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Effect of different levels of butter on the physico-chemical characteristics of meat spread during refrigerated storage

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Abstract

Meat spread is a convenient value-added product that can improve the flavour, texture and nutritional quality for diversified meat products. The present study was undertaken to assess the influence of butter incorporation on the Physico-chemical characteristics of meat spread developed from spent hen meat during a refrigerated storage period of 28 days. The formulations were standardized with different inclusion levels of butter: T₁ (0 per cent), T₂ (3 per cent) and T₃ (5 per cent). The incorporation of 5 per cent butter significantly ($p < 0.01$) improved the water-holding capacity of the meat spread throughout the refrigerated storage period. Tyrosine values did not differ significantly among the treatment groups, whereas the control treatment (without butter) exhibited significantly lower TBA values than the butter-incorporated treatments during refrigerated storage. Overall, meat spread incorporated with butter enhanced the water-holding capacity of the meat spread without significantly affecting tyrosine values, although the butter-incorporated treatments exhibited higher TBA values throughout the storage period.

Keywords: Physicochemical characteristics, spent hen meat, meat spread, butter, refrigerated storage

1. Introduction

The poultry sector has emerged as an important component of Indian agriculture, contributing substantially to the availability of high-quality animal protein and meeting the nutritional requirements of the growing population. The sector has experienced considerable expansion, with an annual growth rate of approximately 8–10 per cent. Over the last two decades, poultry production has developed into a well-established commercial industry, placing India among the leading producers of eggs and broiler meat worldwide (Ministry of Fisheries, Animal Husbandry and Dairy., 2023) [8]. The Indian meat processing sector is also undergoing progressive development, primarily due to rapid urbanization, increasing consumer awareness regarding food quality, and changing dietary preferences. Consumers are increasingly seeking scientifically processed meat products, particularly packaged, convenience, ready-to-eat and ready-to-serve products that require minimal preparation before consumption. The conversion of fresh meat into value-added products can provide substantially greater economic returns, with meat processors potentially obtaining profit margins of 15–20 per cent compared with only 4–5 per cent from the sale of fresh meat (Muthukumar *et al.*, 2021) [11].

Spreadable foods represent a convenient category of products that can be readily applied to or incorporated between food substrates such as bread, thereby improving their flavour, texture and overall palatability. Although products such as cheese spread, mayonnaise, jam and jelly are commonly available in the Indian market, meat-based spreads have comparatively limited acceptance and market penetration among Indian consumers (Kumar *et al.*, 2015b) [7]. Chicken meat possesses several characteristics that make it suitable as a raw material for the development of spreadable meat products and could therefore expand the range of convenient meat-based foods available to consumers. Its relatively affordable cost, desirable nutritional composition, widespread availability and broad consumer acceptance, together with the absence of major religious restrictions on its consumption, contribute to the popularity of poultry meat (Khanam *et al.*, 2020) [4].

Meat spread, which are value-added convenient products, contain various ingredients like meat, fat, spices and other food additives (Khanam *et al.*, 2020) [4]. The incorporation of butter can enhance desirable product characteristics, including flavour, texture and nutritional value. In parallel, increasing consumer interest in diversified meat products has created opportunities for products capable of supplying high-quality protein and other essential nutrients in convenient forms (Raziuddin *et al.*, 2021) [12].

The meat obtained from spent hens is generally characterized by greater toughness and a higher proportion of connective tissue than broiler meat, which can adversely affect consumer acceptability. Traditionally, spent hen meat has been used mainly in preparations such as chicken soup and emulsified meat products. Consequently, the development of alternative processing approaches is necessary to improve the utilization and economic value of this underutilized poultry resource (Mishra *et al.*, 2015) [9]. Efficiently utilizing spent hen meat in food products could revolutionize the meat industry by developing appropriate and economical processing technologies for underutilized meat, thereby creating value-added products that are both palatable and economically viable (Kumar *et al.*, 2015b) [7].

Butter produced by churning dairy cream, is highly valued for its unique aroma and flavour. Butter, butter-oil and ghee are fat rich dairy products essential in various food applications (Mudgil *et al.*, 2020) [10]. Butter's rich flavour attributes are highly prized (Krause *et al.*, 2007) [5]. Butter can be effectively incorporated into meat spread to enhance desirable product characteristics, particularly spreadability and sensory attributes. The incorporation of 5 per cent butter has been reported to maintain superior quality characteristics, indicating its potential as a functional ingredient for improving the overall quality and consumer appeal of spent hen meat spread (Karthikeyan *et al.*, 2024) [3].

Contemporary consumers are increasingly conscious of health and nutrition while simultaneously seeking convenient food products. Their purchasing decisions are influenced by several factors, including price, availability, product choice, sustainability, sensory quality, food safety and nutritional value (Desmond and Troy, 1998) [1]. Considering these changing consumer preferences and the need for better utilization of spent poultry resources, the present study was undertaken to develop a meat spread from broiler breeder spent hens with butter incorporation. The study further aimed to assess the influence of incorporating 0, 3 and 5% butter on the physicochemical characteristics and storage stability of the developed broiler breeder spent hen meat spread during refrigerated storage at $5 \pm 1^\circ\text{C}$ for 28 days.

2. Materials and Methods

2.1 Preparation of Meat Spread

Preliminary experiments were conducted to standardize the formulation and processing conditions for the preparation of spent hen meat spread, based on the procedure described by Kumar *et al.* (2015a) [6]. Broiler breeder spent hens aged 64 weeks, with an average body weight of 5.0–5.5 kg, were slaughtered following standard hygienic practices. The carcasses were manually deboned, and the visible fat and connective tissue were removed from the meat. The lean meat was then cut into smaller pieces and minced through a 4 mm plate using a meat mincer, followed by conditioning at $5 \pm 1^\circ\text{C}$ for 24 hours.

Following conditioning, the minced meat was allocated into three treatment groups, namely T₁ (control, without butter), T₂

(3 per cent butter) and T₃ (5 per cent butter). Each treatment was formulated by incorporating predetermined quantities of salt, spice mix (Table 1), condensed milk, onion and garlic condiments, oil, tomato extract, vinegar, corn flour and water (Table 2), followed by thorough blending to obtain a uniform emulsion. Butter was added to the respective treatments at the specified levels before grinding. The formulated batter was steam-cooked under pressure for 15 min until the internal temperature reached $80 \pm 2^\circ\text{C}$ and was subsequently braised for a further 10 min. The cooked product was then homogenized in a mixer for approximately 3 min to obtain a smooth and easily spreadable consistency. The prepared meat spread was filled into sterilized, food-grade, airtight PET containers and stored at $5 \pm 1^\circ\text{C}$ for 28 days for sensory evaluation. The experimental observations were subjected to one-way analysis of variance (ANOVA), and the results were presented as mean $\pm$ standard error according to Snedecor and Cochran (1995) [13].

Table 1: Composition of spice mix

S. No.	Ingredients	Per cent in the mix
1.	Coriander powder (Dhania)	20
2.	Black pepper (Milagu)	15
3.	Capsicum (Milagai)	13.5
4.	Aniseed (Sombu)	12
5.	Cumin seeds (Zeera)	12
6.	Turmeric (Manjal)	6
7.	Dried ginger (Sukku)	6
8.	Cinnamon (Pattai)	5
9.	Cardamom (Elakkai)	3
10.	Cloves (Kirammbu)	3
11.	Caraway seed (Omam)	2.5
12.	Nutmeg (Jathikkai)	1
13.	Mace (Jathipatri)	1
Total		100

Table 2: Formulation for meat spread

S. No	Ingredients	Percentage (w/w)		
		T ₁ Control	T ₂ 3% butter	T ₃ 5% butter
1	Breeder spent hen meat	48.3	48.3	48.3
2	Salt	1.2	1.2	1.2
3	Spice Mix	2	2	2
4	Condensed milk	3	3	3
5	Condiments	5.5	5.5	5.5
6	Tomato extract	2	2	2
7	Oil	2	2	2
8	Corn flour	2	2	2
9	Vinegar	1	1	1
10	Butter	0	3	5
12	Water	33	30	28
Total		100	100	100

3. Results and Discussion

3.1. Water holding capacity

The mean ($\pm$ S.E.) water holding capacity (WHC) per cent of the meat spread during refrigerated storage ($5 \pm 1^\circ\text{C}$) from day 0 to 28 is presented in Table 3. Treatment group T₃(5 percent butter) had significantly ($p < 0.01$) higher WHC compared to the other treatment groups on 0th, 7th, 14th, 21st and 28th day of refrigerated storage. The treatment group T₁(0 percent butter) had significantly lower WHC compared to the other treatment groups on 0th, 7th, 14th, 21st and 28th day of refrigerated storage. The per cent WHC values decreased significantly with increase in storage period. The addition of 5

per butter to meat spread significantly improved their water holding capacity during refrigerated storage period.

3.2. Tyrosine value

The mean ($\pm$ S.E.) tyrosine values (mg/g) of the meat spread during 28 days of refrigerated storage is presented in Table 3. No significant differences in tyrosine values were observed among the treatment groups (T₁, T₂ and T₃) on the 0th, 7th, 14th, 21st and 28th days of storage. However, the tyrosine content showed a progressive increase within each treatment group throughout the refrigerated storage period, from day 0 to day 28. The recorded tyrosine values of this study align with findings from Talukder *et al.* (2019) [14], who observed a significant increase in tyrosine values in chicken patties during refrigerated storage. Similarly, Indumathi *et al.* (2022) [2] also found a similar increase in tyrosine values of spent hen broiler breeder sausage when stored under refrigerated temperature.

3.3. Thiobarbituric acid value (TBA)

The mean ($\pm$ S.E.) thiobarbituric acid (malondialdehyde/g) values of the meat spread during 28 days of refrigerated

storage are presented in Table 3. On 0th day no significant difference in TBA values was observed among the treatment groups (T₁, T₂ and T₃). However, from day 7 onwards, the butter-incorporated treatments T₂ (3 per cent butter) and T₃ (5 per cent butter), exhibited significantly ($p < 0.01$) higher TBA values than T₁ (0 per cent butter) on 7th, 14th, 21st and 28th days of storage. Correspondingly, T₁ recorded significantly lower TBA values than the butter-incorporated treatments during the same storage intervals. Within each treatment, TBA values showed a progressive increase with advancing storage. The higher TBA values observed in the butter-incorporated treatments (T₂ and T₃) may be attributed to the additional lipid content contributed by butter, which could have increased the susceptibility of the product to oxidative changes during storage. The TBA values recorded in the present study are consistent with the findings of Kumar *et al.* (2015a) [6], who reported a significant increase in TBA values in meat spread during 21 days of refrigerated storage. Similarly, Indumathi *et al.* (2022) [2] observed a significant increase in TBARS values in sausages prepared from broiler breeder spent hens during refrigerated storage.

Table 3: Mean ($\pm$ S.E.) Water holding capacity per cent, Tyrosine values (mg /g) and TBA values (mg Malondialdehyde/g) of the meat spread during refrigerated storage ($5 \pm 1^\circ\text{C}$)

Storage days	Water Holding Capacity			Tyrosine value			TBA		
	T ₁	T ₂	T ₃	T ₁	T ₂	T ₃	T ₁	T ₂	T ₃
0	75.21 ^{cV} $\pm$ 0.09	75.69 ^{bV} $\pm$ 0.06	76.08 ^{aV} $\pm$ 0.03	0.34 ^{aW} $\pm$ 0.00	0.34 ^{aX} $\pm$ 0.00	0.34 ^{aX} $\pm$ 0.00	0.21 ^{aW} $\pm$ 0.00	0.24 ^{aW} $\pm$ 0.01	0.24 ^{aW} $\pm$ 0.03
7	72.52 ^{cW} $\pm$ 0.08	74.79 ^{bW} $\pm$ 0.11	75.48 ^{aW} $\pm$ 0.08	0.38 ^{aW} $\pm$ 0.00	0.36 ^{aX} $\pm$ 0.00	0.37 ^{aX} $\pm$ 0.00	0.29 ^{bW} $\pm$ 0.00	0.32 ^{aWX} $\pm$ 0.00	0.31 ^{aWX} $\pm$ 0.01
14	67.07 ^{cX} $\pm$ 0.20	72.72 ^{bX} $\pm$ 0.08	73.51 ^{aX} $\pm$ 0.05	0.45 ^{aX} $\pm$ 0.00	0.43 ^{abXY} $\pm$ 0.00	0.41 ^{bXY} $\pm$ 0.00	0.45 ^{cX} $\pm$ 0.01	0.50 ^{bXY} $\pm$ 0.00	0.55 ^{aXY} $\pm$ 0.01
21	63.43 ^{cY} $\pm$ 0.05	70.12 ^{bY} $\pm$ 0.24	71.28 ^{aY} $\pm$ 0.08	0.53 ^{aY} $\pm$ 0.00	0.49 ^{aY} $\pm$ 0.00	0.53 ^{aY} $\pm$ 0.02	0.61 ^{cY} $\pm$ 0.01	0.66 ^{bY} $\pm$ 0.00	0.71 ^{aY} $\pm$ 0.00
28	59.70 ^{cZ} $\pm$ 0.11	68.37 ^{bZ} $\pm$ 0.07	69.61 ^{aZ} $\pm$ 0.09	0.63 ^{aZ} $\pm$ 0.01	0.64 ^{aZ} $\pm$ 0.06	0.71 ^{aZ} $\pm$ 0.06	0.94 ^{cZ} $\pm$ 0.06	1.27 ^{bZ} $\pm$ 0.13	1.39 ^{aZ} $\pm$ 0.14
Overall Mean	67.59 $\pm$ 1.05	72.34 $\pm$ 0.51	73.19 $\pm$ 0.45	0.47 $\pm$ 0.02	0.45 $\pm$ 0.02	0.47 $\pm$ 0.02	0.47 $\pm$ 0.07	0.60 $\pm$ 0.07	0.63 $\pm$ 0.07

(n=6)

T₁: Control

T₂: Meat spread with 3 per cent butter

T₃: Meat spread with 5 per cent butter

**Mean values bearing different superscripts within rows (a, b, c, d) and within column (V, W, X, Y, Z) differ significantly ($p < 0.01$)

4. Conclusion

Spent broiler breeder meat can be effectively utilized for the development of a value-added meat spread through the incorporation of butter at 3 and 5 per cent levels. The addition of 5 per cent butter significantly improved the water-holding capacity throughout the 28-day refrigerated storage period, while tyrosine values progressively increased with storage duration without significant differences among treatments. TBA values also increased progressively during storage, with the 3 and 5 per cent butter treatments recording significantly higher values than the control from day 7 onwards.

Conflict of Interest

Not available

Financial Support

Not available

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