In contrast to the findings of our current study, Sharma et al. (1982a) found that broilers had a relatively low total lipid content. Breeds could be to blame for this kind of variation, as Yeats (1965) and Kesari et al. (1990) pointed out for pigeons and squabs, respectively. The desi breed had lower total lipid levels than White Leghorn broilers and culled birds, which may be related to the type of physical activity carried out by these birds in a freerange environment and their different nutritional needs from broilers raised in deep litter systems (Price and Schweigert, 1971; Yeats, 1965). These findings were published in Price and Schweigert's 1971 study and Yeats's 1965 study, respectively. According to Kesri et al.'s (1990) research, there was not a significant difference in the total lipid content of the various muscles. The application of the enzyme therapy had no influence on the total quantity of lipid that was present, indicating that the enzyme had no bearing on the catabolism of the lipid. The pattern in the treated group suggested a considerably reduced concentration of total lipid, which seemed to be the consequence of cooking or incubation at 60°C, during which lipid loss had occurred, notably of the phospholipids. This was the case regardless of the species or the kind of muscle that was being studied. Lee and Dawson (1976) as well as Sharma et al. (1982a) both reported on this occurrence of loss.

A. Quality evaluation of buffalo meat keema

Table 1 shows that the pH of the meat from young buffaloes is statistically significantly (P 0.01) higher than that of the other groups. According to Gregory (1998), the difference between the lower and higher ultimate pH values may be due to the amount of stress that was experienced by each group of animals. There was not a significant difference between the pH of the meat of deceased male and female buffaloes. The pH of the product was comparable to that of the meat in its natural state. According to Karthikeyan and colleagues (2000), the results were quite comparable to the pH of chevon keema. In terms of the amount of keema produced, there was not a detectable difference between the groups.

When compared to the other groups, the meat keema from young male buffalo had a significantly (P0.01) higher percentage of moisture. There was not a discernible shift in the amount of moisture contained in the keema produced from the buffalo groups that were slain. During this particular experiment, a correlation was found between the change in moisture content and the pH value of the product.

Table 2 Physical and chemical characteristics of keema made from several buffalo species

Physicochemical characteristics	Young male	Spent Male	Spent female
Meat pH	5.7±0.03[a]	5.5±0.01[b]	5.5±0.01[b]
Keema pH	6.0±0.02[a]	5.9±0.01[b]	5.9±0.01[b]
Yield (%) #	58.6±2.31	59.7±1.71	57.9±1.65
Moisture (%)	63.1±0.63[a]	59.9±0.75[b]	61.2±0.31[b]
Protein (%)	19.4±0.18[b]	20.3±0.27[a]	19.1±0.34[b]
Fat (%)	9.8±0.48[b]	13.7±1.01[a]	12.6±0.71[a]
Energy (Kcal/100 g DM)	520.0±6.40[b]	549.5±2.11[a]	541.9±6.87[a]
Water activity	0.9±0.01	0.9±0.01	0.9±0.01

n=6, # n=3 The presence of significantly distinct means within the same row indicates the existence of a significant difference (P 0.05).

In comparison to the other groups, the keema that was made from the flesh of male buffalo that had been slaughtered included a statistically significant (P0.05) higher amount of protein. In terms of the quantity of protein that they contained, there was not a significant difference between the young male and wasting female buffalo meat keema (P 0.05). Differences in the amounts of protein that can be found in various cuts of beef are likely to blame for the existence of variations in the quantity of protein that can be found in keema. The higher protein content of the completed product can be attributed, at least in part, to the additional components of the beef keema as well as the moisture loss that takes place when the dish is being cooked.

In comparison to the buffalo groups that had been slaughtered, the meat keema obtained from young male buffalo had a considerably (P0.05) reduced proportion of fat content. The spent buffalo group had a much greater rate of fat deposition as the animal developed, which led to the spent buffalo group having a higher total fat content as a result of this higher rate of fat deposition. In terms of the quantity of fat that was present in the keema of the flesh, there was not a significant variation in the amount of fat that was present across the different groups of extinct buffalo. The degree of moisture that each group's goods included had a direct and significant relationship with the total quantity of fat that those items contained. It was found that there was a significant correlation between the amount of oil that was used to cook the meat, also known as keema, in each group and the increased amount of fat that was found in the keema.

The trend that was seen in each group with regard to the amounts of protein and fat intake was mirrored in the quantity of energy that was consumed. The keema prepared from the meat of young male buffaloes had a lower total number of calories than the keema prepared from the flesh of older buffaloes because it included a lower proportion of protein and fat. Both Charles's study in 1982 and Mohan et al.'s study in 1987 found that the age of the meat and the quantity of fat it had both had an effect on the total amount of calories it contained. It was revealed that the calorie content of the wasted buffalo groups was considerably (P0.01) greater than that of the other groups.

There was not a significant difference between the groups in terms of the water activity (aw) of the buffalo meat keema. This was established by putting several batches of buffalo meat through the same processing with the same ingredients and under the same circumstances. This offered a plausible justification for the behavior that was seen. The results of this investigation showed that the sensory panel gave higher marks to the goods that had an aw score that was relatively close to 0.94.

B. Physicochemical modifications during chilled storage

The buffalo meat keema's pH increased significantly (P 0.05) across all groups as the amount of time it was stored in the refrigerator increased (Table 2). Throughout the duration of the storage, it was discovered that the pH of the young male buffalo meat keema was significantly (P 0.05) higher than that of the wasted buffalo groups. On day 21, a significant rise in pH was seen across all groups (P 0.05). According to Bell and Shelef (1978), the bacteria that were responsible for the production of the basic metabolites that caused the pH to increase were also responsible for the metabolism of proteins. These bacteria were primarily gram-negative psychrophiles.

On days 18 and 21, it was revealed that the measurements of TBARS in the young male group were significantly (P 0.01) higher than those in any of the other groups. The results showed that the TBARS value significantly rose (P 0.01) during the course of the storage period, reaching its highest point on day 21 across all groups. According to Labuza et al. (1972), the increased lipid oxidation that occurred in conjunction with reduced aw values was the root cause of the elevated TBARS level. Cooking and warming cause heme iron to be released from myoglobin, which speeds up lipid oxidation and elevates lipid hydroperoxides, which results in a flavor similar to that of something that has been warmed over (Kerler and Grosch 1996). This also results in a lower shelf life. During the storage process, cooked beef products were permitted to have a TBARS concentration of no more than 0.5 to 1.0 mg/kg (Tarladgis et al. 1960). According to Watts (1962), a rancid flavor might be detected at TBARS readings that are greater than one milligram of malonaldehyde per kilogram of material. On the other hand, the findings of the current investigation demonstrated that an unpleasant flavor began to develop on day 21 at a TBARS value ranging from 0.35 to 0.46 mg/kg. During the process of deterioration, the amount of rancidity in the Keema obtained from the group of deceased male buffaloes was significantly (P 0.05) decreased.

C. Alterations in microbiology at cold storage

Following the application of the extended chilling durations, there was a statistically significant increase (P 0.05) across the board in the total plate count of the buffalo meat keema (Table 3). It is possible that metabolic damage to the microorganisms (Leistner 2000) and direct microbial mortality at higher temperatures (Lawrie 1998) contributed to a significantly (P0.05) lower microbial load on the first day. On day 21, the overall plate count of the young male buffalo meat keema group was considerably (P0.01) lower than that of the spent buffalo group. According to study that was conducted in 1996 by Uriyapongson and colleagues, older buffaloes had a greater number of progeny than younger buffaloes. Over the course of the storage time, there was a correlation between the rise in the microbiological count and changes in the pH, TBARS value, and conducive aw of the refrigerated keema. According to Kemp et al. (1988), the microbial load grew in a manner that was qualitatively comparable to how it has been defined in the past. According to Smolka et al. (1974) and Leistner et al. (1981), the logarithmic development in the aerobic plate count in keema was mostly caused by circumstances with suitable aw and pH. According to the findings of a research that was conducted by Narasimha Rao and colleagues in 1998, meat was considered to have gone bad when its bacterial count was greater than 8 log cfu/g. On the other hand, it was discovered that bacteria were able to destroy cooked and stored buffalo meat keema at a concentration of around 2-3 log10 cfu/g.

There was not a discernible difference in the amount of Staphylococcus aureus present across any of the buffalo groups when comparing the various storage durations. Counts of Staphylococcus aureus in keema obtained from young male and spent male buffalo meat were significantly (P0.05) greater than those obtained from spent female buffalo groups. This increase in population was brought about by Staph. aureus' progressive adaptation to lower temperature growth, which allowed it to thrive at lower temperatures. The constant increase in the amount of Staphylococcus aureus found in refrigerated keema may have something to do with the favorable pH and aw levels, in addition to the right production processes being followed.

On day 1, it was determined that there was no anaerobic count present, with the exception of a cluster of dead female buffalo. After day 21, there was a statistically significant (P 0.05) increase in the count. There was no significant difference in the anaerobic count between the groups. According to Leistner and Gorris (1995), the low initial count of anaerobes in keema may be the result of temperature stress, a slow adaptation to reduced temperatures, or the death of vegetative cells. Alternatively, these factors may have contributed to the problem. Following then, there was a rise in count, and it was connected to the product's vacuum packaging, as well as a variance in aw and an increase in pH.

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According to Goktan and colleagues' (1988) research, the total anaerobic deterioration of vacuum-packed beef tripe was calculated to be 2.7 103/g. An anaerobic count in the range of 1.64 and 1.81 log cfu/g was found to be within the parameters of the present inquiry to determine whether or not the product was acceptable.

Table 3 Buffalo meat keema's physicochemical properties while stored in a refrigerator (4–1 °C)

Parameters/ Groups	Storage period	(days)					
	0	3	6	9	12	15	18	21
pH								
YM	6.0±0.02^{e1}	6.1±0.04^{d1}	6.2±0.05^{c1}	6.3±0.05^{b}	6.3±0.04^{b1}	6.3±0.04^{b1}	6.4±0.03^{a1}	6.4±0.01^{a1}
SM	5.9±0.01^{c2}	5.9±0.01^{c2}	6.0±0.01^{b2}	6.0±0.01^{b}	6.0±0.02^{b2}	6.0±0.02^{b2}	6.0±0.02^{b2}	6.1±0.01^{a2}
SF	5.9±0.01^{b2}	5.9±0.01^{b2}	5.9±0.02^{b2}	5.9±0.02^{b}	6.0±0.03^{a2}	6.0±0.04^{a2}	6.0±0.03^{a2}	6.0±0.03^{a3}
TBARS value (mg malonaldehyde/kg)								
YM	0.1±0.02	0.1±0.02	0.1±0.02	0.1±0.04	0.2±0.02	0.2±0.03	0.3±0.02	0.4±0.03^{1}
SM	0.1±0.01^{c}	0.1±0.01^{c}	0.1±0.02^{c}	0.2±0.02^{b}	0.2±0.01^{b}	0.2±0.01^{b}	0.3±0.01^{a}	0.3±0.01^{a2}
SF	0.1±0.01^{d}	0.1±0.01^{d}	0.1±0.01^{d}	0.1±0.02^{d}	0.2±0.01^{c}	0.2±0.02^{c}	0.3±0.02^{b}	0.4±0.02^{a1}

n=6 YM Male Young, SM Male Spent, SF Female Spent, ND None Found

The use of different superscripts (letters in the same row and numbers in the same column) to indicate a significant difference (P 0.05) is used.

Table 4. Concentrations of volatile fatty acids (VFA) in the rumen fluid of meat goats fed a diet containing brown seaweed extract (Ascophyllum nodosum).

	Diet		
VFA (mM)	Control	Seaweed extract	SEM
Acetate	52.9	58.0	9.45
Propionate	14.5	19.4	2.36
Butyrate	7.97	9.23	1.11
Isobutyrate	3.40	3.46	0.19
Isovalerate	2.19	2.85	0.37
Valerate	1.08	1.37	0.15
Total VFA	81.1	93.4	13.00

Note: Means within a row do not differ significantly (P > 0.05).
SEM, standard error of mean.

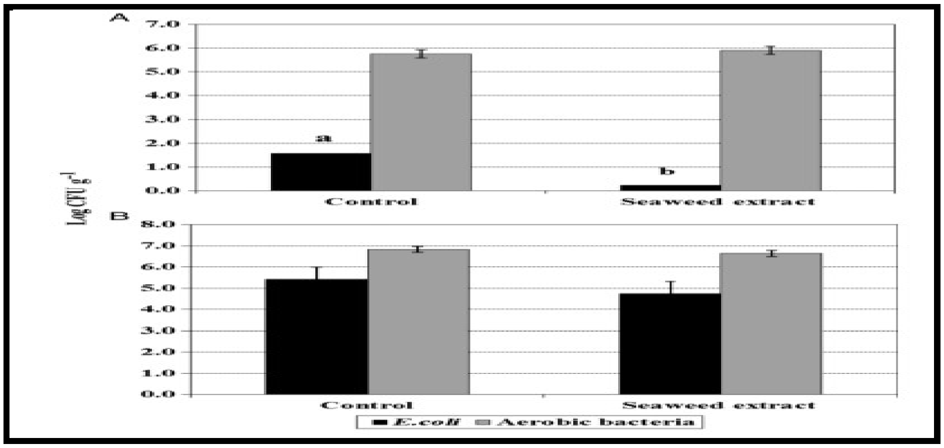

Fig. 1 Effect of supplementing with brown seaweed (Ascophyllum nodosum) extract on bacterial counts in goats' (A) rumen fluid and (B) rectal contents. Bars with various
lettered microbial groups show significant differences (P 0.05). Escherichia coli, E. coli.

V. CONCLUSION

When compared to keema from young male buffalo groups, the product characteristics and overall acceptability of keema from spent buffalo groups were much higher. The microbiological load of keema prepared from processed buffalo meat was unpredictable and exhibited no association with the age or sex of the source animal. Keema was made from buffalo meat. After being stored in the refrigerator for a period of 18 days, the buffalo meat keema had reached an acceptable level of quality. If the buffalo meat is initially marinated in a PPE solution for 15 minutes before being stored in a refrigerator at a temperature lower than five degrees Celsius, the quality of the meat may be preserved for up to eight days. This method can also be utilized for the preservation of the quality of chicken and goat meat. In India, buffalo meat is the most widely consumed animal product and accounts for a significant portion of the country's total exports. By making use of the more male calves, India will be able to produce a significant amount of additional meat; however, this will only be possible if adequate nutrition and higher hygienic standards are maintained throughout the entirety of the production process. Even though nutritional treatment had no effect on the skin or dressed carcass bacterial burdens, rumen E. coli counts were much lower in the group that was supplemented with seaweed extract. This was the case despite the fact that there was no change in the rumen's pH or VFA concentrations. The two-step pathogen reduction approach may be easily implemented in very small plants with just little adjustments required to the existing hazard analysis key control points plans. It is possible for the butcher to reduce the biological dangers associated with goat corpses by incorporating a phase into the process that involves washing the skin of the carcasses. This phase incurs essentially no additional cost. It did not matter whether the enzyme preparation was given to normal combinations or mixtures with lower nutritional content; the results were the same: positive effects on gain and feed conversion were obtained. An analysis of the data acquired demonstrated that the advantages of enzyme preparation surpass the costs associated with their application, which paves the way for enzymes to be used extensively in production because of this finding. If the nation intends to make a substantial contribution to the growth of its livestock sector, considerable development efforts must be undertaken to optimize the use of buffaloes for the production of meat as the animal's primary output. Buffaloes are an important source of income for the country. This will ensure that the animal's resources are exploited to their full potential.

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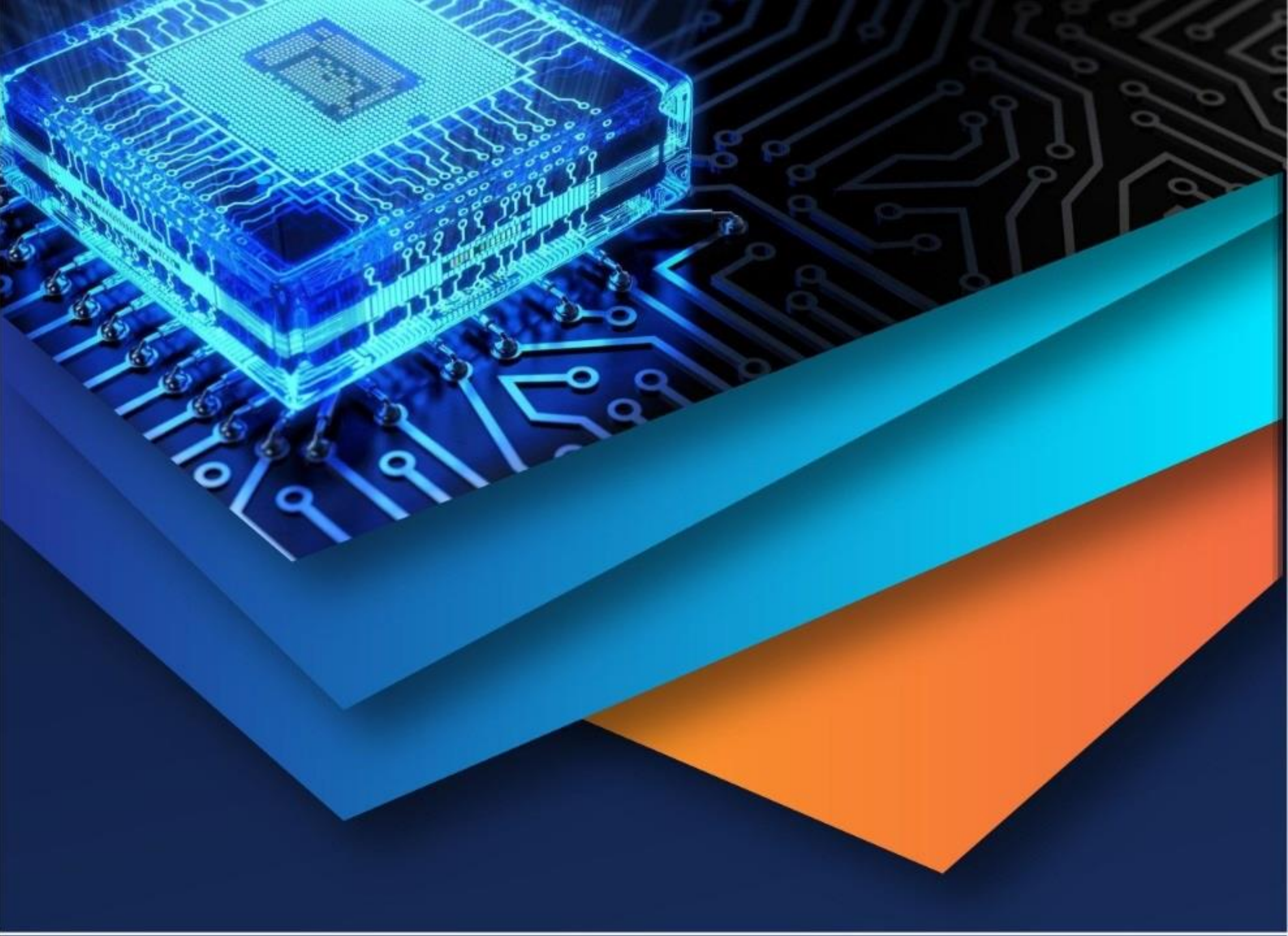

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