Bacteriological and chemical changes occured in minced camel meat and meat substitutes during cold storage .

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The bacterial changes occured in the minced camel meat and meat substitutes during the storage at 5°C showed that the total bacterial counts , proteolytic, and psychrophilic bacteria increased by prolonging the storage period. The increase was higher in the minced camel meat rather than in the mixture of minced camel meat and meat substitutes . On the contrary , coliform as a general trend was decreased during the same period of storage in either camel meat or its mixture with meat substitutes . TBA values were gradually increased during storage in both two types of samples . Meanwhile, as a general trend , the free amino nitrogen was decreased during the first stage of storage , and then a gradual increase was observed by prolonging the storage period .

INTRODUCTION

Meat as a main component of sousage is a suitable medium for the growth of micro-organisms and starts to be contaminated in the slaughtering house till its manufacture in the sausage factories . The microbial activity leads to certain changes in either flavor or color and accumulation of toxins in meats . The development of microflora (bacteria , fungi and yeasts) and different changes occured as a result of their activity during sausage storage were widely studied by many investigators .

The counting of the bacterial cells in camel meat was accomplished by El-Sanafiri (1974) being 430×10^3 cells per gram . After 2 and 4 days of cold storage counts reached 450×10^3 and 510×10^4 cells per gram respectively . Noskova and Pek (1959) reviewed that during storage of sausage both pH value and total bacterial counts increased . . Roiter (1970) stated that the growth of proteolytic bacteria in sausage was markedly low at 4 - 6°C as compared to 10 and 20°C . Ayers et al.,(1956) found that the pseudomonas and achromobacter types increased during the cold storage of sausage at 1.7 to 4.4°C as they reached 95 % of the microbial population at the time of the developed off odor slime , and complete spoilage . Thompson et al.,(1978) reported that at 5°C soy beef formulation had lower oxidation ratio than the ground beef mixtures as detected by the thiobarbituric acid test (TBA) . At the end of 6 days storage , the soy beef formulation had higher numbers of staphylococci , coliform , proteolytic and total organisms , but this was usually statistically insignificant . The ground beef and tap water mixtures consistently had the lowest counts of all enumerations . Williams and Zabik (1975) indicated that although the replacement of 30 % meat with soy appeared to have slightly lower (TBA) value during refrigerated and frozen storage , soy did not appear to prevent the accumulation of TBA reactive compound in cooked meat . Roiter et al., (1968) mentioned that during storage of sausage, the free amino acids markedly increased, especially after 23 days of cold storage .

This investigation was carried out to study the bacteriological and chemical changes occured in the prepared mixtures of minced camel meat and some meat substitutes during cold storage at 5°C .

MATERIALS AND METHODS

Ground camel meat and a mixture of ground camel meat (from shoulders part) , soy curd and soy protein isolate (prepared from soy bean) , potato tubers and spices were stuffed into the mutton intestines after their cleaning according to the method described by Abd El-Baki et al. (1981) . The prepared samples were stored at 5°C for 10 days . Samples were periodically taken every 2 days for the bacteriological analyses .

Total count was carried out according to the method described by Frazier and Foster (1959) . Proteolytic bacteria was counted according to the method described by Difco manual (1953) , using egg meat agar medium . Psychrophilic bacteria was carried out according to the method described by Sharf (1966) . Coliform group was counted by using violet red bile agar medium according to Sharf (1966) . Free amino nitrogen groups were determined as glycine by ninhydrine test as described by Stein and Moore (1954) .

RESULTS AND DISCUSSION

The results of Table (1) show that during storage the total count increased in the minced camel meat samples rather than in the meat substitute ones . This may be due to the ordinary meat spoilage which grow better in meat (Nickerson and Sinskey , 1972) . While the percentage increase reached 13820 in the case of minced camel meat , it was 1818 , 15882 , 4756 and 13243 in the case of the mixtures B , C , D and E respectively . Similar results has been obtained by Noskova and Pek (1959) who mentioned that during storage of sausage the total bacteial counts increased . In the mean time , bacteria did not grow without available moisture , as in the minced camel meat , the higher the moisture content , the faster the growth of bacteria , in comparison to the meat substitute samples . In this respect it is worthy to mention that according to Frazier (1970) the grinding of meat greatly increases the surface , relaises moisture and distributes bacteria . Regarding the changes in the numbers of proteolytic bacteria (table 1) , there was an increase in their count by prolonging the storage period . The proteolytic bacteria increased from 0.76 to 120×10^4 cell/gram sample in the case of minced camel meat during the storage period , while it increased from 0.45 to 52×10^4 , 0.78 to 50×10^4 , 0.27 to 41×10^4 , and 0.22 to 47×10^4 cell/gram sample in the case of prepared mixtures B , C , D and E respectively . Moreover , the percentage increase after the six days was higher than that before the mentioned period , as it reached 1400 in the case of minced camel meat and 829 , 461 , 439 and 411 in the case of the prepared mixtures of B , C , D and E respectively . Moreover , the initial larger number of bacteria present in the minced meat should affect duration of bacterial growth phases than these of the other meat mixtures which contained

dried materials beside the meat . Similar results have been reported by Warneck et al., (1966) who mentioned that a high level of raw material contamination did affect the flavor of processed sausage imediately after processing and during subsequent storage as a prepacked product . Also , the results are in agreement with those reported by Abd El-Salam (1978) who found that the initial load of aerobic proteolytic bacterial counts in camel meat sausage increased during cold storage . At the same time , the obtained data in this investigation do not agree with those recorded by Thompson et al., (1978) who stated that soy formulation had higher numbers of proteolytic organisms in comparison to ground beef and tap water mixture .

From Table (2) it was noticed that there was an appreciable increase in the survival number of psychrophilic bacteria . While the survival number of psychrophilic bacteria was zero at the begining of storage period , it reached 18.4 $x 10^3$ cell/gram sample in the case of minced camel meat , and 16.90 , 15.30 , 19.40 and 21.3 $x 10^3$ cell/gram of the prepared mixtures B , C , D and E respectively at the end of the storage period at $5^{\circ}C$. This results showed that during storage at refrigerator temperature , psychrophilic bacteria increased in the five different types of sausage , which was in agreement with the obtained by Frazier (1970) who mentioned that at temperature neer freezing , cold-tolerant bacteria were favored . In this respect , it is worthy to mention that according to Ayers et al., (1956) pseudomonas and achromobacter type increased during cold storage of sausage at $1.7^{\circ}C$ to $4.4^{\circ}C$. Also , similar results were reported by Roiter et al., (1968) who stated that during cold storage of sausage , both lactobacillus and micrococcus bacteria increased . With respect to the coli-form group , generally there was a decrease in its survival number during the cold storage period (table , 2) while it reached 70 in the minced camel meat and 100 , 100 , 80 and 0.00 in the prepared mixtures B , C D and E respectively .

The tabulated data showed that , in the five investigated samples , E.coli count decreased during storage at refrigerator temperature . This may be due to the effect of nitrate on the genetic material of E.coli cells , nitrous acid usually involves base changes in the nuclic acids which cause permanent changes in the purines and pyrimidines of DNA and RNA by deamination of their respective amino groups (Miller and Litsky , 1976) . At the same time Nickerson and Sinskey (1972) mentioned that the reason for adding nitrite to cured fish is to prevent the growth of certain pathogenic bacteria , which include E.coli (Hobbs, 1974) .

The increase of TBA value occured in sample A was comparatively (1.95) , whereas , it was less in the other samples being 1.40 , 0.94 , 1.17 and 1.09 after 10 days storage in the samples A , B , C , D and E respectively . This could be ascribed to the higher moisture content in sample A (77.95 %) accelerating the rancidity rate followed by the other samples which was 74.74 , 71.69 , 68.64 , and 65.56 % in the samples B , C , D and E respectively . Such results are confirmed with those obtained by Mohamed (1974) , and Abd El-Salam (1978) . This Could be reffered to the parallel increase in the proteolytic bacteria responsible for the protein hydrolysis leading to more free amino nitrogen .

The change in free amino nitrogen took two ways . While it decreased during the begining of storage period , it increased after that at the end of storage period . Moreover , the level of free amino nitrogen at the end of storage period was higher than its value at the begining of storage period .

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Table (1) : Total bacterial count and proteolytic bacteria during storage of the mixtures of minced camel meat and meat substitutes * at 5°C.

Bacterial group	Total count x 10^5					Proteolytic bacteria. x 10^4				
Storage period (days)	Sample No.					Sample No.				
	A	B	C	D	E	A	B	C	D	E
0	0.89	1.65	0.34	0.82	0.37	0.76	0.45	0.78	0.27	0.22
2	1.16	1.85	1.06	1.24	0.80	1.20	0.75	4.50	0.60	6.50
4	7.80	7.50	5.80	8.00	9.50	5.00	5.20	6.50	5.60	8.50
6	9.00	7.80	6.00	8.90	9.80	8.00	5.60	8.90	7.60	9.20
8	12.60	9.00	10.00	9.30	11.40	32.00	40.00	35.00	18.00	22.00
10	123.00	30.00	54.00	39.00	49.00	120.00	52.00	50.00	41.00	47.00

A : The control sample.

B : Mixture containing 70 % minced camel meat and 30 % soy curd.

C : Mixture containing 70 % minced camel meat, 25 % soy curd, 3 % potato , and 2 % soy protein isolate.

D : Mixture containing 70 % minced camel meat, 20 % soy curd, 6 % potato flour, and 4 % soy protein isolate.

E : Mixture containing 70 % minced camel meat, 15 % soy curd, 9 % potato flour, and 6 % soy protein isolate.

* : Soy curd, potato flour, and soy protein isolate.

Table (2) : Changes in Coliform and Psychrophilic bacteria occured during storage of the mixtures of minced camel meat and meat substitutes* at 5°C.

Bacterial group	Coliform x 10^2					Psychrophilic bacteria x 10^3				
Storage period (days)	Sample No.					Sample No.				
	A	B	C	D	E	A	B	C	D	E
0	0.3	0.1	0.4	0.5	0.1	0.00	0.00	0.00	0.00	0.00
2	0.3	0.2	0.3	0.1	0.2	3.80	4.30	4.20	4.00	4.00
4	0.4	0.1	0.0	0.4	0.0	9.50	6.10	5.90	5.70	8.20
6	0.2	0.0	0.0	0.3	0.0	9.90	6.70	6.10	6.00	9.10
8	0.1	0.0	0.0	0.1	0.1	10.20	8.10	7.10	6.50	10.30
10	0.1	0.0	0.0	0.1	0.1	18.40	16.90	15.80	19.40	21.30

A : The control sample.

B : Mixture containing 70 % minced camel meat and 30 % soy curd.

C : Mixture containing 70 % minced camel meat, 25 % soy curd, 3 % potato flour, and 2 % soy protein isolate.

D : Mixture containing 70 % minced camel meat, 20 % soy curd, 6 % potato flour, and 4 % soy protein isolate.

E : Mixture containg 70 % minced camel meat, 15 % soy curd, 9 % potato flour, and 6 % soy protein isolate.

* : Soy curd, potato flour, and soy protein isolate.

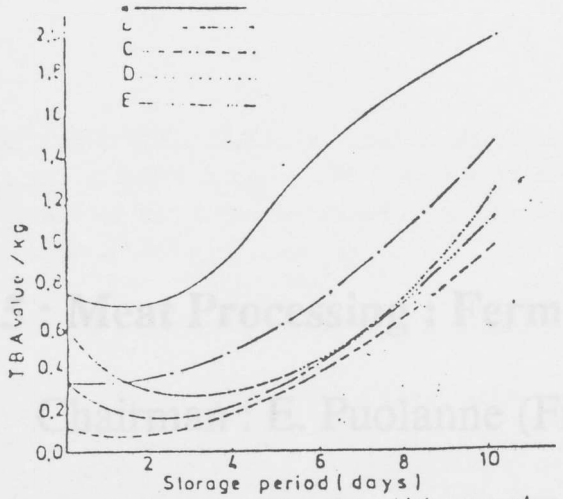

Fig.1 Changes in TBA value which occured during storage of mixtures of minced camel meat and meat substitutes at 5°c.

A: The control sample.
B: Mixture containing 70% minced camel meat and 30% soy curd.
C: Mixture containing 70% minced camel meat, 25% soy curd, 3% potato flour and 2% soy protein isolate.
D: Mixture containing 70% minced camel meat, 25% soy curd, 6% potato flour, and 4% soy protein isolate.
E: Mixture containing 70% minced camel meat, 15% soy curd, 9% potato flour and 6% soy protein isolate.

* Soy curd, potato flour, soy protein isolate.

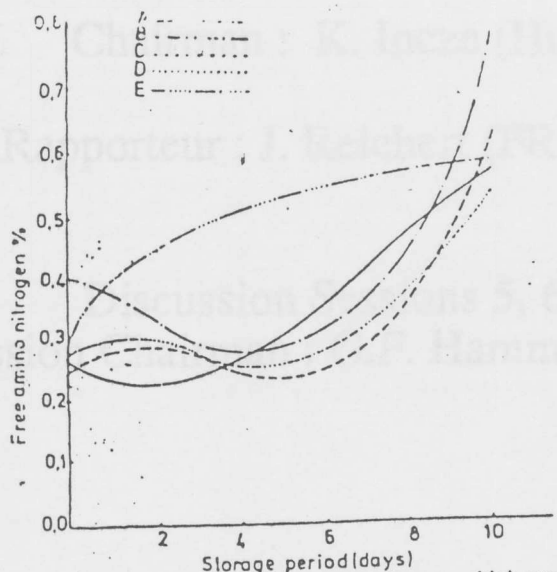

Fig.2: Changes in free amino nitrogen which occured during storage of mixtures of minced camel meat and meat substitutes at 5°c.