PROPERTIES OF NON FERMENTED DRY SAUSAGE MANUFACTURED FROM BEEF AND LAMB MEATS WITH OR WITHOUT SEASONINGS.

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SUMMARY

Sausage samples based on beef and lamb meats were manufactured in the form of non fermented items. Two batches of the previous meat sources were prepared with or without the presence of seasonings, i.e.lactose and glucose. Both of the manufactured sawage samples were kept for ripening at room temperature for 21 days; through which changes that occurred in their chemical and physical constituents were considered. The investigated parameters include; pH value; percent of moisture, protein, fat lactic acid, carbohydrates, weight loss as well as peroxide value, content & nitrite and content of cured meat pigments. Statistical analysis of the results was considered within regression analysis and analysis of variance.

INTRODUCTION

Dry sausage could be manufacture from a wide range of meat sources. On the other hand the keeping qualities of such sausage depend upon curing ingredients, spices and removal of moisture from the product by drying Anonymous, 1966; MacKenzie, 1966; Anonymous, 1968). It is of important to mention that may attempt to speed the drying rate usually lead to a noticeable over drying of the surface of the sausage; a condition known as case hardening. This phenomenon predludes any further attempt to remove moisture from the interior of the sausage. Production of sausage by the traditional method using aged salted meat requires nitrate as curing agent. On the other hand, the elimination of the use of nitrate in meat products is now being considered all over the world by government agencies.

It is of interest to shed light upon the opinion of Zaika et al., 1976 who compared Lebanon bologna sausage containing Na NO_2(78-100 ppm) with other sample containing Na NO_3 (200-1850 ppm) from the view points of the changes in pH, titratable acidity and cured meat pigment. The available data proved that low levels of Na NO_3(100 ppm) gave satisfactory, color formation in the final products. On the other hand, in some experiments with bologna prepared with nitrate, considerable amounts of nitrite were found during the early stages of fermentation. For instance, after 4 days of fermentation, the nitrite concentration was less than 10 ppm.

Drying of sausages in the ripening rooms is usually achieved at 7.2-12.8°C, 70-72% RH, and 15.20 air changes per hour; where they remain for several weeks to permit further development of the desired flavor, aroma and texture (MacKenzie, 1966). For economy, shortening the drying period of any given sausage samples would be desirable so that the product could be marketed in less time. The present work was undertaken to follow up some chemical and physical changes occurring in beef and lamb sausages during ripening for 21 days at room temperature. The available data was compared within statistical analysis.

MATERIALS AND METHODS:

Materials:

Meat sources: About 40 kg of each of fresh beef and lamb meats were obtained from El Basatin salanghter house, Cairo Governorate, EGYPT. The meat samples were grounded after frozen at -18°C through on electric grinder using 6 in plate.

Technological methods:

Beef or lamb meat that previously grinded through a 6 in plate was mixed with 25% NaCl, aged for 48 h. at 4°C, and then regrinded through a 1.5 in.plate. The individual aged meat samples were divided into 15 kg batches and mixed with sodium nitrite, sodium ascorbate and with or without seasonings.(Lactose 0.6% and glucose 0.4%)as given in Table (1).

Each batch was stuffed into the natural small intestine. Both of the manufactured sausage samples were riped at room temperature for 21 days.

Methods:

Analytical methods: Moisture, fat content, nitrite (analyzed colorimetrically by using Griess reaction), peroxide values and protein (Kjeldahel N x 6.25) were determined according to the AOAC (1985). Total carbohydrates were based on the phenol-sulphuric acid method (Dubois et al., 1956). pH and titratable acidity were performed according to (Zaika, et al., 1976).

Determination of meat pigments: Formation of cured meat pigments was followed by the method of Hornsey (1956) which was modified by (Zaika et al., 1976).

$$\text{Conversion to cured meat pigments\%} = \frac{\text{nitrosyl-heme pigments (ppm)}}{\text{total heme pigments (ppm)}} \times 100 = \frac{A_{540nm} \times 290}{A_{640nm} \times 680} \times 100$$

Statistical analysis: Multiple regression and analysis of variance for full regression were carried out by the SAS computer program which was applied according to Helwig(1983) using the 286 PC/AT 80286 computer;Available at the Expiry Date project, Faculty of Agriculture, Ain Shams University.

RESULTS AND DISCUSSION

The major chemical constituents of the beef and lamb sausage samples that given in Fig. (1) indicate the main following points:

- There is a pronounced descending pattern in the moisture content as a function of extending the ripening period. For instance, the moisture content of the beef sausage

containing seasonings that was 60.01% reached 29.52% after 21 days of ripening at room temperature. This simply means that the moisture loss in the beef sausage within the aforementioned ripening period was 30.49% with a corresponding rate value of 0.7994.

- The rate of moisture decrement in lamb sausage containing seasoning ingredients was 0.7994. So, it is expected that moisture loss in beef sausage may occurs in a faster rate than the lamb sample. However, the correlation coefficient (R^2)between moisture and ripening period was 97.09% for beef sausage "A" and 97.61% for lamb sausage "AA". The corresponding slope values were -1.4467 and -1.40186 (H_2O%/days).

- When the protein content of the same samples was considered, the data of the same table showed no noticeable variations in its level during the whole ripening period in both beef and lamb samples.

- With respect to the fat content of the same sample, the data of Table (2) showed the presence of higher "R^2" values between the changes in fat content and ripening periods; being 93.45% in beef sausage "A" and 88.54% "AA" in lamb sausage. The slope of fat reduction was -0.0106 (fat%/day) for the former and -0.0094 (fat%/day) for the latter with a corresponding standard error of 0.0309 and 0.0376 as seen in the same Table.

The previous findings are in close to what had been reported by Lu and Townsend(1973).

The percent of weight loss was given in Fig. (2) from which it was 28.75% in beef sausage "A" after 7 days of ripening and reached 43.65% after 21 days with a corresponding folding value of 1.5. Slope of weight hrs/day was 1.969 and the R^2 was 87.65% as seen in Table (3). In case of lamb sausage, the weight loss % of sample "AA" reached 42.51% by the end of 21 days of ripening which represents also about 1.5 folds of the weight loss % after 7 days of ripening. A similar pattern was noticed for other tested sausage samples; "B"and "BB" as seen in Table(3,4). However, the shrinkage %, a trend which correlated with loss of moisture of the same investigated samples assured also the previous conclusion. Similar pattern of changes was noticed by Townsend et al. (1975). On the other hand, Uram et al. (1984) proved that the addition of emulsion to coarse ground smoked sausage eliminated the significant effect of grind size on total shrinkage. With respect to the changes occurre in the lactic acid content of the investigated sample; data given in Fig. (3) showed the following trends.

- There is a stepwise increase in the lactic acid content of beef or lamb sausage during ripening periods.

- Such previous trend is differed within the tested samples. For instance, the incremental level rate that was 1.3224 (lactic acid %/week) in beef sausage "A" reached only 1.1816 (lactic acid %/week) in beef sausage "B". The corresponding values in lamb sausage are 1.3326 and 1.1386 (lactic acid %/week) for the "AA" and "BB" samples respectively.

The increment of lactic acid may be related to the activity of lactic acid bacteria during ripening periods that extended for 21 days at room temperature. When the pH values of the tested sausages were considered, the data of Fig.(4)proved the presence of slight decrement by the starting of the day 14 with a slight further drop in pH values up to the end of the 21 days of ripening. Such trend could be related to the buffering capacity of the meat samples which resist or minimize the changes in pH values. It is of important to refer to the opinion of Wardlaw(1973) who proved that lactic acid content produced during fermentation of summer sausage remained relatively constand (0.47-0.50%)from the end of fermentation through 30 days of drying. The lactic acid quantity of 0.50-0.73% at 30-60 days is within the concentration range generally reported for summer sausage given by Acton,(1972). The total carbohydrate content of the sausage,samples under investigation that illustrated in Fig.(5) showed a down word trend, a fact which could be related to one of the following reasons:

- The activity of enzyme that breakdown the polysaccharides to simple forms.
- Activity of microorganisms that consumed these simple sugars for their growth.

However, the consumed % given in the same figure was higher in the presence of the added seasoning, i.e. lactose 0.6% and glucose 0.4% which may enhanced the activity of organisms during ripening. In such aspect, Ten Cate (1960)and Tandler (1963) proved that denaturation of salt soluble proteins during ripening of dry sausage is brought about by a decrease in pH due to the production of lactic acid by bacterial metabolism of carbohydrates added or present in the meat.

The cured meat pigments of beef and lamb sausages showed a shight improvement as seen in Figs.(6)and(7). The improvement rate level was 2.0054(% pigment/week)in beef sausage "A" and 1.7457(% pigment/week)in the beef sausage"B". In case of lamb sausage the rate of improvement level was 2.0314(% of pigment/week)and 1.7803(% of pigment/week)in batch "AA"and "BB" respectively. These results indicated the superiority of the sausage samples that containing seasonings over the other one, i.e. no added seasonings. The aforementioned results are going with Townsed et al.,(1983)who found that conversion of total heme pigment to the nitric oxide heme pigment form was not affected by air changes during fermentation, but the method of fermentation did affect this conversion.

Changes in peroxide values during the ripening periods of the same tested sausages are shown in Fig.(8). The pattern of the responsed data indicated a noticeable increment within the first 7 days of ripening after which a constant trend was approximatly realized to the end of the ripening periods. The correlation coefficient of nitrite hydrolyses during ripening periods was 93.78% in beef sausage "A" and 96.27% in beef sausage "B" as seen in Table (3). So, nitrile hydrolysis is more pronounced in the latter sample than the former. To answer what is the tested parameters that highly correlated with ripening periods of the beef and lamb sausage, statistical analysis given in Tables (3,4)assured the periority of changes in lactic % and pH followed by carbohydrates.

CONCLUSION

Moisture, proteins and fats of the investigated beef and lamb sausage samples were considered through ripening periods that extended for 21 days at room temperature. Statistical analysis proved the presence of higher (R^2) in the moisture and fat changes during ripening. The regression analysis and its analysis of variance of the responsed items namely in the two sausage samples carbohydrate %, pH values, nitrite peroxide value, weight loss % pigments and lactic acid content and were also given. Slope of regression in the beef sausage showed a decline trend for the first three parameters, while the slope of the others showed a positive trend. In case of the lamb sausage, the slope of regression of the corresponding parameters showed a negative trend only for pH and a positive value for the other five parameters.

ACKNOWLEDGEMENT

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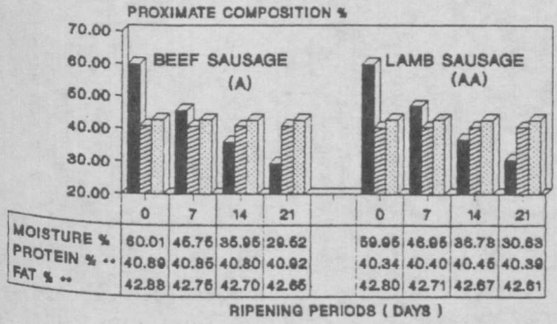
FIG (1) CHANGES IN CHEMICAL COMPOSITION OF BEEF & LAMB SAUSAGES DURING RIPENING



** = CALCULATED ON DRY WEIGHT BASIS

FIG (2) WEIGHT LOSS % OCCURRED DURING RIPENING PERIODS OF THE TESTED SAUSAGES

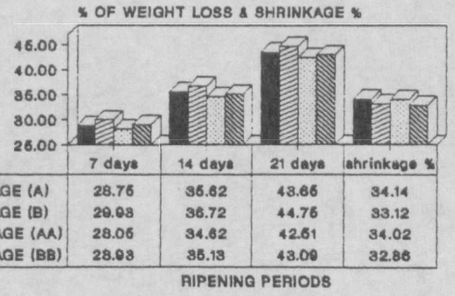


FIG (3) RELATION BETWEEN RIPENING AND LACTIC ACID % OF THE TESTED SAUSAGES

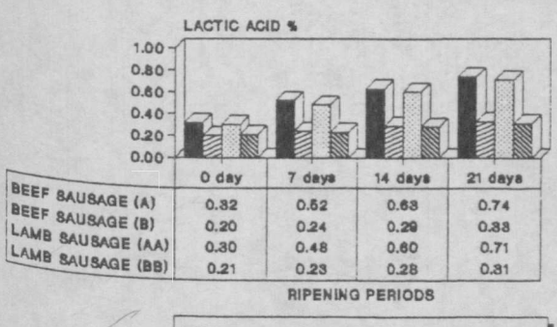


FIG (4) RELATION BETWEEN RIPENING AND pH VALUES OF THE TESTED SAUSAGES

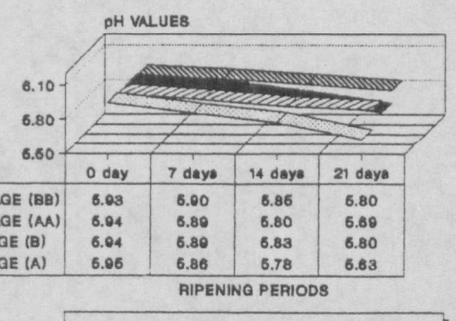


Table (1): Ingredients used in the manufacturing of non-fermented dry sausage samples.

Ingredients	Unit	Meat samples			
		Beef		Lamb	
		Batch (A)	Batch (B)	Batch (AA)	Batch (BB)
Meats cure	kg	30	30	30	30
Sodium nitrite	125ppm	3.75 g	3.75 g	3.75 g	3.75 g
Sodium chloride	2.5 %	750 g	750 g	750 g	7.50 g
Sodium ascorbate	500ppm	15.0	15.0	15.0	15.0
Seasonings:					
Lactose	0.6 %	180	-	180	-
Glucose	0.4 %	120	-	120	-

Table (2): Statistical analysis of the changes occurred in the moisture, protein and fat content of the beef and lamb sausages during ripening for 21 days.

Responsed items	Statistical parameters				
	Intercept	Slope	R^2%	Standard error	F. ratio
Moisture:					
A	57.99	-1.4467	97.09	2.77	66.65
AA	58.29	-1.4018	97.61	2.43	81.596
Protein					
A	40.859	0.0005	0.99	0.0633	0.0199
AA	40.36	-0.002	32.79	0.0452	0.9756
Fat:					
A	42.856	-0.0106	93.45	0.0329	28.521
AA	42.779	-0.0094	88.54	0.0376	15.447

A = Beef sausage. AA = Lamb sausage.

Table (3): Regression analysis and its analysis of varience of selected responsed items in relation to ripening periods of beef sausage samples.

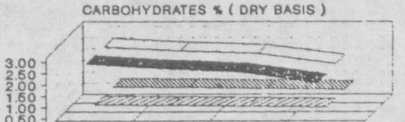
Responsed items	Statistical parameters									
	Intercept		Slope		R^2 %		Stnd. Error		F. ratio	
	A	B	A	B	A	B	A	B	A	B
Lactic acid %	0.347	0.199	0.0195	0.0063	97.48	99.79	0.0349	0.0032	77.24	96.80
Peroxide value	5.877	5.831	0.215	0.216	81.72	82.70	1.127	1.093	8.943	0.56
Carbohydrates %	2.972	0.723	-0.723	-0.037	-5.286	92.16	99.56	0.1213	0.0039	23.50
Weight loss %	6.332	6.694	1.969	2.0149	87.65	86.92	8.181	8.649	14.19	13.29
Pigments	20.4	6.701	3.3121	1.7559	84.09	98.98	15.95	1.977	10.57	193.33
pH value	5.961	5.937	-0.015	-0.0069	97.79	98.46	0.0247	0.0095	88.66	128.00
Nitrite(ppm $NaNO_2$)	5.961	5.937	-0.015	-0.015	-0.0069	97.79	98.46	0.0247	88.66	128.00

Table (4): Regression analysis and its analysis of variance of selected responsed items in relation to ripening periods of lamb sausage samples.

Responsed items	Statistical parameters									
	Intercept		Slope		R^2 %		Stnd. Error		F. ratio	
	AA	BB	AA	BB	AA	BB	AA	BB	AA	BB
Lactic acid %	0.32	0.205	0.0193	0.005	98.54	97.61	0.026	0.0067	135.0	81.67
Peroxide value	5.916	5.971	0.2123	0.213	80.80	80.90	1.145	1.146	8.418	9.468
Carbohydrate %	2.835	0.713	-0.033	0.0053	91.40	99.56	0.112	0.003	21.24	456.33
Weight loss %	6.23	6.467	1.916	1.935	87.57	86.77	7.987	8.364	14.09	13.116
Pigments	20.17	7.30	3.03	1.633	84.48	99.97	13.395	0.297	10.696	739.97
pH value	5.957	5.936	-0.0012	-0.006	96.55	98.78	0.0247	0.0077	56.008	161.33

"A" = Beef sausage with seasonings. "AA" = Lamb sausage with seasonings.
"B" = Beef sausage without seasonings. "BB" = Lamb sausage without seasonings.

FIG (5) RELATION BETWEEN RIPENING AND CARBOHYDRATES % OF THE TESTED SAUSAGES

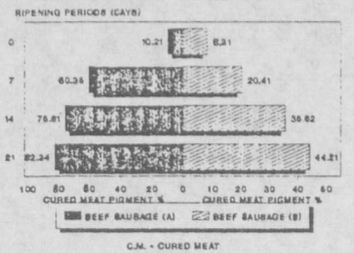


	0 day	7 days	14 days	21 days
LAMB SAUSAGE (BB)	0.71	0.68	0.64	0.60
LAMB SAUSAGE (AA)	2.88	2.70	2.59	2.15
BEEF SAUSAGE (B)	0.72	0.69	0.65	0.61
BEEF SAUSAGE (A)	2.92	2.72	2.58	2.09

RIPENING PERIODS

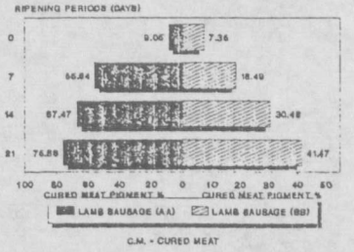
BEEF SAUSAGE (A) BEEF SAUSAGE (B) LAMB SAUSAGE (AA) LAMB SAUSAGE (BB)

FIG (6) RELATION BETWEEN RIPENING AND C.M. PIGMENTS % OF THE BEEF SAUSAGES



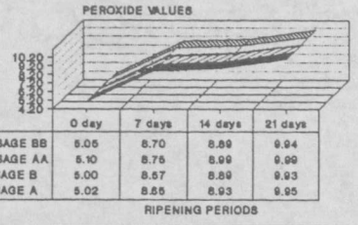
C.M. = CURED MEAT

FIG (7) RELATION BETWEEN RIPENING AND C.M. PIGMENTS % OF THE LAMB SAUSAGES



C.M. = CURED MEAT

FIG (8) RELATION BETWEEN RIPENING AND PEROXIDE VALUES OF THE TESTED SAUSAGES

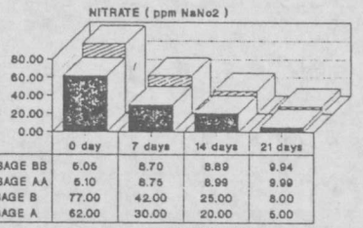


	0 day	7 days	14 days	21 days
LAMB SAUSAGE BB	5.05	8.70	8.89	9.94
LAMB SAUSAGE AA	5.10	8.75	8.99	9.99
BEEF SAUSAGE B	5.00	8.67	8.89	9.93
BEEF SAUSAGE A	5.02	8.85	8.93	9.95

RIPENING PERIODS

BEEF SAUSAGE A BEEF SAUSAGE B LAMB SAUSAGE AA LAMB SAUSAGE BB

FIG (9) RELATION BETWEEN RIPENING AND NITRITE(ppm NaNo2)OF THE TESTED SAUSAGES



	0 day	7 days	14 days	21 days
LAMB SAUSAGE BB	5.05	8.70	8.89	9.94
LAMB SAUSAGE AA	5.10	8.75	8.99	9.99
BEEF SAUSAGE B	77.00	42.00	25.00	8.00
BEEF SAUSAGE A	62.00	30.00	20.00	5.00

RIPENING PERIODS

BEEF SAUSAGE A BEEF SAUSAGE B