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Original Article

The effect of salt on quality and storage stability of beef patties

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Beef patties, Salt, Refrigerated patties, Frozen patties, Proximate analysis, Sensory evaluation

A B S T R A C T

This experiment was conducted to find out the effect of different salt concentration on quality and storage stability of beef patties. For this purpose beef patties samples were kept as fresh, refrigerated and frozen condition. Then the fresh, refrigerated and frozen samples were divided into four subdivisions. These are 0% salt concentration, 1.5% salt concentration, 3.0% salt concentration and 5.0% salt concentration. These samples were stored at (23-25)˚C, 4˚C and -20˚C temperature for 60 days and were analyzed on 0 day, 7th day, 14th day, 21th day in refrigerated condition at 4˚C, and 0 day, 15th day, 30th day, 45th day and 60th day in frozen condition at -20˚C. Dry matter content of all the samples increased with the advancement of storage time & salt concentration and temperature in refrigerated & frozen condition ($P < 0.01$). Beef patties containing 5% salt & stored 21 days resulted higher dry matter in refrigerated condition ($P < 0.01$). Dry matter of beef patties was higher when salt containing 5% & stored 0 day in frozen condition. Ash was increased with the increased of salt concentration in both refrigerated & frozen condition. It was decreased with increasing day in both conditions. Ash % was higher at salt containing 5% & 0 days stored sample in refrigerated condition ($P < 0.01$). In frozen condition ash % of beef patties was higher when salt containing 5% & stored 15, 30 & 45 days. Crude protein content of all the samples increased with advancement of salt concentration but decreased with advancement of storage time in both condition. CP % was higher at salt containing 5% & 0 days stored sample in refrigerated condition. In frozen condition CP% of beef patties was higher when salt containing 3% & stored 0 day ($P < 0.01$). Salt concentration had no effect on EE & storage time had little effect on EE of beef patties. EE% of beef patties containing 0% salt & stored 0 day provided higher EE in refrigerated condition & it had no effect on frozen condition ($P < 0.01$). pH was increased in refrigerated condition with increasing salt% & decreased in frozen condition with decreasing salt%. pH was decreased with increasing days in refrigerated & frozen condition. pH of beef patties containing 0% salt & stored 0 day provided higher pH in both condition. Cooking loss was higher with lower salt concentration in refrigerated & frozen condition. Cooking loss was higher with higher storage time both refrigerated & frozen condition ($P < 0.01$). Cooking loss of beef patties was higher when salt containing 0% & stored 21 days in refrigerated & 60 days in frozen condition ($P < 0.01$). According to proximate composition sample containing 5% salt & stored at higher days provided higher DM%, CP% and ash%. The sensory based on firmness ,color, flavor, texture, tenderness, juiciness, chewiness, softness, hardness, taste and overall acceptance of the warm meat patties were evaluated by a trained sensory panel ($N = 5$). The panel consisted of experts who routinely evaluate beef patties. In case of sensory evaluation sample containing 1.5% salt provided best result of all above cases. Patties containing 3% salt was better than other sample containing 0% & 5% salt. Sample containing 0% & 5% salt of in case of sensory evaluation.

Introduction

Meat and meat products are important sources of many essential nutrients and contribute considerable proportions of the dietary intakes of various nutrients that are essential for optimal growth and development. There are many meat products like meat burger, meat sauces, meat patties, meat ball etc. Meat can be preserved long time but meat products can be preserved longer time than meat preservation. Moreover meat products are popular, nutritious, tasty, and valuable than meat. Salt is essentials ingredients to beef patties production. Common salt (NaCl) was used in the production of meat patties because of its effects on texture, flavor and shelf life. When the salt level rises, the increase in saltiness is more noticeable in fatty products than in lean ones (Matulis, Brewer, 1994). Salt reduction in meat patties thus had adverse effects on water and fat binding, impairing overall texture and increasing cooking loss, and also on sensory quality, especially taste.

Beef patties can be preserved longer time than meat by maintaining proper nutrition. Salt free food products are suggested to take diabetics patient. Reports linking excessive sodium intake to the incidence of hypertension (Law et al., 1991) is the main reason for reducing the sodium content of processed meats. Meat products with different salt content effect on meat quality and shelf life. Salt reduces water content of product; water is suitable medium for microbial growth thus reduces product quality. The perceived saltiness of NaCl is produced by the Na^+cation in combination with the Cl^- anion (Miller & Bartoshuk,1991) Salt also acts as a flavor enhancer, increasing the flavor intensity of meat products (Brewer,1995). Methods used for improving the shelf-life of meat products can be classified as physical, microbiological and chemical. Addition of salt is a well-known chemical method of meat preservation besides its antimicrobial activity; sodium chloride has been utilized in processed meat products since ancient times as flavoring or flavor enhancer and responsible for development of desired textural characteristics. Sodium, which forms of salt has many biological functions such as maintaining the correct volume of circulating blood and tissue fluids in the body. However excessive intake of sodium is considered to be a potential health treat. High dietary sodium intake is one of the causes of hypertension, which is a major risk factor for cardiovascular and renal disease although other factors such as age, body, mass index, activity levels are other factors affecting blood pressure. Sodium is naturally present in most foods and may rarely come insufficient. As an important nutrient and an essential ingredient in manufacturing safe foods with desirable organoleptical characteristics and structures, sodium chloride is generally consumed much more than the current recommended amount. The maximum sodium intake of an adult diet is recommended to the level of 2.4 g/day. Due to all negative treats related to high dietary sodium intake, research in recent years has focused on reducing sodium intake.

Thus, salt reduction does not reduce only the perceived saltiness but also weakens the overall flavor in meat products. Salt in tandem contribute too many of the sensory properties that are characteristic of beef patties. Varying amounts of different meat components (water, fat, and minerals) are lost during cooking of meat products, and these losses can significantly affect fat (fatty acid content) consumption and energy intakes (Serrano et al., 2007). Salt also acts as a flavor enhancer, increasing the flavor intensity of meat products (Gillette, 1985). By reducing salt beef patties is preferable specially diabetics patients. This present experiment was to the preparation of Bangladeshi beef patties with different salt concentration which was popular in the world but now a day it becomes more popular in our country. The aim of the research was to determine effect of salt on quality and storage stability of beef patties.

Materials and Method

Materials Collection

Boneless cattle meat (beef) of 2.5 kg from freshly slaughtered cattle was collected from "Sheep & Goat & Horse Farm", Bangladesh Agricultural University, Mymensingh at 10.00 a.m. The meat sample was immediately transferred to the "Animal Science Laboratory".

Preparation of Jar and Other Instruments

All necessary instruments and jars or containers were cleaned with hot water and detergent powder and then dried properly before starting the experimental activities.

Sample Preparation

1.5 kg of fresh beef sample was taken for the preparation of beef patties. First the beef was properly cleaned with fresh water and the fat was trimmed of with sharp knife. Then the beef was grinded properly and the spices, garam masala, salt, biscuit crumbs and egg were mixed with the grinded beef properly. Then beef patties of proper shape were prepared. Patties shape was prepared with help of flour and prepared beef was placed into patties shape flour after that it was fried with cooking oil.

Ingredients needed

1. Beef	2. Garlic chopped	3. Pepper corn
4. Egg	5. Coriander powder	6. Turmeric powder
7. Potato	8. Biscuit powder	9. Garam Masala
10. Chilli powder	11. Salt	
12. Onion chopped	13. Flour	
14. Coocking oil	15. Meat spices	

Procedure for sample preparation:

I. First the beef was cleaned properly with water.
II. All visible fat was trimmed of from the beef with knife.
III. The beef was partially grinded with meat grinder.
IV. All meat spices, garam masala, salt, onion, garlic, egg yolk, Biscuit crumbs were mixed properly and made into patties shaped.
V. Patties shape was prepared with flour.
VI. Meat was inserted into patties shaped flour.
VII. The meat patties were fry in hot oil until reddish brown color is attained.

Experiment Details

Parameter	Treatments		
	Fresh Meat patties	**Refrigerated Meat patties**	**Frozen Meat patties**
No. of sample	4 (Each sample was three replication)	4 (Each sample was three replication)	4 (Each sample was three replication)
Concentration of Salt	0%, 1.5%, 3.0%, 5%	0%, 1.5%, 3.0%, 5%	0%, 1.5%, 3.0%, 5%
Preservative temperature	(23-25) ^oC	4 ^oC	-2o ^oC
Observation taken	0 days	7, 14, 21 days	15, 30, 45, 60 days
Duration of the experiment	0 days	21 days	60 days

Packaging of the Sample: The samples were packaged in polyethylene bags separately. Then it was kept into the freeze.

Sensory evaluation: The saltiness, intensity, firmness, color, flavor, texture, tenderness, juiciness, chewiness, softness, hardness and overall acceptance of the meat patties (70 °C) were evaluated by a trained sensory panels ($N = 5$). The panels consisted of experts who routinely evaluate meat products. The ground meat patties were sectioned (one-half patty per panelist) and served to the panelists. Attribute intensities were rated using graphic intensity scales, which were anchored on both ends (0=Very poor, 1=Poor, 2=Fair, 3=Good, 4=Very good, 5= Excellent). The samples were presented to the panelists with three-digit codes and in a random order, and tap water was provided for rinsing the mouth between samples. The samples were evaluated twice. The mean of all of the evaluations of the 5 panelists was used as the input score for each of the 40 trials.

Proximate Composition: Proximate composition such as Dry Matter (DM), Ether Extract (EE), Crude Protein (CP) and Ash were carried out according to the methods (AOAC, 2005). All determination was done in triplicate and the mean value was reported.

Crude Protein: Crude protein was determined by micro kjeldahl method. Total nitrogen content of each sample was determined in triplicate by using kjeldahl apparatus. In this case total nitrogen was determined by digestion the samples with 20 ml concentrated sulphuric acid (H_2SO_4) in presence of K_2SO_4, $CuSO_4$ and selenium powder followed by distillation of ammonia liberated by alkali (NaOH) into boric acid and titrated with standard HCl. The nitrogen values thus obtained were converted to total crude protein by multiply with a factor of 6.25.

Ether Extract: Ether extract content was determined by soxhlet apparatus using dyethylether. At first flask weight was taken. Then 2 gm sample was taken in a thimble and added 200 ml acetone in a soxhlet. Extraction was done at 40-45°C which took about 7-8 hours. After extraction the flask were taken out and dried in oven for 30 minutes at 100°C. The flask containing ether extract was cooled in desiccators and weighed. The calculated value for ether extract content was obtained as percent of the sample.

Moisture: Moisture was determined by placing an accurately weighed known amount of ground sample in a preweighed porcelain crucible in an electric oven at 105°C for about 24 hours unit constant weight was obtained.

Ash: Weighed samples were taken in porcelain crucibles and pre-ashed at 100°C in an electric oven. The crucibles were then placed in a muffle furnace and heated at 550°C for 6 hours. The crucibles were then cooled in a desicator. The average weight in percentage of each sample of the remaining material was taken as ash.

pH measurement: pH value of beef patties was measured using pH meter from meat homogenate. The homogenate was prepared by blending 2 g of meat with 10 ml distilled water.

Cooking loss: Beef patties sample weights were recorded before and after cooking and the differences in weights recorded. Beef patties were wrapped in foil and cooked in a zanussi convection oven at 150^0 C for 10 minutes to reach an internal temperature greater than 72^0 C. Before weighing samples were blotted with a paper towel to remove excess surface moisture.

Data analysis: Data were analyzed using SAS software (Version 9.1) in CRD. Mean comparison was done by DMRT.

Results and Discussion

1. Refrigerated beef patties

Table 1.1. Effect of Salt concentration on proximate components of beef patties.

Treatment (Salt %)	DM%	Ash%	CP%	EE%	pH	Cooking Loss %
S_1(0.0)	33.53d± 0.1354	1.12c± 0.0231	20.87c± 0.1943	8.48±0. 0734	5.09bc± 0.0508	26.89a± 0.1074
S_2 (1.50)	34.10c±0 .1354	1.08c± 0.0231	21.70b± 0.1943	8.59±0. 0734	4.96c±0. 0508	26.22b± 0.1074
S_3 (3.00)	35.20b± 0.1354	1.35b± 0.0231	20.81c± 0.1943	8.48±0. 0734	5.17ab± 0.0508	24.74c± 0.1074
S_4 (5.00)	37.46a±0 .1354	1.61a± 0.0231	23.41a± 0.1943	8.39±0. 0734	5.30a±0. 0508	22.96d± 0.1074
Level of Significance	**	**	**	NS	**	**
CV (%)	1.34	6.17	3.10	3.00	3.43	1.48

NS= Means are not significantly different (P>0.01)
** Mean values with different superscript letters in the same row indicate significant difference at 1% significance level.

Dry matter of refrigerated beef patties of 0%, 1.5%, 3% & 5% salt concentrated sample was respectively (33.53±0.1354) %, (34.10±0.1354) %, (35.10± 0.1354) % & (37.46± 0.1354) %. There showed significant difference ($P < 0.01$) among samples, CV was 1.34%. Dry matter value was increased with the increase of salt concentration. Another composition Ash%, CP%, pH were also increased significantly with increasing salt concentration, which agreed to Bernthal *et al.* (1989), who studied on the effect of sodium chloride concentration on pH, water-holding capacity and extractable protein of patties with salt. Meat patties containing salt had higher pH, water holding capacity and extractable protein content than patties without salt. This study agreed to the present study. Ruusunen *et al.* (1918) indicated that although no difference was examined in the pH of patties, sodium chloride decreased the pH of low-salt phosphate free patties upon cooking. This study disagreed to the present study in case of pH. The salt used in this study increased the pH value of the beef patties was studied by Department of Food Technology, University of Helsinki, P.O. Box 66 (Viikki EE), FIN 00014, Finland. This study was also resembled to author study. Chae *et al*, 2004 and Turhan *et al.*, 2005. Reported the physicochemical properties of the beef patties were associated with the low salt concentrations used in (0.5%), which resulted in low salt-soluble protein concentrations and limited the fat and water binding properties of the meat matrix. Weight loss during cooking of ground products varies widely depending on product formulation (e.g. salt content, protein level) and processing conditions, but the values recorded in this experiment are within the range given for comparable ground meat products. This study disagreed to the present study. The present study provided EE became

increased with increasing salt concentration which agreed to Puolanne and Ruusunen (1980b), he found that the water-binding capacity of patties without phosphate increases almost linearly as the salt content rises to ≈2.5%. With phosphate there is a marked increase in water-holding in the range of 1.0–1.5% NaCl and the salt maxima are shifted to lower values with increasing fat content of the batter (Puolanne & Ruusunen, 1980a).

Puolanne, 2002 have also described the effect of pH on the binding properties of tetra-sodium pyrophosphate in meat patties. The highest binding occurs at a pH value of about 6, and binding increases with an increase in salt content which agreed to that research. Beef patties, like other foods, will normally be cooked prior to consumption, and that in itself may affect composition. Varying amounts of different meat components (water, fat, and minerals) are lost during cooking of meat products, and these losses can significantly affect fat (fatty acid content) consumption and energy intakes (Librelotto *et al.,* 2008, Serrano *et al.,* 2007 and Sheard *et al.,* 1998.) Higher salt concentration reduced cooking loss in case of beef patties which was agreed to Puolanne and Ruusunen (1980). He found that the water-binding capacity of cooked sausage without salt increases almost linearly.

From above discussion beef patties containing 5% salt had higher DM%, Ash%, CP%, EE% than other patties containing different salt. Cooking loss & acidity also less in 5% containing salt than other patties. According to proximate composition 5% salt containing patties was best.

From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature, & other factors were responsible for that dissimilarity.

Table 1.2. Effect of Time Interval (Day) on proximate components of beef patties.

Treatment (Day)	DM%	Ash%	CP%	EE%	pH	CL%
D_1 (0 day)	32.93c±0.1354	1.45a±0.0231	23.29a±0.1943	8.69a±0.0734	5.72a±0.0508	22.84c±0.1074
D_2 (7 day)	34.92b±0.1354	1.34b±0.0231	21.59b±0.1943	8.54ab±0.0734	5.01b±0.0508	25.69b±0.1074
D_3 (14day)	35.53b±0.1354	1.25c±0.0231	21.09bc±0.1943	8.41bc±0.0734	4.96bc±0.0508	25.97b±0.1074
D_4 (21day)	36.90a±0.1354	1.13d±0.0231	20.82c±0.1943	8.31c±0.0734	4.83c±0.0508	26.31a±0.1074
Level of Significance	**	**	**	**	**	**
CV (%)	1.34	6.17	3.10	3.00	3.43	1.48

NS= Means are not significantly different (P>0.01)

* Mean values with different superscript letters in the same row indicate significant difference at 1% significance level.

Dry Matter of beef patties at 0, 7, 14, & 21 days refrigerated sample was respectively (32.93 ± 0.1354) %, (34.92 ± 0.1354) %, (35.53 ± 0.1354) % & (36.90 ± 0.1354) %. Dry matter was increased with the increasing of storage time. The loss of moisture probably associated to increased dry matter was also observed by Konieczny *et al.* (2007) and reported that dry matter content increased during storage. Dry matter increased for the going out of water with advance of storage time during freezing. This study agreed to the present study. The initial dry matter was 86.13%. After 120 days this value reached to 91.73%. The results support the findings of Szmanko *et al.* (1997). This agreed to the present study.

The effect of freezing and cooking on chemical composition and some biological quality on patties and imported beef. The results showed that the fat ash, carbohydrate and energy contents of patties imported meat was increased, whereas their moisture and protein contents were decreased during frozen storages Zaky (2004) studied. This study disagreed to the present study. Ash%, CP%, EE% was reduced due to increasing storage time. The influence of freezing time on the quality of beef patty. The initial protein, lipid, ash and moisture ranged from 22.06 to 23.41%, 3.48 to 4.20%, 1.02 to 1.16% and 70.28 to 72.00%, respectively. The initial pH 5.6 which is decreased up to 20 days and increased at the end of storage period was studied by Azad *et al.* (2005). This study agreed to refrigeration condition but disagreed to frozen condition. Cooking Loss was higher at 21 days sample & lower at 0 day sample. Cooking Loss was increased with increasing days.

From above discussion storage time reduced DM%, Ash%, CP%. 0 days stored patties contained higher DM%, Ash%, CP% & less acidic than other patties stored in different time. Cooking loss was also less in 0 days stored patties. From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature, & other factors were responsible for that dissimilarity.

DM%, Ash %, CP %, EE%, pH, cooking loss of beef patties due to interaction of salt concentration & days showed significant difference among samples. Sample containing 5% salt & it was stored 21 days showed higher dry matter. This study suggested interaction of salt & storage time increased dry matter.

Sample containing 5% salt & it was stored 0 days showed higher CP % & ash%. This study suggested interaction of salt & storage time increased CP% & ash%.

Sample containing 0% salt & it was stored 0 days showed higher EE. Sample containing 0% salt & it was stored 21 days showed higher Cooking loss. In the other hand sample containing 5% salt & it was stored 0 days showed lower Cooking loss. This study suggested interaction of salt & storage time decreased Cooking loss & Cooking lossincreased when storage time increased. Prabhakar Reddy (1995) reported that the pH value of chicken meat patties increase significantly (F'<0.05) with the increase of storage period. The mean pH values of 0, 3 and 6 days stored patties 6.02±0.03, 6.12±0.04 and 6.2±0.04 respectively. In duck meat observed increased in pH during refrigerated storage loss of moisture content in chicken-patties was responsible for of giving rise to higher levels of CP, EE and total ash. This study disagreed to the present study. pH of beef patties at 0, 7, 14, & 21 days sample were respectively 5.72, 5.01, 4.96 & 4.83. There showed significant difference among samples in case of pH. pH was higher at 0 days sample. pH was decreased with increasing days. According to proximate composition patties containing 5% salt & it was stored 0 days provided higher in case of DM%, Ash%, CP% & pH. Cooking loss was also lower than other patties with different salt concentration & different storage time.

From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature, & other factors were responsible for that dissimilarity.

Table 1.3. Effect of combination of salt & time on proximate component of beef patties.

Treatment (Salt ×Day)	DM%	Ash%	CP%	EE%	pH	Cooking loss %
S1×D1	30.84k ±0.270	1.20fgh±0.046	22.51cd±0.388	8.813±0.146	5.797a ±0.101	25.593d±0.214
S1×D2	33.34i ±0.270	1.13ghi±0.046	20.57efg±0.388	8.560±0.146	4.827de±0.101	27.173abc±0.214
S1×D3	33.90hi±0.270	1.09hij±0.046	20.25fg±0.388	8.293±0.146	4.877de±0.101	27.367ab ±0.214
S1×D4	36.03cde±0.2708	1.08hil±0.0462	20.14fg±0.3886	8.257 ±0.1468	4.873de ±0.1015	27.450a ±0.2147
S2×D1	31.68j ±0.2708	1.26fg±0.0462	22.88bc±0.3886	8.747 ±0.1468	5.753a ±0.1015	24.077e ±0.2147
S2×D2	34.49gh ±0.2708	1.10hij±0.0462	21.66de±0.3886	8.640 ±0.1468	4.750de ±0.1015	26.700bc ±0.2147
S2×D3	34.80fg ±0.2708	1.02ij ±0.0462	21.14ef ±0.3886	8.547 ±0.1468	4.707de ±0.1015	27.070abc±0.2147
S2×D4	35.42ef ±0.2708	0.96j ±0.0462	21.13ef ±0.3886	8.447 ±0.1468	4.640e ±0.1015	27.053abc±0.2147
S3×D1	33.37i ±0.2708	1.50cd ±0.0462	23.55abc ±0.3886	8.617 ±0.1468	5.693a ±0.1015	21.057g ±0.2147
S3×D2	35.47def ±0.2708	1.45de ±0.0462	20.33fg ±0.3886	8.533 ±0.1468	4.967cde ±0.1015	25.510d ±0.2147
S3×D3	35.63c-f ±0.2708	1.30f ±0.0462	19.80g ±0.3886	8.473 ±0.1468	5.237bc ±0.1015	25.740d ±0.2147
S3×D4	36.31cd ±0.2708	1.15ghi ±0.0462	19.56g ±0.3886	8.307 ±0.1468	4.797de ±0.1015	26.653c ±0.2147
S4×D1	35.81cde ±0.2708	1.84a ±0.0462	24.22a ±0.3886	8.587 ±0.1468	5.647a ±0.1015	20.640g ±0.2147
S4×D2	36.37c ±0.2708	1.68b ±0.0462	23.80ab ±0.3886	8.430 ±0.1468	5.513ab ±0.1015	23.390f ±0.2147
S4×D3	37.81b ±0.2708	1.59bc ±0.0462	23.16abc ±0.3886	8.330 ±0.1468	5.033cd ±0.1015	23.717ef ±0.2147
S4×D4	39.86a ±0.2708	1.34ef ±0.0462	22.47cd ±0.3886	8.233 ±0.1468	5.017cd ±0.1015	24.107e ±0.2147
Level of significance	**	**	**	NS	**	**
CV (%)	1.34	6.17	3.10	3.00	3.43	1.48

NS= Means are not significantly different (P>0.01)
* Mean values with different superscript letters in the same row indicate significant difference at 1% significance level.

2. Frozen beef patties

Table 2.1. Effect of Salt concentration on proximate components of beef patties.

Treatment(Salt %)	DM%	Ash%	CP%	EE%	pH	Cooking loss %
S_1(0.00)	34.79b ±0.2245	1.09d ± 0.0157	19.86c ± 0.1198	7.50a ± 0.0972	5.69a ± 0.0284	27.13a ± 0.1189
S_2 (1.50)	35.64b ± 0.2245	1.58c ± 0.0157	22.51ab ± 0.1198	6.61b ± 0.0972	5.45b ± 0.0284	24.51b ± 0.1189
S_3 (3.00)	35.49b ± 0.2245	1.63b ± 0.0157	22.70a ± 0.1198	6.19c ± 0.0972	4.88c ± 0.0284	23.95c ± 0.1189
S_4 (5.00)	38.17a ± 0.2245	1.72a ± 0.0157	22.27b ± 0.1198	6.63b ± 0.0972	4.94c ± 0.0284	24.41b ± 0.1189
Level of Significance	**	**	**	**	**	**
CV (%)	2.41	4.03	2.12	5.59	2.10	1.84

NS= Means are not significantly different (P>0.01)
** Mean values with different superscript letters in the same row indicate significant difference at 1% significance level.

Dry matter of beef patties of 0%, 1.5% 3% & 5% salt sample was respectively 34.79%, 35.64, 35.49%, & 38.17% in frozen condition. There showed significant difference ($P < 0.01$) among samples. DM%, CP%, Ash%, value was higher at 5% salt conc. It was provided DM%,CP%, Ash%, were higher with higher salt concentration & lower pH which was similar to Bernthal *et al*. (1989), he studied on the effect of sodium chloride concentration on pH, water-holding capacity and extractable protein of patties with salt had higher pH, water holding capacity and extractable protein content than patties without salt. Higher salt concentration reduced cooking loss & storage time increased cooking loss in case of beef patties which was agreed to Puolanne and Ruusunen (1980). He found that the water-binding capacity of cooked patties without salt increases & storage time increased cooking loss almost linearly. From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature & other factors were responsible for that dissimilarity.

Table 2.2. Effect of Time Interval on proximate components of beef patties.

Treatment(Day)	DM%	Ash%	CP%	EE%	P^H	Cooking Loss %
D_1(0.00 day)	33.45e±0.2510	1.53a ±0.0176	22.91a±0.1339	7.11ab± 0.1087	5.61a± 0.0318	23.39d± 0.1329
D_2 (15day)	35.46d±0.2510	1.51ab ±0.0176	22.10b±0.1339	6.88b± 0.1087	5.38b± 0.0318	24.65c ± 0.1329
D_3 (30 day)	36.13c±0.2510	1.54a ±0.0176	21.53c±0.1339	7.42a± 0.1087	5.25c± 0.0318	25.31b ± 0.1329
D_4 (45 day)	37.14b±0.2510	1.48ab ±0.0176	21.39c±0.1339	6.27c± 0.1087	5.10d± 0.0318	25.65ab ± 0.1329
D_5 (60 day)	37.97a±0.2510	1.47a ±0.0176	21.26c±0.1339	6.00c± 0.1087	4.86e± 0.0318	26.03a ± 0.1329
Level of significance	**	**	**	**	**	**
CV (%)	2.41	4.03	2.12	5.59	2.10	1.84

NS= Means are not significantly different (P>0.01)
** Mean values with different superscript letters in the same row indicate significant difference at 1% significance level.

Dry Matter of beef patties at 0, 15, 30, 45, & 60 days sample was respectively 33.45%, 35.46%, 36.13%, 37.13% & 37.97%. There showed significant difference among samples in case of DM. DM was higher at 60 days sample. Frozen condition provided dry matter was higher with higher storage time.

The initial dry matter was 86.13%. After 120 days this value reached to 91.73%. Was observed by Szmanko *et al*. (1997) was agreed to the present study. Ash was higher at 30 days

&lower at 60 days sample. It was also said Ash was decreased with increasing storage time.

Hanenian and Mittal (2004) reported the effect of freezing on meat patty. The effects of three successive freeze thaw cycles on ground beef patty shrinkage. They reported that total losses increase significantly after refrigeration which was dissimilar in case of DM% but similar to CP%, Ash%, EE%.

The pH value of chicken meat patties increase significantly (F'<0.05) with the increase of storage period. The mean pH values of 0, 3 and 6 days stored patties 6.02+0.03, 6.12+0.04 and 6.2+0.04 respectively. In duck meat observed increased in pH during refrigerated storage loss of moisture content in chicken-patties was responsible for of giving rise to higher levels of crude protein, ether extract and total ash was reported by Prabhakar Reddy (1995) which was dissimilar to the author study.

The effect of freezing and cooking on chemical composition and some biological quality on patties and imported beef. The results showed that the fat ash, carbohydrate and energy contents of patties imported meat was increased, whereas their moisture and protein contents were decreased during frozen storages Zaky (2004) studied. This disagreed to the author study.

From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature & other factors were responsible for that dissimilarity.

Table 4.2.3 Effect of combination of Salt & Time on proximate components of beef Patties.

Treatment (Salt ×Day)	DM%	Ash%	CP%	EE%	P^H	Cooking Loss %
S1×D1	31.13h ± 0.5020	1.13e ± 0.0351	22.30cd± 0.2679	8.897a± 0.2174	5.850a± 0.0635	25.703e ± 0.2659
S1×D2	34.03g ± 0.5020	1.08e ± 0.0351	20.10f± 0.2679	7.987b± 0.2174	5.700ab± 0.0635	26.973bc ± 0.2659
S1×D3	35.25fg ± 0.5020	1.13e ± 0.0351	18.84g± 0.2679	7.663b± 0.2174	5.677ab± 0.0635	27.337abc ± 0.2659
S1×D4	36.95cde ± 0.5020	1.07e ± 0.0351	19.04g± 0.2679	6.627c-g± 0.2174	5.647abc± 0.0635	27.567ab ± 0.2659
S1×D5	37.50bcd ± 0.5020	1.05e ± 0.0351	19.03g± 0.2679	6.367efg± 0.2174	5.580bc± 0.0635	28.107a ± 0.2659
S2×D1	31.57h ± 0.5020	1.56cd ± 0.0351	22.73abc± 0.2679	6.720c-f± 0.2174	5.760ab± 0.0635	24.137ghi ± 0.2659
S2×D2	35.46efg±	1.61bcd ± 0.0351	22.71abc± 0.2679	7.300bcd± 0.2174	5.673ab± 0.0635	24.433gh± 0.2659
S2×D3	36.13def ± 0.5020	1.59bcd ± 0.0351	22.50abc± 0.2679	6.853cde± 0.2174	5.617bc± 0.0635	24.547g ± 0.2659
S2×D4	37.35cd ± 0.5020	1.57cd ± 0.0351	22.46bc± 0.2679	6.123e-h± 0.2174	5.240e± 0.0635	24.693fg ± 0.2659
S2×D5	37.68bcd ± 0.5020	1.55d ± 0.0351	22.18cde± 0.2679	6.080fgh± 0.2174	5.000f± 0.0635	24.767fg ± 0.2659
S3×D1	31.66h ± 0.5020	1.68abc ± 0.0351	23.38a± 0.2679	6.243e-h± 0.2174	5.467cd± 0.0635	23.180j ± 0.2659
S3×D2	35.25fg ± 0.5020	1.60bcd ± 0.0351	22.85abc± 0.2679	5.933ghi±	4.893fg± 0.0635	23.570ij ± 0.2659
S3×D3	36.54c-f ± 0.5020	1.68abc ± 0.0351	22.32cd± 0.2679	7.867b± 0.2174	4.767gh± 0.0635	23.957g-j ± 0.2659
S3×D4	36.28def ± 0.5020	1.59bcd ± 0.0351	22.63abc± 0.2679	5.593hi± 0.2174	4.703gh± 0.0635	24.400ghi ± 0.2659
S3×D5	37.74bcd ± 0.5020	1.60bcd ± 0.0351	22.33bcd± 0.2679	5.353i± 0.2174	4.597h± 0.0635	24.667fg ± 0.2659
S4×D1	39.44a ± 0.5020	1.74a ± 0.0351	23.22ab± 0.2679	6.607d-g± 0.2174	5.383de± 0.0635	20.550k± 0.2659
S4×D2	37.10cd±	1.75a ± 0.0351	22.76abc± 0.2679	6.307efg± 0.2174	5.277de± 0.0635	23.640hij ± 0.2659
S4×D3	37.32cd ± 0.5020	1.73a ± 0.0351	22.46bc± 0.2679	7.327bc± 0.2174	4.963f± 0.0635	25.430ef ± 0.2659
S4×D4	38.00abc ± 0.5020	1.69ab ± 0.0351	21.42e± 0.2679	6.740c-f± 0.2174	4.817fg± 0.0635	25.977de ± 0.2659
S4×D5	38.98ab ± 0.5020	1.68abc ± 0.0351	21.50de± 0.2679	6.200e-h± 0.2174	4.270i± 0.0635	26.607cd ± 0.2659
Level of significance	**	**	**	**	**	**
CV (%)	2.41	4.03	2.12	5.59	2.10	1.84

NS= Means are not significantly different (P>0.01)

**Mean values with different superscript letters in the same row indicate significant difference at 1% significance level.

Dry matter% of beef patties due to interaction of salt conc. & days showed significant difference ($P < 0.01$) among samples. Dry matter value was higher at S4×D4 & lower at S1×D1 in refrigerated condition. That means sample containing 5% salt & it was stored 21 days showed higher dry matter. In the other hand sample containing 0% salt & it was stored 0 days showed lower dry matter. This study suggested interaction of salt & storage time increased dry matter.

Dry matter value was higher at S4×D1 & lower at S2×D1 in frozen condition. That means sample containing 5% salt & it was stored 0 days showed higher dry matter. In the other hand sample containing 1.5% salt & it was stored 0 days showed lower dry matter. This study suggested salt played vital role for increasing dry matter.

Matulis *et al.* (1994) have also shown that when the salt level rises in meat patties, the increase in saltiness & dry matter. Dry matter was also increased when it was stored. This study agreed to refrigeration condition but disagreed to frozen condition.

Ash % of beef patties due to interaction of salt conc. & days showed significant difference ($P < 0.05$) among samples. Ash value was higher at S4×D1, S4×D2, S4×D3, & lower at S1×D1, S1×D2 in frozen condition. That means sample containing 5% salt & it was stored 0, 15, 30 days showed higher ash %. In the other hand sample containing 0% salt & it was stored 0, 15 days showed lower ash %. This study suggested salt played vital role for increasing ash.

CP value was higher at S3×D1& lower at S1×D4, S1×D3 in frozen condition. That means sample containing 3% salt & it was stored 0 days showed higher CP. In the other hand sample containing 0%, 1.5% salt & it was stored 45, 30 days showed lower CP. This study suggested salt played vital role for increasing CP %.

EE value was higher at S1×D1 & lower at S3×D5 in frozen condition. That means sample containing 0% salt & it was stored 0 days showed higher EE. In the other hand sample containing 3% salt & it was stored 60 days showed lower EE. This study suggested salt played vital role for decreasing EE.

Addition of 2% salt and phosphate significantly improves pH, water holding and emulsifying capacity of proteins was observed by Kondaiah and Sharma (1988). This study agreed in refrigerated condition but disagreed frozen condition to the present study.

From above discussion sample containing 5% salt & it was stored 0 days provided higher DM & Ash because combined effect of salt and time usually salt was prime responsible for this. Sample containing 3% salt & it was stored 0 days showed higher CP here salt concentration was prime responsible.

From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature & other factors were responsible for that dissimilarity.

3. Sensory evaluation of different salt concentrated beef patties

Table 3.1 Sensory evaluation based on color, tenderness, juiciness, flavor, texture, coarsens, Hardness, taste, overall impression.

Treatment	Color	Tenderness	Juiciness	Flavor	Texture	Coarseness	Hardness	Taste	Overall impression
1	3.00b±0.71	4.400a±0.55	4.60b±0.55	3.40b±0.89	3.60b±0.89	3.00b±0.71	2.20bc±0.45	1.60c±0.55	1.40d±0.55
2	4.80a±0.45	4.80a±0.45	4.60a±0.55	4.40a±0.55	4.80a±0.45	4.60a±0.55	4.40a±0.55	4.60a±0.55	4.80a±0.45
3	2.40b±0.55	2.60b±0.55	3.20b±0.84	3.40b±0.55	4.00ab±0.71	3.40b±0.55	2.60b±0.55	2.80b±0.45	4.00b±0.71
4	1.40c±0.55	1.80b±0.84	2.60b±0.55	2.00c±0.00	3.60b±0.55	3.80b±0.45	1.60c±0.55	1.20c±0.45	2.60c±0.55
Significance level	**	**	**	**	**	**	**	**	**
CV (%)	19.66	18.01	16.87	17.93	16.77	15.41	19.42	19.61	17.82

Lawless & Heymann, 1998 The saltiness, flavour intensity, firmness and Juiciness of the warm meat patties (70°C) were evaluated by a trained sensory panel (N = 10). The panel consisted of experts who routinely evaluate meat products. The ground meat patties were sectioned (one-half patty per panelist) and served to the panelists. Attribute intensities were rated using 10-unit graphic intensity scales, which were anchored on both ends (0 = weak, 10 = strong).

The present study **(**0-5) scale was used (0 = Very poor, 5 = Excellent), 0=Very poor, 1=Poor, 2=Fair, 3=Good, 4=Very good, 5= Excellent.

Sensory evaluation was done by panelist. It was done based on color, tenderness, juiciness, flavor, texture, Hardness, coarsens, taste, overall impression. **(**0-5) scale was used to determine sensory evaluation. 0=Very poor, 1=Poor, 2=Fair, 3=Good, 4=Very good, 5= Excellent.

Sensory evaluation of all samples based on (color, tenderness, juiciness, flavor, texture, coarsens, Hardness, taste, overall impression) was significant difference ($P < 0.01$).

Among four samples, sample containing 1.5% salt had large value in case of color, tenderness, juiciness, flavor, texture, coarsens, Hardness, taste, overall impression. Sample containing 5% salt had lowest value in case of color, tenderness, juiciness, flavor, texture, coarsens, taste, overall impression. Sample containing 3% & 0% salt provided more or same result except tenderness, hardness, taste & overall impression.

The amount of fat in the patty mixture has been found to significantly affect the quality of meat patties. Reduction of fat in ground beef patties causes a loss of palatability, especially when the fat is reduced to the 5–10% level (Troutt et al. 1992). Beef patties containing 1.5% salt had high EE than other patties containing different salt which was more palatable. In this study, fat content had the largest overall effect on meat patty juiciness, as Kregel *et al.* (1986), Egbert, Huffman, Chen, and Dylewski (1991) and Berry (1992) also found.

When fat levels are increased in beef patties, tenderness and juiciness also increase (Berry & Leddy, 1984; Cross, Berry & Wells, 1980) which was also similar to patties containing 1.5% salt. In this study, fat content also had the largest effect on sensory firmness, as found by Kregel, Prusa, and Hughes (1986) and Troutt *et al.* (1992).

Perez-Alvarez *et al.* (2004) conducted an experiment to evaluate the chemical and physical aspects of color in frozen muscle based foods. They reported on the relation between the color of muscle based foods (beef, fish) and their quality as well as the different methods for measuring color in food.

Excessive sodium intake to the incidence of hypertension is the main reason for reducing the sodium content of beef patties. A major portion of sodium in the diet derives from processed foods, mostly in the form of sodium chloride (NaCl). Common salt (NaCl) is used in the production of meat patties because of its effects on texture, flavour and shelf life. Salt reduction in meat patties thus has adverse effects on water and fat binding, impairing overall texture and increasing cooking loss, and also on sensory quality, especially taste was Reported by Dahl, 1972; Law *et al.*, 1991, author study 5% salt containing beef patties had excessive high proximate composition & reduced cooking loss sensory quality was not so better than beef containing 1.5% salt. Optimum yield and textural properties, low-fat precooked ground beef patties should be produced using comitrol flaking-coarse grinding combination rather than flaking or grinding alone was suggested by Lin and Keeton *et al*, (1994). According to proximate composition 5% salt containing patties was best but overall like nutritional & sensory based patties containing 1.5% salt was best among all patties.

From literature of review maximum scientist study agreed to the author study but some study disagreed to author study, because ingredients amount, storage time & temperature, & other factors were responsible for that dissimilarity.

Summery and Conclusion

This experiment was conducted to find out the effect of different salt concentration on quality and storage stability of meat patties. For this purpose beef patties samples were divided into three portions. They are fresh sample, refrigerated sample and frozen sample. Then the fresh, refrigerated and frozen samples were divided into four subdivisions.

These are 0% salt concentration, 1.5% salt concentration, 3.0% salt concentration and 5.0% salt concentration. These Samples were stored at (23-25)˚C, 4˚C and -20˚C temperature for 60 days and were analyzed on 0 day, 7th day, 14th day, 21th day, 30th day, 45th day and 60th day .The sensory(color, tenderness, juiciness, flavor, texture, coarsens, Hardness, taste, overall impression), physic-Chemical (Proximate analysis, pH, cooking loss) changes were analyzed.

Dry matter content of all the samples increased with the advancement of storage time & salt concentration and temperature in refrigerated & frozen condition. In combination effect of salt & time proximate components of beef patties salt containing 5% & stored 21 days provided higher dry matter in refrigerated condition & frozen condition containing 5% salt also stored 0 day provided higher dry matter. It was suggested salt was prime responsible for increasing dry matter. Ash was increased with increased of salt concentration in refrigerated & frozen condition & decreased with increasing day in both conditions. In combination effect of salt & time on Ash of beef patties salt containing 5% & stored 0 day provided higher ash.

Crude protein content of all the samples increased with advancement of salt concentration but decreased with advancement of storage time in both condition. In combination effect of salt & time on crude protein of beef patties salt containing 5% & stored 0 day provided higher ash.

Salt concentration had no effect on EE & storage time had little effect on EE of beef patties. During observation of combination of salt & time on EE of beef patties salt containing 0% & stored 0 day provided higher EE in refrigerated condition & it had no effect on frozen condition. Salt % increases pH in refrigerated condition & frozen condition decreases pH. pH was decreased with increasing days in refrigerated & frozen condition. In combination effect of salt & time pH of beef patties salt containing 0% & stored 0 day provided higher pH. Cooking loss was higher with lower salt concentration in refrigerated & frozen condition. Cooking loss was higher with higher storage time both refrigerated & frozen condition. In combination of salt & time on Cooking loss of beef patties salt containing 0% & stored 21 days in Refrigerated & 60 days in frozen condition provided higher Cooking loss.

According to proximate composition sample containing 5% & stored at higher days provided higher DM%, CP% and ash%. The sensory based on firmness ,color, flavor, texture, tenderness, juiciness, chewiness, softness, hardness, taste and overall acceptance of the warm meat patties (70°C) were evaluated by a trained sensory panel (N = 5). The panel consisted of experts who routinely evaluate beef patties. In case of sensory evaluation sample containing 1.5% salt provided best result of all above cases. Patties containing 3% salt was better than other sample containing 0% & 5% salt. Sample containing 0% & 5% salt of beef patties were more or less same in case of sensory evaluation.

The salt contents in beef patties effect the perceived saltiness & increase proximate composition, taste, hardness coarseness overall impression & reduces cooking loss. When the salt content increases the perceived saltiness also increases, but when the meat content increases the perceived saltiness decreases. The effect of salt content on perceived saltiness is weaker than the effect of meat content. The use of salt has no marked effects on perceived saltiness, but it effectively decreases cooking loss, particularly in high fat and low-sodium patties. Sensory evaluation resulted 1.5% salt containing patties is best among other patties containing different salt. According to proximate composition sample containing 5% & stored at higher days provided higher DM%, CP% and ash% but due to high saltiness it is not suggested to eat. Salt concentration increases storage time also.

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