Research Article

EFFECT OF PARTIAL SUBSTITUTION OF SODIUM CHLORIDE WITH POTASSIUM CHLORIDE AND THE USE OF GARLIC (*Alium sativum* L.) ON THE SENSORY QUALITIES OF FRANKFURTER

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ABSTRACT

A study was carried out from 1st July to 21st October 2003 at the Institute of Animal Science (IAS), University of the Philippines, Los Baños, College Laguna, Philippines. The study was based on the overall acceptability of substitution of sodium chloride by potassium chloride, frankfurters of broiler chicken and buffalo meat, which were prepared with or without garlic at 1:1 ratio. Frankfurters stored in chiller for over-night after the preparation (as fresh) and stored in freezer (-5 to -7^{0}C) were taken out at 45 and 75 days for sensory evaluation. Ten experienced panelists were involved to evaluate sensory characteristics of frankfurters. Required amount of franks were cut into approximately 2.5 cm size and heated in microwave before serving to the panelists after randomly coding. Each panelist was served with four randomly allocated samples such that in each replication (block), two panelists were assigned. Juiciness, tenderness, color, flavor, off-flavor and overall acceptability were evaluated using the seven point Hedonic scale score card. Type of meat used and the storage period had significant influence in some of the sensory traits, such as juiciness, tenderness and color. Scores for juiciness and tenderness were significantly (P>0.05) higher with chicken franks. However, highly significant (P>0.01) difference was observed for color, favoring buffalo meat franks. Traits such as flavor and overall acceptability had higher scores for chicken than buffalo meat, although scores for off-flavor had opposite values; higher with chicken, but was not significantly different. Sensory characteristics for stored products were scored lower than fresh. Color was influenced significantly (P>0.05) by meat type, salt, garlic and also storage period of 75 days. Meat type and storage interaction had significant (P>0.05) differences on juiciness, overall acceptability and tenderness. However, their effects as individual variable were not significant. When garlic was used at 2% level in combination with NaCl+KCl at 1:1 ratio the effectiveness was more pronounced from all respects. However, same percentage of garlic could not produce more acceptable franks with sodium chloride alone. All sensory parameters considered in the study were scored less either for 45 or 75 days storage than the fresh. However, statistically; except for off-flavor, no significant differences were observed between 45 and 75 days.

Key words: Frankfurter, substitution, sensory evaluation, panelist, Hedonic scale, garlic

INTRODUCTION

Food safety is a major concern to both consumer and meat processor. Good manufacturing practices, proper storage, and sanitary food preparation can help prevent contamination of food products, resulting in increased consumer safety. Besides the palatability, overall acceptability of the consumer is of major concern. With urbanization and associated income improvement, there is inevitably, an increased demand for meat; and more expensive meat products. Various types of sausages are available but mostly smoked, cooked and dried sausages are popular in our country (TLDP, 2003). Chopped or ground meat that has been blended with spices and other seasonings and usually stuffed in natural or artificial casings is called the sausage, which includes hot dog, hamburger, frankfurter, bologna, meat loaves etc. The term sausage is derived from Latin word "salsus", which means salt because of the fact that major ingredient of the sausage is salt. One of the types of sausage in Germany is called as frankfurter, which in US is commonly known as hot dog.

One of the earliest uses of salt was as a preservative. It reduces water activity (a_W), which in turn, inhibits or slows down the growth of food poisoning or spoilage microorganisms (www.ifr.ac.uk/2000). The many vital roles of NaCl in meat processing include: emulsification, protein extraction, water holding, fat binding, bactericidal action, development of better color and more acceptable product yield and texture, better flavor and lengthen

shelf life of the product. Sodium chloride, most frequently encountered in food as a common table salt, is an essential part of human diet. It is required to maintain the blood pressure and volume, besides controlling the passage of water into and out of the body's cells (IFT, 1980). Insufficient salt clearly prevents our bodies from functioning properly. However, on the other side, an excess of salt in the diet has been linked to several serious diseases, namely hypertension, gastric cancer and osteoporosis. The debate is further fuelled by conflicting results from studies on the effectiveness of reduction in dietary sodium intake for normal healthy people (www.ifr.ac.uk/2000). Excess sodium in the diet is a major hazard for persons who have high blood pressure. Therefore, the public health authorities, regulatory agencies and concerned groups of individuals have indicated that there is a need for reduction of sodium in the human diet. The current demands for the sodium reduced meat products have forced the industry and scientists to look for ways to either totally or partially replace NaCl. Partial substitution of sodium chloride either through potassium and other chloride salts in processed meat has had some success but flavor differences, particularly bitterness, have been a limiting factor (Hand *et al.*, 1982). A concept of reducing NaCl content rather than using chloride salt substitute to replace all or the part of the sodium may be most viable option for cured meat (Hand *et al.*, 1982). Seman *et al.* (1980) reported that 50% replacement of the total 2.5% NaCl with KCl or 50% replacement of the total 1.25% NaCl with KCl or $MgCl_2$ plus added phosphate resulted in acceptable bologna. Besides salt, the use of garlic, ginger and onions are preferred as seasonings and flavor enhancer by majority of Nepalese people.

To date, limited number of studies on the effect of partial replacement of sodium salt through other salts or acids has been carried out. Furthermore, condiments like garlic as a flavor enhancer, seasonings and antimicrobial in combination with the reduction and substitution of sodium chloride in chicken and buffalo meat frankfurter and its impact on the sensory qualities is limited. Considering the production trend, the share of the buffalo meat and preferences of spices in particular to Nepal, an alternative of processing and preserving buffalo and poultry meat frankfurters under freezer condition was designed to compare the effect of substitution of sodium chloride through potassium chloride with and without garlic on the sensory attributes of the frankfurters preserved under -5^0 to -7^0C for a period of 75 days.

MATERIALS AND METHODS

For the purpose of sensory evaluation, the required amount of the frankfurter prepared from the optimally substituted salt were taken as fresh (0 day), 45 and 75 days stored in the walk in chiller at temperature range of -5 to -7^0C. Optimized amount involved the level of salt used at different percentage to find the most acceptable through sensory evaluation in the first study and 2% salt was considered the most desirable level. In the same optimized level of salt, fresh garlic at 2% was used in one and none in the other treatment. Samples for initial sensory tests were taken after they brought down to room temperature. However, frozen samples stored for 45 and 75 days were thawed by transferring to the refrigerator, a day before testing of the different parameters. The samples were taken when the internal temperature of franks reached 2-4^0C. Ten trained and experienced male and female panelists from the different divisions of the IAS and PCC were invited to evaluate the sensory characteristics of the frankfurters. The sensory tests were carried out at about 2-3 PM each time.

Sample preparation and serving

Frankfurters were stored overnight in the chiller. The casing was peeled off, and franks were cut into approximately 1 x 2.5 cm size during the time of preparing samples for sensory evaluation. These franks were heated in the microwave oven under medium heat for three minutes before using for testing.

Because of 8 samples in each treatment, which were not possible to give to one judge to carry out evaluation as per the rules of sensory evaluation, blocks were formed. In each block (replication), two judges were allowed to evaluate randomly allocated four samples only. Altogether five blocks (replication) involving 10 panelists were used. Juiciness, tenderness, color, flavor, off-flavor and overall acceptability of frankfurters were evaluated using the 7 point Hedonic scale score card (Galaraga, 1983); the score of 7 indicated most desirable and the 1 the least desirable sensory characteristics. However, for off-flavor, a score of seven indicated the least and 1 denoted the most desirable characteristic. The data obtained from the sensory evaluation were carried out in three factor factorial (meat, salt and with or without garlic: 2x2x2 =8) in Randomized Complete Block Design (RCBD), where two panelists were assigned in each replication (block).

RESULTS AND DISCUSSION

Juiciness

Scores produced by the panelists for the two types of franks revealed that on the whole, chicken franks were juicier than buffalo meat frank (Table 1). The mean scores for all the period of studies were 5.14, 5.70, 5.48, 5.33, and 4.81, 5.19, 5.30, and 4.49, respectively, for chicken and buffalo meat frankfurters (Table 1). The trend of reduced juiciness is also indicated by the mean scores of different treatments (5.92, 5.25, 5.09 in chicken and 5.52, 4.72 and 4.95 in buffalo meat), respectively, for 0, 45 and 75 days (Table 1). The mean scores for any treatment decreased from 0 to 45 days; although the differences were not significant. The overall scoring for juiciness decreased at higher rate at 45 days than 75 days as compared to 0 day. The reason behind this change might be due to drip loss during early storage period, which could be higher for early than the later period. It can be inferred that the storage of frankfurter at freezing temperature (-5^{0}C to -7^{0}C) reduces the juiciness than the fresh but not to the extent of significance.

Table 1. Juiciness scores of different formulations of frankfurters stored at 0, 45 and 75 days

Treatments	Storage period (days)			
	0	45	75	Mean
Chicken frank				
NaCl with garlic	5.55	5.21	4.67	5.14
NaCl without garlic	6.22	5.33	5.56	5.70
NaCl + KCl (1:1) with garlic	5.89	5.33	5.22	5.48
NaCl + KCl (1:1) without garlic	6.00	5.11	4.89	5.33
Mean	5.92	5.25	5.09	-
Beef frank				
NaCl with garlic	5.33	4.78	4.33	4.81
NaCl without garlic	5.67	4.89	5.00	5.19
NaCl + KCl (1:1) with garlic	5.67	4.56	5.67	5.30
NaCl + KCl (1:1) without garlic	5.39	4.64	4.79	4.94
Mean	5.52	4.72	4.95	-

Tenderness

The mean scores for tenderness also followed similar trend as of juiciness (Table 2) wherein the tenderness reduced as the period of storage extended. The mean values being 6.07, 5.59, 5.28 and 5.80, 5.01and 5.17 for chicken and buffalo meat frank for fresh (0 day), 45 and 75 days respectively. The tenderest frankfurter for the whole period of observation in chicken was scored the highest (5.93) in NaCl salt with out garlic and (5.52) in combined salt with garlic respectively. However, there was no significant influence observed individually either due to salt, or with or without garlic.

Means of the tenderness scores due to the interaction between meat type and storage period are presented in Table 3. Accordingly, storage period and meat type had significant ($P<0.05$) influence on the tenderness of the frankfurters except at 75 days. Highly significant ($P<0.01$) difference due to meat type was observed, which showed chicken frankfurter being more tender than beef. The sensory taste results for tenderness showed similar trend as of the mechanical

evaluation observed in shear force values. It can be concluded that the storage of frankfurter at freezing temperature induced toughness than the fresh. Based on previous results, a lot of differences still exist on the effect of freezing on the tenderness of meat and meat products. When meat was held at 0^{0}C to -5^{0}C after slaughter, tenderness decreased during the first 24 hours, while rigor mortis set in and then increased gradually. Frozen pork roast held at -120C, -18^{0}C and -23^{0}C were less tender and had a higher shear force value after storage for one year (AMIF, 1960). Also, it had been reported that the increase in tenderness is greater as the freezing temperature is decreased from -10^{0}C to -80^{0}C (AMIF, 1960).

Table 2. Tenderness scores of different formulation of frankfurters at 0, 45 and 75 days

Treatments	Mean sensory scores			
	Storage period (days)			
	0	45	75	Mean
Chicken frank				
NaCl w/ garlic	5.94	5.58	5.12	5.21
NaCl w/o garlic	6.22	5.78	5.78	5.93
NaCl + KCl(1:1) with garlic	6.00	5.78	5.11	5.63
NaCl + KCl(1:1) without garlic	6.11	5.22	5.11	5.48
Mean	6.07	5.59	5.28	-
Buff frank				
NaCl with garlic	5.67	5.11	5.11	5.30
NaCl without garlic	6.00	5.00	5.45	5.48
NaCl + KCl(1:1) with garlic	6.11	5.22	5.22	5.52
NaCl + KCl(1:1) without garlic	5.42	4.72	4.88	5.01
Mean	5.80	5.01	5.17	-

Table 3. Interaction effect on tenderness due to of meat type and storage of frankfurters Storage period

Days	Meat type		
	Chicken	Buff	Mean
0	6.02a	5.65a	5.84*
45	5.58b	4.90b	5.24*
75	5.22c	5.10b	5.16ns
Mean	5.61	5.22	-

*Significant at P<0.05; Means within column with different superscripts differ significantly P<0.05

The influence on the tenderness of frankfurters due to salt type, and with or without garlic is shown in Table 4. Scoring for tenderness was higher (5.58 vs. 5.24) in garlic frankfurter indicating a significant (P<0.05) difference in two types of salt. A significant difference was also observed in without garlic, however single salt was contributing better in tenderness than combined salt. It can be inferred that the use of garlic and salt type in the frankfurter could influence significantly (P<0.05) on the tenderness of the frankfurter.

Table 4. Synergistic effect on tenderness of franks due to salt type and garlic

Salt type	With garlic	Without garlic	Mean
NaCl	5.24^{b}	5.56^{a}	5.40*
NaCl + KCl	5.58^{a}	5.27^{b}	5.43*

*Significant at P<0.05; Means within column having different superscripts differ significantly P<0.05

Overall acceptability

Like juiciness and tenderness, the scores for overall acceptability dropped at 45 days storage, showing less acceptable product compared to the fresh. Table 5 presents the overall acceptability scores. In general, the overall acceptability scores (5.57 vs. 5.52) in fresh (0 day) for chicken and buffalo meat frank respectively showed better acceptability of chicken over that of buffalo. However, for rest of the period the over all scores were slightly higher than that of chicken indicating better acceptability after 45 and 75 days storage. The values were statistically nonsignificant either due to individual treatment or combined synergistic effect. However, Seman et al. (1980) noted that turkey frankfurters containing 1.25% NaCl plus 1.25% KCl scored significantly higher than the 2.5% NaCl for overall preference. The addition of combined salts significantly (P<0.05) influenced the overall acceptability compared to NaCl alone with garlic. Garlic was the most acceptable for the judge if a combined salt of NaCl+ KCl (1:1 ratio of 2% salt) were used. Not only could it influence the overall acceptances, but also could affect juiciness and tenderness of frankfurter. Powers and Thompson (1982) did not find any significant difference in taste panel scores for acceptability when freshly prepared samples were compared with stored samples for 1-2 weeks at -2^{0}C to 0^{0}C. The present result differs from the finding of Semen et al (1980) and is in the opinion of Powers and Thompson (1982).

Table 5. Overall acceptability of the different frank formulation stored at 0, 45, and 75 days

Treatments	Storage period (days)			
	0	45	75	Mean
Chicken frank				
NaCl with garlic	5.49	4.91	4.61	5.00
NaCl without garlic	5.78	5.00	5.55	5.44
NaCl + KCl(1:1) with garlic	5.56	5.00	5.22	5.26
NaCl + KCl(1:1) without garlic	5.44	4.78	4.78	5.00
Mean	5.57	4.92	5.04	-
Buff frank				
NaCl with garlic	5.44	5.33	4.67	5.15
NaCl with garlic	6.11	5.45	5.44	5.67
NaCl + KCl(1:1) with garlic	5.33	4.78	5.89	5.33
NaCl + KCl(1:1) without garlic	5.18	4.70	4.55	4.81
Mean	5.52	5.07	5.14	-

Effect of meat type on sensory traits

Mean scores for juiciness, tenderness, color, flavor, off-flavor and overall acceptability of chicken and beef frankfurters are presented in Table 6. The type of meat influenced the juiciness (5.31 vs. 5.01), tenderness (5.61 vs. 5.22) significantly ($P<0.05$). The chicken frankfurter was juicier and tenderer as compared to buffalo meat frankfurter. Lawrie (1979) observed less juicy beef held at 0^0C stored for few days than the beef held at -10^0C for a period of 20 weeks. This is due to species differences, wherein the chicken meat was very tender and juicy compared to buffalo meat. The results for tenderness obtained from sensory evaluation were comparable with the results of instrumental evaluation. In relation to color, overall rating for chicken was between cream and beige, while for buffalo moderately brown to brown. The overall ratings of color for chicken and buffalo were significantly ($P<0.01$) different (3.50 vs. 6.56) (Table 6). The myoglobin content varies greatly due to species, breed, sex, age, muscle and training, plane of nutrition, pH, salt etc. The panelists' mean score for traits like flavor, off-flavor and overall acceptability were slightly higher with that of chicken frankfurter than buffalo meat frank, the differences were non-significant. The higher score of off-flavor indicated more deteriorated frank of chicken than buff which might be due to more contaminated conditions in wet market than buffalo meat procured from university slaughterhouse. Though the score for chicken frankfurter for overall acceptability was slightly higher (5.11 vs. 5.07) than buffalo but statistically they were similar.

Table 6. Meat type variation on juiciness, tenderness, color, flavor and off-flavor acceptability

Meat type	Sensory qualities					
	Juiciness	Tenderness	Color	Flavor	Off-flavor	Acceptability
Chicken	5.31^a	5.61^a	3.50^b	5.50^a	2.11^a	5.11^a
Buff	5.01^b	5.22^b	6.56^a	5.35^a	2.07^a	5.07^a

Means within column having different superscripts differ significantly at $P<0.05$

Effect of storage period

Mean scores for juiciness, tenderness, color, flavor, off-flavor and acceptability, due to storage of frankfurters are presented in Table 7. Mean juiciness score for 0, 45 and 75 days were 5.62, 4.96 and 4.90, respectively. At the beginning, the score differed significantly ($P<0.05$) with the rest of the period indicating fresh frankfurter being juicier than the frozen stored. However, there was no difference in terms of juiciness if stored for 45 or 75 days. Juiciness scores for vacuum packed and fresh sample did not vary significantly but other packaging treatments differed with storage at –17^0C (Brewer and Harber, 1991). The score of fresh frankfurter for tenderness also showed a similar trend which differed significantly ($P<0.05$) than stored either for 45 or 75 days. The values between 45 and 75 days were statistically not significant.

Scores for the color followed a different trend than the rest of the sensory traits. The scores for the color increased until 45 days of storage and then declined slightly at 75 days, with higher values than the fresh. The increment of color scores might be due to the contribution of some of the ingredients like Prague powder and

ascorbic acid, which are responsible in color development and retention besides flavor enhancement during the display (AMIF, 1960).). For higher scores, the results which promoted nitrosomyoglobin formation must be due to the reaction taking place during storage in some of the ingredients (Prague powder, FOS, ascorbic acid) used in the formulation. However, declining trend followed after 45 days, indicating some discoloration during longer period of storage. The discoloration of color in cured meat is influenced by oxygen, temperature, bacterial growth, enzymatic action or auto-oxidation, which deteriorates the fresh meat color (AMIF, 1960). The mean scores for 0, 45, and 75 days were 4.88, 5.12 and 5.09, respectively (Table 7). The values for 0 day differed significantly ($P<0.05$) with the rest of the period. Flavor and off-flavor scores also followed the same trend as those of juiciness and tenderness. The highest scores for flavor (5.73) of fresh frankfurter differed significantly ($P<0.05$) than the scores given to either for 45 or 75 days. However, the scores for 45 and 75 days were not significant. Similarly, the highest scores (2.39) for off-flavor of 75 days differed significantly ($P<0.05$) than the values of 0 or 45 days. The higher values given to off-flavor are the indications for more off-flavor present in the product. Thus, indicating no much difference in off-flavor development either in fresh or stored at -5^0 to -7^0C for a period of 45 days. It could be inferred that franks could remain fresh at -5^0 to -7^0C up to 45 days if well packed in polyvinylchloride bags. The data also confirmed that as the storage period increases, development of off-flavor increases. The increasing score for off-flavor indicated development of rancidity of the product. Brewer and Harber (1991) reported increased rancid odor over time for all packaging treatments except vacuum packaging. Similarly, for flavor there was no much difference either stored for 45 or 75 days at the said temperature range. Flavor score also followed the same trend, fresh having significantly ($P<0.05$) strong flavor than the rest. The overall acceptability score was the highest (5.46) for fresh, followed by frozen for 45 days (4.92) and the least (4.88) for 75 days. When this trait is considered for a storage period of either for 45 or 75 days, they did not differed significantly. Sensory traits like juiciness, tenderness, color, flavor, off-flavor and acceptability decreased after frankfurters were stored at -5^0C to -7^0C for a period of 75 days. However, Kotula et al. (1976) did not find any significant change in flavor, aroma and overall acceptability when beef patties were stored at -17^0C for one year.

Table 7. Effect of storage on juiciness, tenderness, color, flavor, off-flavor and acceptability of franks

Storage period (days)	Sensory qualities					
	Juiciness	Tenderness	Color	Flavor	Off-flavor	Acceptability
0	5.62^a	5.83^a	4.88^b	5.73^a	1.84^b	5.46^a
45	4.96^b	5.24^b	5.12^a	5.23^b	2.04^b	4.92^b
75	4.90^b	5.16^b	5.09^a	5.32^b	2.39^a	4.88^b

Means within column having different superscripts differ significantly $P<0.05$

Synergistic effect on color and off-flavor

Color: Table 8 presents the mean color scores for interaction among meat type, salt substitution, addition of garlic and storage. Highly significant ($P<0.01$) differences were found for all the storage periods with all the possible combinations due to meat types. The results clearly indicated that between two meat types the color could be significantly influenced by all the conditions considered in the study. As fresh (0 day), the color of chicken frank formulated in NaCl only, preferred better with garlic ($P<0.05$). However, when combination of NaCl + KCl, was used, the score was significantly ($P<0.05$) higher in without garlic indicating more attractive color. The scores for the same period either due to salt type or with garlic or with out remained same in buffalo meat frankfurter. Color scored for 45 days in chicken frank also followed the same trend; higher scoring of NaCl in combination with garlic, and reverse preference in case of without garlic in NaCl + KCl salt combination. At 75 days, both NaCl or NaCl + KCl formulation with garlic were better preferred as against with out garlic (Table 8). In the same period, the scores with garlic was higher than without both in the single or combined salt, the difference in single salt being significant ($P<0.05\%$) in chicken frank while the same scores were reverse in buffalo meat frank. Likewise, the frankfurter differed significantly ($P<0.01$) in between species. Beef frankfurter was better preferred over chicken in terms of color ($P<0.01$).

Off-flavor: Off-flavor scores due to meat type and storage is presented in Table 9. The scores for chicken and buffalo meat frankfurter were 1.87 and 1.82, 1.87 and 2.22 and 2.60 and 2.18 for 0, 45 and 75 days, respectively. The storage of chicken frankfurter until 45 days did not have a significant effect, however, a significant difference

in the score was observed for 75 days. When the buffalo meat frankfurter scores were considered, a significant difference was observed between the fresh and stored either for 45 or 75 days. The scores showed some variations both due to meat type and storage period. The trend of increment in scores were higher (undesirable) in both frankfurter as the storage time progressed, more so at 75 days with the exception of buffalo meat, where the score was slightly lower than 45 days. However, the values did not differ significantly. Kotula *et al.* (1976) observed some panelists being able to detect old or rancid condition in the products during 9 and 12 months of storage at –17^{0}C. Hand *et al.* (1982) concluded that regardless of storage period or formulation, replacing 100% NaCl either by KCl or $MgCl_2$ had the most off-flavor than control or 35% KCl replacement.

Table 8. Synergistic effects on color of franks due to meat type, salt substitution, garlic and storage period

Storage period (days)	Meat type					
	Chicken			Beef		
Salt type	With garlic	without garlic	Sig	with garlic	without garlic	Sig
0 day						
NaCl	3.67^a	2.67^b	*	6.47^a	6.47^a	ns
NaCl+ KCl	3.20^b	3.47^a	ns	6.40^a	6.67^a	ns
NaCl	3.80^a	3.33^b	*	6.40^b	6.53^a	ns
45 days						
NaCl+KCl	3.40^b	3.87^a	*	6.93^a	6.67^a	ns
NaCl	3.67^a	3.27^a	*	6.67^a	6.53^a	ns
75 days						
NaCl+KCl	3.47^a	3.40^a	ns	6.34^b	6.67^a	*

LSD (0.05) 0.28 *significant at P<0.05 ns-nonsignificant, a–c Means within the same row with no common superscript differ significantly (P < 0.05)

Table 9. Synergistic effect on off-flavor of frankfurters due to meat type and storage

Storage period (days)	Meat type		
	Chicken Mean score	Beef Mean score	Mean
0	1.87b	1.82b	1.85
45	1.87b	2.22a	2.05
75	2.60a	2.18a	2.39

LSD (0.05) 0.23, Means within column having different superscripts differ significantly (P<0.05)

CONCLUSIONS

Chicken and buffalo meat frankfurters prepared by replacing the NaCl with KCl and the addition of garlic are alternate formulations that do not drastically compromise the quality of the product. When NaCl +KCl was used at 1:1 ratio of 2% salt in combination of 2% garlic, it resulted in better overall acceptability, tenderness, and juiciness of frankfurter up to a storage period of 45 days, however, off-flavor score was higher during 75 days storage at -5^{0}C to -7^{0}C. While incorporating 2% garlic in the frankfurter formulation, it would be better to use 2% combined salt of NaCl and KCl (1: 1 ratio) instead of NaCl alone. However, in the absence of garlic, preferably NaCl would be better choice for more desirable juiciness, tenderness and overall acceptance.

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