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EFFECT OF SALT AND STORAGE TEMPERATURE ON BEEF SAUSAGE QUALITY

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ABSTRACT

The experiment was conducted to find out the effect of salt and storage temperature on the quality of sausage. For this purpose sausage samples were divided into two portions. One is called fresh sausage and another is preserved sausage at different temperature. Then the fresh samples as well as the preserved samples were divided into four subdivisions, treated with different salt levels and e.g. control group-0% and the others are 1.5%, 3% and 5% of salt concentration. The preserved samples were stored at 4^{o}C and -20^{o}C. Samples preserved at 4^{o}C were stored in the refrigerator for 21 days and were analyzed on 7th, 14th and 21th day and on the other hand samples preserved at -20^{o}C were stored in the freezer for 60 days and were analyzed on 15th, 30th, 45th and 60th day. Dry matter and Ash content of all the samples increased with the advancement of storage time and salt concentration level. Dry matter in fresh sample was less compared to preserved samples. Crude protein (CP) percent of fresh samples were 23.13, 22.63, 22.48 and 22.44 at different salt concentration level. The values of CP, DM, Ash & Fat also varied among the samples significantly ($P<0.01$). Sausage can be preserved for 60 days in different techniques with different changes in the quality. Highly significant difference was observed in preserved samples than in fresh samples at different salt levels. Fresh sausage treated with 1.5% salt found to be more acceptable in terms of sensory evaluation.

Key Words: Beef sausage, Salt, Forzen saugage, Refrizerated sausage

INTRODUCTION

Meat is recognized as a highly nutritious food, being an excellent source of high quality protein. Meat is essential to build a healthy nation by providing energy, health and vigor. Meat product like sausage also contains all of these nutrients. Bangladesh is densely populated country. Now-a-days every people are busy with their works. So they have not enough time to prepare food. In this case sausage can help the people, as sausage is a ready-made food.

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Studies on meat consumption in last decade have shown nutritional value of a product is a major factor in consumer preference (Angulo and Gil, 2007; Fonseca and Salay, 2008). Cardiovascular disease (CVD) accounts for 30% of all deaths across the world (World Health Organization, 2009). Hypertension a term which describes high blood pressure has high a global prevalence. Many studies have shown a link between a high intake of dietary sodium and hypertension (Dahl, 1972). The main source of sodium (75% of total dietary intake) in most of our diets has been shown by Apaydn *et al.*, 2003 to come from processed food.

Aggett *et al.* (2005) reported that processed meats contain high levels of animal fat which have been associated with increased risk of promoting obesity, diabetes and also cancers especially colon cancers.

Salt is a vital ingredient in processed meat as it has numerous technological benefits such as preservation, taste enhancement and water holding capacity (Durack *et al.,* 2008). Water holding capacity is defined as the ability of a food to enclose liquid within a three dimensional structure (Chantrapornchai and McClements, 2002). Salt is able to increase the water holding capacity of a meat product by extracting myofibrillar proteins which associate into a gel when heated (Foegeding and Lanier, 1987).

However, it is still important to obtain an acceptable limit at which salt can be reduced from processed meat products without negatively impacting functionality, product quality or adversely affect sensorial acceptability, so as to enhance the health status of processed meats. Research work carried out by Tobin *et al.* (2012 a,b) have shown that salt content can be successfully reduced in processed meat products such as burgers and frankfurters.

The aim of preservation is not only to retard the food spoilage but also to control undesirable changes of wholesomeness, nutritive value and growth of microorganisms (Fennema, 1975). Freezing is the only known method by which Sausage can be preserved in a condition similar to their normal state. Freezing at different temperature affect the sausage quality.

The present research work was conducted with a view to identify the acceptable salt level of sausage, the quality of sausages and to find the effect of preservation temperature on the chemical composition of sausage.

MATERIALS AND METHODS

Collection of meat

Fresh samples were collected from cattle slaughtered in Sheep and Goat Farm, Department of Animal Science, Bangladesh Agricultural University, Mymensingh. Chemical analysis was carried out in the Animal Science Laboratory, Department of Animal Science, BAU, Mymensingh.

Sample preparation

All visible fat and connective tissue were trimmed off as far as possible with the help of knife and the sample was cut into small pieces. Beef was grinded with the help of meat grinder, then mixed with some spices i.e. chili powder, turmeric powder etc. The meat was aliquot into 4 parts. Each part was mixed with salt at 0%, 1.5%, 3%, 5% respectively according to weight basis. Meat from each mixture was taken and wrapped with small square pieces of plastic as a casing. Both end of bag were tied with thread for not entering water and were then placed in to boiling water for cooking. These procedure were made for three times to prepare sample to analyze the first one as fresh basis and the other two were kept in two different freezes at 4^{o}C and -20^{o}C, respectively for further analysis in various days interval of preservation; it was named the refrigerated sausage. The second portion (freezing temperature -20^{o}C) of the sausage was named the frozen sausage. Then the samples were packaged in polyethylene bags separately and was kept into the freeze.

Defrosting process

After storing 7, 14 and 21 and for 15, 30, 45 and 60 days, the samples were defrosted by air, water and microwave oven to prepare for chemical analysis.

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, 1995). All determination was done in triplicate and the mean value was reported.

pH measurement

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

Statistical analysis

Data were analyzed statistically using the analysis of variance technique in a computer using SAS statistical computer package programmed in accordance with the principle of Completely Randomized Design (CRD). Duncan's Multiple Range Test was done to compare variations between treatments where ANOVA showed significant differences.

RESULTS AND DISCUSSION

Proximate Composition

Dry matter

Dry matter content of sausage at different salt concentration, storage temperature and days are presented in Table 1. Dry matter of fresh sausage of 0% salt was 29.57%, refrigerated sausage and frozen sausage of 0% salt at 21 days and 60 days were 29.84% and 30.84%, respectively. Dry matter of fresh sausage of 1.5% salt was 29.63% and refrigerated and frozen sausage of 1.5% salt at 21 and 60 days were 29.47% and 30.37%, respectively. Dry matter content of fresh sausage of 3.0% salt was 30.0% and refrigerated

and frozen sausage of 3.0% salt at 21 and 60 days were 30.52% and 31.29%, respectively. Dry matter of fresh sausage of 5.0% salt was 31.59% and refrigerated and frozen sausage of 5.0% salt at 21 and 60 days were 31.44%, 32.44%, respectively. There were little changes of dry matter content during storage time. Dry matter content was higher with the increase of storage time and salt concentration in all samples. The loss of moisture probably associated to increased dry matter. Dry matter increased for the moisture loss of sausage with advanced of storage time during freezing. Jihad *et al.*, 2009 reported that Mortedella plan and Mortedella with olive beef sausage contain 34.5% and 36.8% dry matter, respectively, which are partially matched with our findings.

Ash

Ash was also analyzed up to the end of the storage period of 60 days and the results are presented in Table 1. Ash of fresh sausage of 0% salt was 1.09%, refrigerated and frozen sausage of 0% salt at 21 days and 60 days were 1.13% and 1.22%, respectively. Ash of fresh sausage of 1.5% salt was 1.05% and refrigerated and frozen sausage of 1.5% salt at 21 and 60 days were 1.06% and 1.20 %, respectively. Ash of fresh sausage of 3.0% salt was 1.00% and refrigerated and frozen sausage of 3.0% salt at 21 and 60 days were 1.03% and 1.08%, respectively. Ash of fresh sausage of 5.0% salt was 0.98% and refrigerated and frozen sausage of 5 .0% salt at 21 and 60 days were 1.02% and 1.09%, respectively. Ash value increased with the increase of storage time and salt concentration. Jihad *et al.*, 2009 also reported that Mortedella plan beef sausage contains 2.2% ash which is consistent with our findings.

Crude protein

Crude protein (CP) content was also determined at the end of the storage period of 60 days and the results are presented in Table 1. CP of fresh sausage of 0% salt was 23.31%, refrigerated sausage and frozen sausage of 0% salt at 21 days and 60 days were 21.55% and 20.33%, respectively. CP of fresh sausage of 1.5% salt was 22.63% and refrigerated and frozen sausage of 1.5% salt at 21 and 60 days were 22.11% and 21.15%, respectively. CP of fresh sausage of 3.0% salt was 22.48% and refrigerated and frozen sausage of 3.0% salt at 21 and 60 days were 21.62% and 23.53%, respectively. CP of fresh sausage of 5.0% salt was 22.44% and refrigerated and frozen sausage of 5 .0% salt at 21 and 60 days were 21.45% and 20.51%, respectively. The CP content decreased due to loss of protein during storage in those samples may be related with loss of sarcoplasmic protein, osmosis and poor water holding capacity. Jihad *et al.*, 2009 reported that Mortedella plan and Mortedella with olive beef sausage contain 13.1% and 12.1% crude protein, respectively which are inconsistent with our findings. It might be due to variation of sausage type.

Fat

Fat content of samples was also analyzed up to the end of the storage period of 60 days and the results are presented in Table 1. Fat of fresh sausage of 0% salt sample was 8.85%, refrigerated sausage and frozen sausage of 0% salt sample at 21 days and 60 days were 8.50% and 7.90%, respectively. Fat of fresh sausage of 1.5% salt sample was 8.61% and refrigerated and frozen sausage of 1.5% salt sample at 21 and 60 days were 8.47% and

7.97%, respectively. Fat of fresh sausage of 3.0% salt sample was 8.74% and refrigerated and frozen sausage of 3.0% salt sample at 21 and 60 days were 8.44% and 7.84%, respectively. Fat of fresh sausage of 5.0% salt sample was 8.75% and refrigerated and frozen sausage of 5 .0% salt samples at 21 and 60 days were 8.39% 7.79%, respectively. Fat value of sausage decreased with advanced of storage time, temperature and salt concentration. Jihad *et al.*, 2009 reported that Mortedella plan and Mortedella with olive beef sausage contain 14.8% and 17.9% fat, respectively which are inconsistent with our findings. It might be due to variation of sausage type.

Table 1. Proximate composition of saugage

Treatment	Parameters	Fresh sample	Refrigerated sample			Frozen sample			
			7 Days	14 Days	21 Days	15 Days	30 Days	45 Days	60 Days
T_1	DM%	29.57	29.46	29.65	29.84	29.96	30.15	30.34	30.84
	Ash%	1.09	1.11	1.12	1.13	1.16	1.18	1.17	1.22
	CP%	23.31	21.55	21.13	21.55	21.22	21.15	20.73	20.33
	Fat%	8.85	8.53	8.52	8.50	8.23	8.22	8.20	7.90
	pH	5.64	5.41	4.76	4.81	5.63	4.69	4.65	4.20
	CL%	27.67	29.19	29.16	29.17	31.19	31.17	31.16	32.16
T_2	DM%	29.63	29.64	29.72	29.47	30.14	30.22	29.97	30.37
	Ash%	1.05	1.09	1.09	1.06	1.14	1.11	1.15	1.20
	CP%	22.63	22.30	21.95	22.11	21.90	21.71	21.55	21.15
	Fat%	8.61	8.54	8.43	8.47	8.24	8.13	8.27	7.97
	pH	5.66	4.71	4.70	4.66	4.93	4.88	4.92	5.14
	CL%	24.63	27.35	29.06	29.03	29.35	31.03	31.06	32.06
T_3	DM%	30.00	30.40	29.97	30.52	30.90	30.47	30.79	31.29
	Ash%	1.00	1.030	0.98	1.03	1.08	1.09	1.03	1.08
	CP%	22.48	21.24	24.33	21.62	20.84	21.22	23.93	23.53
	Fat%	8.74	8.48	8.49	8.44	8.18	8.19	8.14	7.84
	pH	5.63	4.48	5.20	4.66	4.71	4.84	5.42	5.25
	CL%	23.02	27.53	28.64	27.49	29.53	29.16	30.64	31.64
T_4	DM%	31.59	31.57	31.43	31.44	32.07	31.93	31.94	32.44
	Ash%	0.98	0.99	0.99	1.02	1.04	1.07	1.04	1.09
	CP%	22.44	21.47	21.37	21.45	21.07	21.05	20.94	20.51
	Fat%	8.75	8.46	8.47	8.39	8.09	8.17	8.09	7.79
	pH	5.70	4.46	4.92	4.60	4.67	4.82	5.14	5.13
	CL%	22.63	25.35	26.71	25.12	27.35	27.12	28.71	29.71

T_1 = 0% salt; T_2 = 1.5% salt concentration; T_3 = 3% salt concentration and T_4 = 5% salt concentration

pH

pH value of samples was also analyzed up to the end of the storage period of 60 days and the results are presented in Table 1. pH of fresh sausage of 0% salt sample was 5.64, refrigerated sausage and frozen sausage of 0% salt sample at 21 days and 60 days were 4.81 and 4.20, respectively. pH of fresh sausage of 1.5% salt sample was 5.66 and refrigerated and frozen sausage of 1.5% salt sample at 21 and 60 days were 4.66 and 5.14, respectively. pH of fresh beef sausage of 3.0% salt sample was 5.63 and refrigerated and frozen sausage of 3.0% salt sample at 21 and 60 days were 4.66 and 5.25, respectively. pH of fresh sausage of 5.0% salt sample was 5.70 and refrigerated and frozen sausage of 5 .0% salt sample at 21 and 60 days were 4.60 and 5.13, respectively. pH value of sausage increased with the increase of storage time and decreased with advanced of temperature and salt concentration. Jihad *et al.*, 2009 reported that Mortedella plan beef sausage contains 6.4 pH, respectively which is inconsistent with our findings. It might be due to variation of sausage type.

Table 2. Attributes on sensory evaluation of beef sausage

	Acceptability of color	Juiciness	Flavor	Saltiness Taste	Overall impression
T_1	$3.40^{b} \pm 0.12$	$4.60^{a} \pm 0.12$	$3.60^{b} \pm 0.12$	$0.00^{c} \pm 0.00$	$0.20^{d} \pm 0.10$
T_2	$3.20^{b} \pm 0.19$	$4.00^{b} \pm 0.00$	$4.80^{a} \pm 0.10$	$4.60^{a} \pm 0.12$	$4.80^{a} \pm 0.10$
T_3	$4.60^{a} \pm 0.12$	$3.00^{c} \pm 0.16$	$3.80^{b} \pm 0.10$	$2.40^{b} \pm 0.12$	$3.60^{b} \pm 0.12$
T_4	$3.60^{b} \pm 0.12$	$2.00^{d} \pm 0.00$	$2.00^{c} \pm 0.00$	$0.40^{c} \pm 0.12$	$2.80^{c} \pm 0.10$

T_1 = 0% salt; T_2 = 1.5% salt concentration; T_3 = 3% salt concentration and T_4 = 5% salt concentration. Within same column having mean with different superscripts differ significantly ($P<0.05$)

Cooking loss

Cooking loss of samples was also analyzed up to the end of the storage period of 60 days and the results are presented in Table 1. Cooking loss of fresh sausage of 0% salt sample was 27.67%, refrigerated sausage and frozen sausage of 0% salt sample at 21 days and 60 days were 29.17%, and 32.16%, respectively. Cooking loss of fresh sausage of 1.5% salt sample was 24.63% and refrigerated and frozen sausage of 1.5% salt sample at 21 and 60 days were 29.03% and 32.06%, respectively. Cooking loss of fresh sausage of 3.0% salt sample was 23.02% and refrigerated and frozen sausage of 3.0% salt sample at 21 and 60 days were 27.49% and 31.64%, respectively. Cooking loss of fresh sausage of 5.0% salt sample was 22.63% and refrigerated and frozen sausage of 5 .0% salt sample at 21 and 60 days were 25.12% and 29.71%, respectively. Cooking loss of sausage decreased with the increase of salt concentration but increased with advances of storage time and temperature.

Sensory evaluation

Table 2 shows the result of sensory evaluation of beef sausage. Fresh sausage samples were analyzed for their color, tenderness, juiciness, flavor, texture, coarseness, hardness, saltiness taste and overall impression by 5 panelists familiar with sausage evaluation. Panelists were selected among teachers. Sensory evaluation was carried out in individual booths under controlled conditions of light, temperature, and humidity. Prior to sample evaluation, all panelists participated in orientation sessions to familiarize with the scale

attributes (off-odor, freshness, overall, and so on) of fresh sausage using an intensity scale. Sensory qualities of the samples were evaluated using a 5-point scoring method. Sensory scores were 5 for excellent, 4 for very good,3 for good, 2 for fair, and 1 for poor. All samples were served in the Petri dishes and were returned for further chemical analysis. Sensory evaluation was accomplished at day 0.

Interaction effects

Interaction effects of proximate composition, pH and cooking loss of sausage on storage time and salt concentration was shown in Table 3, 4 and 5. There were little changes of dry matter content during storage time. Dry matter content increased with the increase of storage time salt concentration in all samples and differed significantly (P<0.01) among the parameters. Ash value increased with the increase of storage time salt concentration in all samples and differed significantly (P<0.01) among the parameters. The CP content decreased due to loss of protein during storage time in those samples might be related with the loss of sarcoplasmic protein, osmosis and poor water holding capacity and differed significantly (P<0.01) among the parameters. Fat value of sausage decreased with the advances of storage time, temperature and salt concentration and differed significantly (P<0.01) among the parameters. pH value of beef saugage increased with the advances of storage time and decreased with the increase of temperature and salt concentration and differed significantly (P<0.01) among the parameters. Cooking loss of beef sausage decreased with the advances of salt concentration but increased with the advances of storage time and temperature and differed significantly (P<0.01) among the parameters.

Table 3. Interaction effect of proximate composition, pH and cooking loss (CL) on salt concentration

Parameters	Treatment	Fresh sample	Refrigerated sample			Sig. Level	Frozen sample					Sig. Level
			7 Days	14 Days	21 Days		Fresh 0 Day	15 Days	30 Days	45 Days	60 Days	
DM on salt	T_1	29.57	29.46^{c}	29.65^{b}	29.84^{bc}	*	29.57	29.96^{c}	30.15^{b}	30.34^{b}	30.84^{bc}	*
	T_2	29.63	29.64^{c}	29.72^{b}	29.47^{c}		29.63	30.14^{c}	30.22^{b}	29.97^{b}	30.37^{c}	
	T_3	30.00	30.40^{b}	29.97^{b}	30.52^{b}		30.00	30.90^{b}	30.47^{b}	30.79^{b}	31.29^{b}	
	T_4	31.59	31.57^{a}	31.43^{a}	31.44^{a}		31.59	32.07^{a}	31.93^{a}	31.94^{a}	32.44^{a}	
Ash	T_1	1.09^{a}	1.11^{a}	1.12^{a}	1.13^{a}	*	1.09^{a}	1.16^{a}	1.18^{a}	1.17^{a}	1.22^{a}	*
	T_2	1.05^{ab}	1.09^{ab}	1.09^{ab}	1.06^{ab}		1.05^{ab}	1.14^{ab}	1.11^{ab}	1.15^{ab}	1.20^{ab}	
	T_3	1.00^{bc}	1.03^{bc}	0.98^{ab}	1.03^{b}		1.00^{bc}	1.08^{bc}	1.09^{b}	1.03^{b}	1.08^{b}	
	T_4	0.98^{c}	0.99^{c}	0.99^{b}	1.02^{b}		0.98^{c}	1.04^{c}	1.07^{b}	1.04^{b}	1.09^{b}	
CP	T_1	23.31^{a}	21.55^{b}	21.13^{c}	21.55^{bc}	*	23.14^{a}	21.22^{b}	21.15^{bc}	20.73^{c}	20.33^{c}	*
	T_2	22.63^{b}	22.30^{a}	21.95^{b}	22.11^{a}		21.56^{c}	21.90^{a}	21.71^{a}	21.55^{b}	21.15^{b}	
	T_3	22.48^{b}	21.24^{b}	24.33^{a}	21.62^{b}		22.48^{b}	20.84^{b}	21.22^{b}	23.93^{a}	23.53^{a}	
	T_4	22.44^{b}	21.47^{b}	21.37^{bc}	21.45^{c}		22.44^{b}	21.07^{b}	21.05^{c}	20.94^{bc}	20.51^{bc}	
Fat	T_1	8.85^{a}	8.53	8.52	8.50	*	8.85^{a}	8.23	8.22	8.20	7.90	*
	T_2	8.61^{b}	8.54	8.43	8.47		8.61^{b}	8.24	8.13	8.27	7.97	
	T_3	8.74^{ab}	8.48	8.49	8.44		8.74^{ab}	8.18	8.19	8.14	7.84	
	T_4	8.75^{ab}	8.46	8.47	8.39		8.75^{ab}	8.09	8.17	8.09	7.79	

Parameters	Treatment	Fresh sample	Refrigerated sample			Sig. Level	Frozen sample					Sig. Level
			7 Days	14 Days	21 Days		Fresh 0 Day	15 Days	30 Days	45 Days	60 Days	
pH	T_1	5.64	5.41^{ab}	4.76^{c}	4.81^{a}	*	5.64	5.63^{a}	4.69	4.65^{b}	4.20^{c}	*
	T_2	5.66	4.71^{b}	4.70^{c}	4.66^{b}		5.66	4.93^{b}	4.88	4.92^{ab}	5.14^{b}	
	T_3	5.63	4.48^{b}	5.20^{a}	4.66^{b}		5.63	4.71^{b}	4.84	5.42^{a}	5.25^{a}	
	T_4	5.70	4.46^{b}	4.92^{b}	4.60^{b}		5.70	4.67^{b}	4.82	5.14^{ab}	5.13^{b}	
CL	T_1	27.67^{a}	29.19^{a}	29.16^{a}	29.17^{a}	*	27.67^{a}	31.19^{a}	31.17^{a}	31.16^{a}	32.16^{a}	*
	T_2	24.63^{b}	27.35^{ab}	29.06^{b}	29.03^{b}		24.63^{b}	29.35^{ab}	31.03^{a}	31.06^{b}	32.06^{b}	
	T_3	23.02^{c}	27.53^{ab}	28.64^{c}	27.49^{c}		23.02^{c}	29.53^{ab}	29.16^{b}	30.64^{c}	31.64^{c}	
	T_4	22.63^{d}	25.35^{b}	26.71^{d}	25.12^{d}		22.63^{d}	27.35^{b}	27.12^{c}	28.71^{d}	29.71^{d}	

T_1 = 0% salt; T_2 = 1.5% salt concentration; T_3 = 3% salt concentration and T_4 = 5% salt concentration. Mean with different superscripts within same column differ significantly. Significant at 1% level ($P<0.01$)

Table 4. Interaction effect of proximate composition, pH and cooking loss (CL) of fresh and refrigerated sausage on storage time

Parameters	Duration (days)	Treatment				Sig. Level
		T_1	T_2	T_3	T_4	
DM	0	29.57	29.63	30.00	31.59	NS
	7	29.46	29.64	30.40	31.57	
	14	29.65	29.72	29.97	31.43	
	21	29.84	29.47	30.52	31.44	
Ash	0	1.09	1.05	1.00	0.98	NS
	7	1.11	1.09	1.03	0.99	
	14	1.12	1.09	0.98	0.99	
	21	1.13	1.06	1.03	1.02	
CP	0	23.31^{a}	22.63	22.48^{b}	22.44^{a}	*
	7	21.55^{b}	22.30	21.24^{c}	21.47^{b}	
	14	21.13^{b}	21.95	24.33^{a}	21.37^{b}	
	21	21.55^{c}	22.11	21.62^{c}	21.45^{b}	
Fat	0	8.85	8.61	8.74^{a}	8.75^{a}	*
	7	8.53	8.54	8.48^{b}	8.46^{b}	
	14	8.52	8.43	8.49^{b}	8.47^{b}	
	21	8.50	8.47	8.44^{b}	8.39^{b}	
pH	0	5.64^{a}	5.66^{a}	5.63^{a}	5.70^{a}	*
	7	5.41^{ab}	4.71^{b}	4.48^{d}	4.46^{c}	
	14	4.76^{b}	4.70^{b}	5.20^{b}	4.92^{b}	
	21	4.81^{b}	4.66^{b}	4.66^{c}	4.60^{c}	
CL	0	27.67^{b}	24.63^{b}	23.02^{c}	22.63^{d}	*
	7	29.19^{a}	27.35^{a}	27.53^{b}	25.35^{b}	
	14	29.16^{a}	29.06^{a}	28.64^{a}	26.71^{a}	
	21	29.17^{a}	29.03^{a}	27.49^{b}	25.12^{c}	

T_1 = 0% salt; T_2 = 1.5% salt concentration; T_3 = 3% salt concentration and T_4 = 5% salt concentration. Mean with different superscripts within same column differ significantly; Significant at 1% level ($P<0.01$), NS, indicates non significant

Table 5. Interaction effect of proximate composition, pH and cooking loss (CL) of fresh and frozen sausage on storage time

Parameters	Storage time (Days)	Treatment				Sig. Level
		T_1	T_2	T_3	T_4	
DM on storage time	0	29.57^{b}	29.63^{b}	30.00	31.59^{b}	*
	15	29.96^{ab}	30.14^{ab}	30.90	32.07^{ab}	
	30	30.15^{ab}	30.22^{ab}	30.47	31.93^{ab}	
	45	30.34^{ab}	29.97^{b}	30.79	31.94^{ab}	
	60	30.84^{a}	30.37^{a}	31.29	32.44^{a}	
Ash	0	1.09	1.05^{c}	1.00^{c}	0.98^{b}	*
	15	1.16	1.14^{ab}	1.08^{ab}	1.04^{ab}	
	30	1.18	1.11^{b}	1.09^{a}	1.07^{a}	
	45	1.17	1.15^{a}	1.03^{bc}	1.04^{ab}	
	60	1.22	1.20	1.08^{a}	1.09^{a}	
CP	0	23.14^{a}	21.56^{ab}	22.48^{b}	22.44^{a}	*
	15	21.22^{b}	21.90^{a}	20.84^{c}	21.07^{b}	
	30	21.15^{b}	21.71^{ab}	21.22^{c}	21.05^{b}	
	45	20.73^{c}	21.55^{ab}	23.93^{a}	20.94^{b}	
	60	20.33^{d}	21.15^{b}	23.53^{a}	20.51^{b}	
Fat	0	8.85^{a}	8.61^{a}	8.74^{a}	8.75^{a}	*
	15	8.23^{b}	8.24^{b}	8.18^{b}	8.09^{b}	
	30	8.22^{b}	8.13^{bc}	8.19^{b}	8.17^{b}	
	45	8.20^{b}	8.27^{b}	8.14^{b}	8.09^{b}	
	60	7.90^{b}	7.97^{c}	7.84^{c}	7.79^{c}	
pH	0	5.64^{a}	5.66^{a}	5.63^{a}	5.70^{a}	*
	15	5.63^{a}	4.93^{c}	4.71^{d}	4.67^{d}	
	30	4.69^{b}	4.88^{c}	4.84^{d}	4.82^{c}	
	45	4.65^{b}	4.92^{c}	5.42^{b}	5.14^{b}	
	60	4.20^{b}	5.14^{b}	5.25^{c}	5.13^{b}	
CL	0	27.67^{c}	24.63^{c}	23.02^{d}	22.63^{e}	*
	15	31.19^{b}	29.35^{b}	29.53^{c}	27.35^{c}	
	30	31.17^{b}	31.03^{ab}	29.16^{c}	27.12^{d}	
	45	31.16^{b}	31.06^{ab}	30.64^{b}	28.71^{b}	
	60	32.16^{a}	32.06^{a}	31.64^{a}	29.71^{a}	

T_1 = 0% salt; T_2 = 1.5% salt concentration; T_3 = 3% salt concentration and T_4 = 5% salt concentration. Mean with different superscripts within same column differ significantly; Significant at 1% level ($P<0.01$)

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