RESULTS AND DISCUSSION

Part I

4.1. Luncheon:

4.1.1- Chemical composition:

Data in **Table** (1) show the proximate chemical composition of the different samples of luncheon obtained from Cairo, Benha and Zagazig.

The moisture content of luncheon ranged from 44.71% (sample 2) to 61.65% (sample 3) for local luncheon and ranged from 54.14% (sample 6) to 58.43% (sample 8) for imported canned luncheon as given in **Table** (1). It did not exceed the limit specified by the E.S.S. (1991) which stated that the moisture content of luncheon should not to exceed 55%, Except for samples 3 and 8. Samples No. 1, 2, 4 and 5 were the lowest being significantly ($P<0.05$) different in moisture content when compared with that of other samples, while samples No. 3 and 8 were the highest significantly ($P<0.05$) in moisture content than that of the E.S.S. (1991). These results are in the range of moisture content found by Hemeida *et al.* (1986), Abu Salem *et al.* (1987), Abd El-Salam *et al.* (1987) and Shalaby (1992) for luncheon.

It is clear from data in **Table** (1) that protein content of luncheon ranged from 9.68% (sample 3) to 15.03% (sample 5 and 7). The protein content of samples No. 1, 2, 3 and 4 was lower than that specified by E.S.S. (1991) which stated that the protein content must be not less than 15%. The protein content in samples 5, 6, 7 and 8 was higher significantly ($P<0.05$) than that of the other samples, while the

protein content of samples 5 and 7 was within the limit set up by the E.S.S. (1991). Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 5, 6, 7 and 8 for protein content.

Data in **Table** (1) indicate that the fat content of luncheon ranged from 18.16% (sample 3) to 28.60% (sample 4) of locally manufactured luncheon and ranged from 16.03% (sample 8) to 20.84% (sample 6) for the imported canned luncheon. The fat content of samples 3 and 8 was within the limits set up by the E.S.S. (1991), which reported that the fat content of luncheon should not exceed 20%, while the fat content of samples 1, 6 and 7 was higher. The fat content of samples 2 and 4 was higher significantly ($P<0.05$) than those of the other samples. The above results indicated that the fat content of all samples was higher than that of protein. The presence of high proportion of fat lowers the quality of the finished product. These results agree with the findings reported by Hemeida *et al.* (1986), Abu Salem *et al.* (1987), Abd El-Salam *et al.* (1987) and Shalaby (1992).

Ash content of luncheon ranged from 3.95% (sample 2) to 6.15% (sample 4) for locally luncheon and ranged from 3.43% (sample 6) to 3.48% (sample 7) in imported canned luncheon. Statistical analysis did not indicate any significant differences ($P>0.05$) between all imported canned luncheon samples. Sodium chloride content varied between samples, (as salt was added), which ranged from 2.03% (sample 1) to 3.84% (sample 3) of locally produced luncheon and ranged from 2.33% (sample 6) to 2.56% (sample8) for imported canned luncheon. Sodium chloride of samples No. 1, 2, 6, 7 and 8 was within the limit, while samples 3, 4 and 5 were higher in sodium chloride than that specified by E.S.S. (1991) which specified that

sodium chloride must not exceed 3% in the final product. These results are in a good agreement with those reported by Awaad and Youssef (1972), Hemeida *et al.* (1986) and Shalaby (1992).

Carbohydrate content in luncheon ranged from 4.24% (sample 4) to 14.23% (sample 2) of locally manufactured luncheon and ranged from 6.00% (sample 7) to 7.27% (sample 8) of imported canned luncheon. Carbohydrate content of sample 4 was within the limit set by the E.S.S. (1991) which stated that carbohydrates must not exceed 5% in the final product. Samples 1, 2, 5, 6 and 8 were higher significantly ($P<0.05$) in carbohydrate content. These results are in good agreement with the findings reported by Shalaby (1992).

Energy values of luncheon ranged from 225.4 calories /100g (sample 3) to 341.6 calories/100 (sample 2) of local luncheon and ranged from 232.6 calories/100g (sample 8) to 285.8 calories/100g for imported canned luncheon . Certain samples had the highest energy values as in samples 2 and 4, while samples 3 and 8 show lower values in energy, this may be due to the high moisture content and low fat content when compared to the other samples. On the other hand samples 1, 5, 6 and 7 had intermediate energy value.

From data presented in **Table** (1) a big variation in sodium nitrite could be noticed between different samples of luncheon collected from different sources (locally manufactured) and imported canned luncheon. The residual nitrite of local luncheon samples ranged from 271 ppm (sample 5) to 464 ppm (sample 2) and ranged from 156 ppm (sample 6) to 225 ppm (sample 7) for imported canned luncheon. The results in **Table** (1) indicate that the amount of nitrite present in locally luncheon samples greatly exceeded the amount

Table (1): Proximate chemical composition of locally manufactured and imported canned luncheon obtained from different locations of Egyptian markets (on wet weight basis).

Component	Locally manufactured samples					Imported samples			L.S.D. at 0.05	E.S.S.**
	1	2	3	4	5	6	7	8		
Moisture%	50.20^{e}	44.71^{g}	61.65^{a}	47.29^{f}	51.75^{d}	54.14^{c}	55.3^{c}	58.43^{b}	1.34	55.00 Max.
Protein%	13.13^{c}	9.85^{d}	9.68^{d}	13.72^{b}	15.03^{a}	14.65^{a}	15.03^{a}	14.85^{a}	0.57	15.00 Min.
Fat%	21.02^{cd}	27.26^{b}	18.16^{e}	28.60^{a}	21.38^{c}	20.84^{cd}	20.19^{d}	16.03^{f}	1.11	20.00 Max.
Ash%	4.14^{c}	3.95^{c}	4.71^{b}	6.15^{a}	4.69^{b}	3.43^{d}	3.48^{d}	3.45^{d}	0.47	
NaCl%	2.03^{b}	2.17^{b}	3.84^{a}	3.61^{a}	3.38^{a}	2.33^{b}	2.38^{b}	2.56^{b}	0.56	3.00 Max.
Carbohydrate*%	11.51^{b}	14.23^{a}	5.80^{e}	4.24^{f}	7.14^{cd}	6.94^{cde}	6.00^{de}	7.24^{c}	1.15	5.00 Max.
Energy Calories	287.7^{c}	341.6^{a}	225.4^{f}	329.3^{b}	281.1^{cd}	273.9^{de}	285.8^{e}	232.6^{f}	9.75	
$NaNO_2$ ppm	339.0^{c}	464.0^{a}	307.0^{d}	387.0^{b}	271.0^{e}	156.0^{g}	225.0^{f}	174.7^{g}	26.18	125.00 Max.

a-g There is no significant differences between any two means have the same letter within certain components..

* Calculated by difference.

** E.S.S. = Egyptian Standard Specification

imported canned luncheon samples than that of locally manufactured products.

The high NH_3 values may be a reasonable index for breakdown of the protein by proteolysis. Statistical analysis did not indicate any significant differences ($P>0.05$) between all samples of imported canned luncheon and between samples 4 and 5 from local luncheon for ammonia content.

TMA ranged from 0.54 mg/100g (sample 1) to 2.33 mg/100g (sample 5) in local luncheon and ranged from 1.05 mg/100g (sample 6) to 1.35 mg/100g (sample 8) for imported canned luncheon. Some of local luncheon samples (4 and 5) were higher significantly ($P<0.05$) in TMA than that of others samples.

From **Table** (2) it could be noticed that the TBA values ranged from 0.38 mg malonaldehyde/kg (sample 3) to 1.72 mg malonaldehyde/kg (sample 5) in local luncheon and ranged from 0.23 mg malonaldehyde/kg (sample 7) to 0.36 malonaldehyde/kg (sample 6) for imported canned luncheon . These TBA values indicated that there were no significant differences ($P>0.05$) among all samples, except sample (5) which was higher significantly ($P<0.05$) in TBA. On the other hand it is difficult to suggest a critical acceptability limit of TBA in luncheon (Pearson, 1968). Statistical analysis did not indicate any significant differences ($P>0.05$) between all samples of imported canned luncheon and between all local luncheon samples except sample 5 for TBA values.

The pH value of meat products varied according to the state and type of the food included.

Table (2): Chemical tests of freshness of locally manufactured and imported canned luncheon obtained from different locations of Egypt. (on wet weight basis).

Components	Locally manufactured samples					Imported samples			L.S.D.	E.S.S
	1	2	3	4	5	6	7	8		
T.V.N. mg/100g	6.53^{d}	4.90^{d}	9.33^{d}	20.77^{bc}	16.33^{c}	29.17^{a}	29.07^{a}	27.53ab	6.78	16.5*
Ammonia mg/100g	1.75^{cd}	1.40^{d}	2.45^{c}	3.97^{b}	3.73^{b}	8.39^{a}	9.10^{a}	8.52^{a}	0.90	--
T.M.A. mg/100g	0.54^{c}	0.70^{c}	0.65^{c}	2.10^{ab}	2.33^{a}	1.05c	1.21b^{c}	1.3b5^{c}	0.89	--
T.B.A. mg /kg	0.86^{b}	0.84^{b}	0.38^{b}	0.61^{b}	1.72^{a}	0.36^{b}	0.23^{b}	0.26^{b}	0.69	--
pH value	5.95^{a}	5.82^{e}	6.09^{a}	6.22^{b}	6.33^{a}	6.44^{a}	6.48^{cd}	6.51^{a}	0.09	--

a-d There is no significant differences between any two means have the same letter within certain components.

E.S. S. Egyptian Standard Specification (1991).

T.V.N. Total volatile nitrogen.

T.M.A. Trimethylamine.

T.B.A. Thiobarbituric acid (as malonaldehyde).

* Pearson (1962)

The pH values of luncheon samples ranged from 5.82 (sample 2) to 6.33 (sample 5) in local luncheon and ranged from 6.44 (sample 6) to 6.51 (sample 8) for imported canned luncheon. These data indicate that the pH values of imported luncheon samples were higher significantly ($P<0.05$) than that of locally luncheon samples. This increase of pH values could be largely attributed to the liberation of ammonia (Van Buren *et al.*, 1972 and Agosin *et al.*, 1989).

These results of chemical freshness tests parameters are in agreement with the findings of Abu Salem *et al.* (1987) ;Abu Salem and Khalaf (1988) and Shalaby (1992).

4.1.3. Minerals content composition:

In fact the aim of this part of study is to carry out a nutritional evaluation of locally manufactured and imported luncheon samples to serve as potential source for human food. The present study comprised the analysis of nine essential mineral elements, five macroelements: sodium (Na), potassium (K), phosphorus (P), magnesium (Mg) and calcium (Ca) and four microelements: iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn), present in luncheon.

Luncheon samples varied greatly from the point of mineral availability and the order of gradual distribution pattern.

Each sample was characterized by having higher concentration of one or more mineral element than the other samples. For example sample 2 was characterized by having higher concentration of Cu;

sample 4 was characterized by having higher concentration of P; sample 5 was characterized by having higher concentration of K and sample 6 was characterized by having higher concentration of Na, Fe, Zn and Mn; sample 7 was characterized by having higher concentration of Ca and sample 8 was characterized by having higher concentration of Mg than other samples tested.

From the point of availability of mineral elements in different luncheon samples, minerals were ranked in a decreasing order of abundance, as P, Na, K, Ca, Mg, Fe, Zn, Cu and Mn in samples 3, 4, 5 and 7; in samples 1, 2 and 8 were P, Na, K, Mg, Ca, Fe, Zn, Cu and Mn; while in sample 6 were K, Na, P, Mg, Ca, Fe, Zn, Cu and Mn, respectively.

It is clear that all different luncheon samples contained appreciable amounts of Ca, P, Fe, Cu, Mn and Zn compared to many other food sources. Local and imported luncheon samples could be considered as a rich source of Ca that their calcium average content is 457.5 and 369.3 mg/100g, respectively which is higher than cow's milk Ca content which was reported to be 72mg/100g (Pellet and Shadarevian, 1970). The present data in **Table** (3) indicated that Ca content ranged from 133.93 mg/100 (sample 1) to 281.69 mg/100 (sample 5) of locally luncheon and ranged from 212.77 mg/100g (sample 8) to 317.46 mg/100g (sample 7) of imported canned luncheon.

Average concentration of Mg in local and imported luncheon samples (384.8 and 407.9 mg/100g, respectively) is quite higher than those found in human milk or cow's milk, 4 and 12 mg/100g, respectively (NAS, 1974). The present data indicated that Mg content

ranged from 55.3 mg/100g (sample 4) to 214.29 mg/100 (sample 1) in local luncheon and ranged from 63.49 mg/100g (sample 7) to 229.78 mg/100g (sample 8) for imported canned luncheon.

The present data indicated that P content ranged from 166.35 mg/100g (sample 2) to 193.13 mg/100 g (sample 4) of locally luncheon and ranged from 176.23 mg/100g (sample 8) to191.01 mg/100g (sample 6) for imported canned luncheon.

Iron has an important physiological function in the structure of hemoglobin, myoglobin and cytochrome enzyme systems and iron salt are often added to baby foods as an essential trace element (Sherman, 1958). The present data indicated that iron content ranged from 3.33 mg/100g (sample 2) to 6.32 mg/100g (sample 4) of locally luncheon and ranged from 5.77 mg/100g (sample 7) to 8.42 mg/100g (sample 6) in the imported canned luncheon.

The present elementary analysis (**Table** 3) showed that zinc level ranged from between 1.7 mg/100g (sample 1) to 2.31 mg/100g (sample 2), all tested samples were within the limits (50 mg/kg) given by Harold *et al.* (1981). Harold *et al.* (1981) mentioned that the permitted copper content in food is 20 mg/kg. This amount of permitted metal is very high compared to copper content found in different samples of luncheon under study, which contained Cu content ranged from 0.12 mg/100g (sample 5) to 0.18 mg/100g (sample 2) of local luncheon and ranged from 0.11 mg/100g (sample 7) to 0.17 mg/100g (sample 8) in the imported canned luncheon.

Manganese is an essential nutritive trace element. Daily requirements from this element could be covered from usual normal diet. The different luncheon samples varied in its content of

Table (3): Minerals content of locally manufactured and imported luncheon obtained from different locations of Egypt (mg/100g on wet weight basis).

Elements	Locally samples					Imported samples		
	1	2	3	4	5	6	7	8
Macroelements:								
Na	562.5	535.7	645.8	798.4	591.5	1081.9	476.2	702.1
K	281.12	117.43	291.67	290.32	295.77	104.05	33.33	35.74
P	192.25	166.35	166.96	193.13	181.27	191.01	177.75	176.23
Mg	214.29	171.43	71.34	55.30	112.68	216.22	63.49	229.78
Ca	133.93	163.27	277.78	230.41	281.69	225.22	317.46	212.77
Microelements								
Fe	3.95	3.33	3.73	6.32	4.86	8.42	5.77	7.7
Zn	1.7	2.31	1.87	1.87	1.86	2.95	2.15	2.32
Cu	0.13	0.18	0.16	0.15	0.12	0.15	0.11	0.17
Mn	0.45	0.24	0.4	0.32	0.19	1.26	0.53	0.72
Ash content%	4.14	3.95	4.71	6.15	4.69	3.43	3.48	3.45

manganese which ranged from 0.19 mg/100g (sample 5) to 0.45 mg/100g (sample 1) in local luncheon and ranged from 0.53 mg/100g (sample 7) to 1.26 mg/100g (sample 6) for imported canned luncheon..

The results obtained from minerals composition of different luncheon samples are in agreement with those reported by Greenfield *et al.* (1985).

4.1.4.Microbiological examination:

Data presented in **Table** (4) show total bacterial count (TBC) (cfu/g), coliform bacteria group counts (colonies/g) and mould and yeast counts (colonies/g) of different luncheon samples.

It could be noticed that big variations in total bacterial count between different samples of luncheon collected from different sources which reflect different degrees of contamination. Total bacterial count ranged from $1.7x10^5$ (sample 2) to 3.9×10^6 colonies/g (sample 5) of locally luncheon and ranged from3.8×10^3 colonies/g (sample 7) to $1.6x10^4$ (sample 6) of imported canned luncheon. Such a big variation in microbial contamination between samples may be attributed to raw materials, namely meat and other ingredients, hygienic conditions during processing and storage conditions as well as the level of nitrite and nitrate which may be incorporated in each sample. Samples 6, 7 and 8 showed the least degree of contamination (1.6×10^4, 3.8×10^3 and 5.0×10^3 colonies/g, respectively) which could be attributed to the high nitrite content and low pH values as a bacteriostatic agent. On the other hand, samples 1, 2, 3, 4 and 5 showed the highest microbial contamination (1.9×10^6, 1.7×10^5, 2.9×10^6, 2.5×10^5 and 3.9×10^6

colonies/g, respectively) which may be also due to the low nitrite content and high pH values.

The results obtained indicate that the total bacterial count present in all samples of locally luncheon greatly exceeded the total bacterial count specified by the E.S.S. (1991) which stated that the total bacterial count of luncheon must not exceed 10^4 colonies/g.

The results obtained of total bacterial count of the different luncheon samples are in agreement with those reported by Duitschaever, (1977), Abd El-Rahman *et al.* (1984), Hemeida *et al.* (1986), Fathi *et al.* (1992) and Shalaby (1992).

As the presence of coliform bacteria and the detection of high counts of microorganisms in locally produced luncheon (ready to eat product) as indications of the unsanitary conditions practiced during the preparation, the storage and the marketing of such product.

Data presented in **Table** (4) indicate that the count of coliform bacteria of different luncheon samples ranged from 0.9×10^2 colonies/g (sample 2) to 1.1×10^4 colonies/g (sample 5) of locally luncheon. Coliform bacteria in sample 2 was within the limits specified by the E.S.S. (1991) which stated that the coliform bacteria of luncheon should not to exceed 10^2 colonies/g in the final product, which could be attributed to the high nitrite content. The coliform bacteria in samples 1, 3, 4 and 5 greatly exceeded the coliform bacteria specified by the E.S.S. (1991). In addition, the samples 6, 7 and 8 were free from coliform bacteria.

Mould and yeast counts of luncheon ranged from 2.5x103 colonies/g (sample 2) to $8.7x10^4$ colonies/g (sample 5) of locally luncheon. Sample 6 from imported canned luncheon contained $1x10^2$

Table (4): Microbiological examination (total bacterial count, colifrom bacteria group and mould and yeast counts) of locally manufactured and imported canned luncheon obtained from different locations of Egypt.

Microbiological tests	Locally samples					Imported samples			E.S.S.
	1	2	3	4	5	6	7	8	
Aerobic plate count cfu/g	$1.9x10^6$	$1.7x10^5$	$2.9x10^6$	$2.5x10^5$	$3.9x10^6$	$1.6x10^4$	$3.8x10^3$	$5.0x10^3$	10^4
Log of survivors	6.28	5.23	6.46	5.40	6.28	4.20	3.58	3.7	4.0
Coliform group cfu/g	$1.9x10^3$	$0.9x10^2$	$2.8x10^3$	$2.5x10^2$	$1.1x10^4$	Nil	Nil	Nil	10^2
Log of survivors	3.28	1.95	3.45	2.4	4.01				
Mould & yeast cfu/g	$6.9x10^4$	$2.5x10^3$	$9.8x10^4$	$4.5x10^3$	$8.7x10^4$	$1x10^2$	Nil	Nil	
Log of survivors	4.84	4.4	4.99	3.65	4.94	2			

E. S. S. Egyptian Standard Specification, (1991).

colonies/g. Samples 2, 4 and 6 showed the least degree of contamination by the mould and yeast ($2.5x10^3$, $4.5x10^3$ and $1x10^2$ colonies/g, respectively) which could attributed to the high nitrite content. On the other hand, samples 1, 3 and 5 showed the highest contamination by the mould and yeast ($6.9x10^4$, $9.8x10^4$ and $8.7x10^4$ colonies/g, respectively). In addition, the samples 7 and 8 were free from mould and yeast.

These results emphasize the value of sanitation during the preparation and storage on the quality of the product. Selecting raw materials with low microbial load for manufacturing, adding suitable concentration of nitrite and nitrate, proper thermal processing and suitable conditions for storage and marketing, favor to have products of accepted high qualities. These results obtained are in agreement with those reported by Abd El-Rahman *et al.* (1984); Hemeida *et al.* (1986), Fathi *et al.* (1992) and Mousa *et al.* (1993).

4.1.5. Fatty acids composition:

Data presented in **Table** (5) show the fatty acids composition in the different samples of luncheon (from 1 to 5 locally samples and from 6 to 8 imported canned samples), while evaluation of the fatty acids composition is shown in **Table** (6).

It could be noticed that the major fatty acids for samples 1, 3, 5, 7 and 8 were $C_{18:1}$, $C_{16:0}$ and $C_{18:0}$, while the major fatty acids of samples 2, 4 and 6 were $C_{18:1}$, $C_{18:0}$ and $C_{16:0}$. Therefore the dominant fatty acid for all samples was the $C_{18:1}$ showing higher level for samples 1, 2 and 8 followed by 3, 4, 5, 6, and 7. Nevertheless, all

samples were higher in total saturated fatty acids except for sample 6 which was higher in total unsaturated fatty acids.

Palmitic acid ($C_{16:0}$) constituted the major saturated fatty acid of samples 1, 3, 5, 7 and 8 which contained 25.26, 18.31, 21.73, 16.89 and 21.62%, respectively, while it constituted the second major saturated fatty acid of samples 2, 4 and 6 which contained 16.82, 20.99 and 17.68%, respectively. In contrast stearic acid ($C_{18:0}$) constituted the major saturated fatty acid of samples 2, 4 and 6, which contained 20.69, 21.76 and 19.94%, respectively, while it constituted the second major saturated fatty acid, which contained 14.97, 17.19 and 14.13%, 15.64 and 17.88% for samples 1, 3, 5, 7 and 8, respectively.

Oleic acid ($C_{18:1}$) costituted the major unsaturated fatty acid of all luncheon samples which had 33.57, 30.54, 27.60, 27.36, 25.97, 25.84, 19.97 and 30.02% for samples 1, 2, 3, 4, 5, 6, 7 and 8, respectively. Palmitoleic acid ($C_{16:1}$) constituted the second major unsaturated fatty acid in most samples which contained 5.61, 12.38, 8.41, 11.14, 10.07 and 8.79% for samples 1, 2, 3, 4, 5, and 7, respectively. While it constituted the third major unsaturated fatty acid, which had 11.22 and 9.85% for samples 6 and 8, respectively. Lenoleic acid ($C_{18:2}$) constituted the second major unsaturated fatty acid of samples 6 and 8 which contained 13.38 and 10.57%, respectively, while it constituted the third major unsaturated fatty acid of most luncheon samples which contained 3.74, 3.07, 2.32, 6.01, 8.25 and 5.73% for samples 1, 2, 3, 4, 5 and 7., respectively.

From reults in **Table** (6) more than 52% of the total lipids of luncheon samples 1, 2, 3, 4, 5 and 7 were saturated which contained

Table (5): Fatty acids composition of locally manufactured and imported canned luncheon obtained from different locations of Egypt.

Fatty acids	Locally samples					Imported samples		
	1	2	3	4	5	6	7	8
C8:0	-	0.97	0.62	-	-	-	2.66	-
C10:0	-	-	-	-	-	-	2.78	-
C12:0	-	0.24	0.12	0.21	0.44	0.95	9.16	0.48
C14:0	2.81	5.93	15.61	3.94	3.30	4.43	9.50	3.31
C15:0	0.94	2.76	1.66	1.68	1.47	1.06	1.55	1.33
C16:0	25.26	16.82	18.31	20.99	21.73	17.68	16.89	21.62
C16:1	5.61	12.83	8.41	11.14	10.07	11.22	8.79	9.85
C17:0	-	1.95	0.93	1.63	1.44	0.52	0.54	1.28
C18:0	14.97	20.69	17.19	21.76	14.13	19.94	15.64	17.88
C18:1	33.57	30.54	27.60	27.36	25.97	25.84	19.97	30.02
C18:2	3.74	3.07	2.32	6.01	8.25	13.38	5.73	10.57
C18:3	-	-	0.62	-	0.35	1.55	0.58	0.40
C20:0	-	0.57	1.00	0.73	2.65	0.86	-	-
C20:1	-	0.91	-	0.83	3.30	-	0.86	0.48
C22:0	13.1	2.73	5.60	3.73	6.89	2.57	5.32	2.78

Table (6): Evaluation of Fatty acids composition of locally manufactured and imported canned luncheon obtained from different locations of Egypt.

	Locally samples					Imported samples		
	1	2	3	4	5	6	7	8
Total monoenoic FA %	39.18	44.28	36.01	39.33	39.34	37.06	29.62	40.35
Total dienoic FA %	3.74	3.07	2.32	6.01	8.25	13.38	5.73	10.57
Total trienoic FA %	-	-	0.62	-	0.35	1.55	0.58	0.40
Total essential FA %	3.74	3.07	2.94	6.01	8.60	14.93	6.31	10.97
Total unsaturated FA %	42.92	47.35	38.95	45.34	47.94	51.99	35.93	51.32
Total saturated FA %	57.08	52.66	61.04	54.67	52.05	48.01	64.04	48.68
Ks	0.75	0.90	0.64	0.83	0.92	1.08	0.56	1.05
Du	0.47	0.50	0.43	0.51	0.57	0.68	0.43	0.63

The degree of total lipids unsaturation was evaluated by calculation of Ks and Du values as follows:

Ks = Total unsaturated fatty acids/Total saturated fatty acids.

Du = 1(monounsaturated FA/100) +2 (diunsaturated FA/100) + 3(triunsaturated FA/100).

57.08, 52.66, 61.04, 54.67, 52.05 and 64.04% total saturated fatty acids, respectively, while samples 6 and 8 contained 51.99 and 51.32% total unsaturated fatty acids, respectively.

Total monoenoic fatty acids were higher in samples 2 and 8 which contained 44.28 and 40.35%, lower in samples 1, 3, 4, 5 and 6 which contained 39.18, 36.01, 39.33, 39.34 and 37.06%, respectively and the lowest in sample 7 which contained 29.62%. On the other hand, total dienoic fatty acids and total essential fatty acids were higher in samples 6 and 8 which contained 13.38 and 10.57% and 14.93 and 10.97% followed by sample 5 (8.25 and 8.60%), 7 (5.73 and 6.31%) and 4 (6.01 and 6.01%), respectively. While total essential fatty acids were lowest in samples 1, 2 and 3 which contained 3.74, 3.07 and 2.94%, respectively.

4.1.6. Organoleptic evaluation:

Sensory evaluation was used to test the consumer preference in respect to the effect of processing techniques of different factories on quality attributes of all luncheon products.

The sensory properties of the products were evaluated in terms of flavor (35 degrees), texture (30 degrees), color (20 degrees) and appearance (15 degrees), according to El-Shazely, (1976).

The average of the obtained scores for ten panelists were presented in **Table** (7). Analysis of variance was carried out that data were treated as complete randomization design. Least significant differences (L.S.D.) were calculated and tabulated in the same **Table**. Least significant difference test indicated that there is no significant difference ($P>0.05$) between samples 3 (locally luncheon), 6, 7 and 8

(imported luncheon) from the stand point view of flavor and texture. There average scores were 28.99 and 25.85; 31.10 and 26.40; 30.15 and 26.00 and 30.65 and 26.30 for samples 3, 6, 7 and 8, respectively. Statistical analysis did not indicate any significant differences ($P > 0.05$) between samples 3, 7 and 8 for color and between samples 3, 5 and 7 for appearance. Average scores of flavor and texture of imported luncheon samples (6, 7 and 8) were significant higher ($P < 0.05$) than those for some locally luncheon samples 1, 2, 4 and 5. Statistical analysis indicated that sample 3 from locally luncheon samples obtained the higher scores ($P<0.05$) 28.99, 25.85, 17.80 and 13.40 for flavor, texture, color and appearance, respectively than those of other locally luncheon samples.

Statistical analysis indicated also that the average scores in appearance of samples 3 and 5 from locally luncheon samples were significant higher ($P<0.05$) (13.40 and 13.00) than those of samples 6 and 7 (imported luncheon) and the other locally luncheon samples.

With respect to overall acceptability, there was no significant differences ($P>0.05$) between samples 3, 5 (locally luncheon), 6, 7 and 8 (imported luncheon) which obtained the higher scores 86.04, 85.14, 87.55, 87.30 and 87.25, respectively.

From these results it can be concluded that samples 3 and 5 from locally luncheon and 6, 7 and 8 from imported canned luncheon were the best products in the sensory evaluation by all panelists.

Table (7): Organoleptic evaluation * of locally manufactured and imported canned luncheon obtained from different locations of Egypt.

Characteristics	Locally samples					Imported samples			L.S.D.
Scores	1	2	3	4	5	6	7	8	
Flavor /35	27.30^{b}	21.10^{d}	28.99^{a}	25.85^{d}	28.45^{ab}	31.10^{a}	30.15^{a}	30.65^{a}	1.21
Texture /30	24.55^{b}	21.25^{c}	25.85^{a}	23.50^{b}	24.45^{b}	26.40^{a}	26.00^{a}	26.30^{a}	1.08
Color /20	15.70^{d}	13.00^{f}	17.80^{ab}	14.40^{e}	17.00^{c}	17.70^{bc}	18.50^{a}	18.10^{ab}	0.74
Appearance /15	11.75^{c}	10.70^{d}	13.40^{a}	11.95^{c}	13.00^{ab}	12.35^{bc}	12.90^{cb}	12.15^{bc}	0.87
Acceptability /100	79.30^{b}	69.10^{d}	86.04^{a}	75.70^{c}	85.14^{a}	87.55^{a}	87.30^{a}	87.25^{a}	2.41

* Average of 10 panelists.

a-f There is no significant differences between any two means have the same letter within certain components.

Part II

4.2. Beefburger:

4.2.1. Chemical composition:

Data in **Table** (8) show the proximate chemical composition of the different hamburger samples obtained from Cairo, Benha and Zagazig.

The moisture content ranged from 51.02% (sample 1) to 58.14% (sample 4) which did not exceed the limit specified by the E.S.S. (1991) which stated that the moisture content of beefburger must not exceed 60%. Moisture content was higher significantly ($P<0.05$) in samples 2, 3 and 4 (56.66, 57.11 and 58.14 %, respectively) than those of samples 5 (55.16%). While sample 1 contained lower significantly ($P<0.05$) moisture content. Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 2, 3 and 4 for moisture content. These results are in agreement with those reported by Greenfield *et al.* (1981), Wills and Greenfield (1981) and Miles *et al.* (1984).

Data in **Table** (8) indicate that the protein content ranged from 12.98% (sample 1) to 15.55% (sample 4). Protein content in samples 4 and 5 was within the limits set up by the E.S.S. (1991) which reported that the protein content of beefburger must be not less than 15% in the final product. Samples 1, 2 and 3 were lower significantly ($P<0.05$) in protein content (12.98, 13.34 and 13.48%, respectively) than those of samples 4 and 5. Statistical analysis did not indicate any significant differences ($P>0.5$) between 1, 2 and 3 and between samples 4 and 5 for protein content. These results are in agreement with those reported

by Price and Schweigert (1970), Greenfield *et al.* (1981), Wills and Greenfield (1981) and Beilken *et al.* (1990).

The fat content of beefburger ranged from 19.02% (sample 4) to 25.00% (sample 1). Fat content of sample 4 was within the limit set up by the E.S.S. (1991), which mentioned that the fat content of beefburger should not exceed 20% in the final product. Fat content of samples 1, 2 and 3 was higher significantly (P>0.5) than those of sample 5. Statistical analysis did nit indicate any significant differences between samples 1 and 3 and between samples 4 and 5. These results agree with the finding reported by Price and Schweigert (1970), Kadic and Uncanin (1982), Miles *et al.* (1984) and Beilken *et al.* (1990).

Ash content of beefburger ranged from 2.63% (sample 5) to 3.64% (sample 1). Statistical analysis did not indicate any significant differences (P>0.5) between samples 1, 2 and 3. Sodium chloride content varied between the samples and ranged from 1.74% (sample 5) to 2.87% (sample 1). Sodium chloride of sample 5 was within the limit set up by the E.S.S. (1991) which stated that sodium chloride must not exceed 2% in the final product. Sodium chloride of samples 1, 2, 3 and 4 was higher insignificantly (P>0.05) (2.87, 2.40, 2.48 and 2.40%, respectively) than those of sample 5. This increase of ash and sodium chloride contents could be attributed to the addition of the salt. These results obtained are in agreement with that mentioned by Greenfield *et al.* (1981) and Wills and Greenfield (1981).

Carbohydrate content in beefburger ranged from 2.06% (sample 3) to 7.36% (sample 1). Carbohydrate content of samples 2, 3 and 4 (4.38, 2.06 and 4.39%, respectively) was within the limit set up by the

Table (8): Proximate chemical composition of locally manufactured beefburger obtained from different locations of Egypt (on wet weight basis).

Components	Samples					L.S.D.	E.S.S.
	1	2	3	4	5		
Moisture %	51.02^{c}	56.66^{a}	57.11^{a}	58.14^{a}	55.16^{b}	1.53	60.0
Protein %	12.98^{b}	13.34^{b}	13.48^{b}	15.55^{a}	15.47^{a}	0.71	15.0
Fat %	25.00^{a}	22.02^{b}	24.14^{a}	19.02^{c}	20.38^{c}	1.61	20.0
Ash %	3.64^{b}	3.60^{b}	3.20^{c}	2.90^{a}	2.63^{b}	0.13	-
NaCl %	2.87^{a}	2.40^{b}	2.48^{b}	2.40^{b}	1.74^{c}	0.31	2.0
Carbohydrate %*	7.36^{a}	4.38^{bc}	2.06^{d}	4.39^{c}	6.36^{b}	1.13	5.0
Energy K calories	306.40^{a}	269.10^{b}	279.40^{b}	265.00^{b}	270.80^{b}	24.41	
$NaNO_2$ ppm	114.30^{c}	155.70^{a}	71.30^{e}	129.70^{b}	87.70^{d}	12.60	

a-f There is no significant differences between any two means have the same letter within certain components.

E. S. S. Egyptian Standard Specification, (1991).

* Calculated by difference.

E.S.S. (1991) which noting that the carbohydrate content must be not exceed 5% in the final product. Samples 1 and 5 contained higher significantly ($P<0.05$) in carbohydrate content than those of the other samples. Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 2 and 4.

Energy values of beefburger ranged from 265.0 calories (sample 4) to 306.4 calories (sample 1). These results indicated that sample 1 had the highest significantly ($P<0.05$) energy value which was mainly due to its high fat and carbohydrate contents and lower moisture content. Statistical analysis did not indicate any significant differences ($P>0.05$)between all samples except sample 1 for energy value.

From data presented in **Table** (8) it could be noticed that a wide variation in sodium nitrite between different samples of locally produced beefburger collected from different sources. The residual nitrite ranged from 71.3 ppm (sample 3) to 155.7 ppm (sample 2).

Statistical analysis indicated that sample 2 contained higher significantly ($P<0.05$) of sodium nitrite (155.7 ppm) than those of the other samples, while sample 3 contained lowest significantly ($P<0.5$) amount (71.3 ppm) of sodium nitrite.

4.2.2. Freshness test parameters:

Data presented in **Table** (9) show the values recorded for freshness tests parameters, namely total volatile nitrogen (TVN), ammonia (NH_3), trimethylamine (TMA), thiobarbituric acid (TBA) and pH value of different beefburger samples.

TVN of beefburger ranged from 10.97% mg/100g (sample 2) to 16.8 mg/100g (sample 5). TVN of samples 1, 2, 3 and 4 which

contained 11.20, 10.97, 12.83 and 14.63 mg/100g, respectively was within the limits specified by Pearson (1976). From results obtained in **Table** (9) indicate that TVN of sample 5 was higher insignificantly ($P>0.05$) than that of other samples. Statistical analysis did not indicate any significant differences between all samples for TVN. According to Pearson (1976) and on the basis of the TVN determination, meat could be described as follows:

State of meat	mg TVN/100g meat
- Fresh	0.0 - 13.0
- Accepted	13.0 - 17.0
- Spoiled	more than17.0

From **Table** (9) it can be seen that the values of TVN of beefburger samples 1, 2 and 3 was within the range of 10.97 to 12.83 mg/100g (still fresh) and was within the range of 14.93 to 16.80 mg/100g (still accepted) of samples 4 and 5. These results are in agreement with those reported by El-Kary (1986).

Data shown in **Table** (9) indicate that the ammonia content of beefburger ranged from 3.03 mg/100g (samples 1 and 3) to 3.97 mg/100g (sample 5). Ammonia content of sample 5 was higher significantly ($P<0.05$) than those of samples 1 and 3. Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 2, 4 and 5 and between 1, 2, 3 and 4 for ammonia content.

TMA content of beefburger ranged from 1.28 mg/100g (sample 3) to 3.03 mg/100g (sample 5). Statistical analysis did not indicate any significant differences ($P>0.05$) between all samples for TMA.

Table (9): Chemical freshness tests of locally manufactured beefburger obtained from different locations of Egypt. (on wet weight basis).

Tests	Samples					L.S.D.
	1	2	3	4	5	
T.V.N.mg/100g.	11.20^{a}	10.97^{a}	12.83^{a}	14.93^{a}	16.80^{a}	7.00
Ammonia mg/100g.	3.03^{b}	3.50^{ab}	3.03^{b}	3.50^{ab}	3.97^{a}	0.81
T.M.A.mg/100g.	2.22^{a}	2.64^{a}	1.28^{a}	2.33^{a}	3.03^{a}	1.97
T.B.A.mg /kg.	0.60^{a}	0.18^{b}	0.69^{a}	0.14^{b}	0.20^{b}	0.16
pH value	6.08^{c}	5.69^{e}	6.28^{a}	6.14^{b}	5.94^{d}	0.05

a-b There is no significant differences between any two means have the same letter within certain components.

T.V.N. Total volatile nitrogen.

T.M.A. Trimethylamine.

T.B.A. Thiobarbituric acid (as malonaldhyde).

From **Table** (9) it could be noticed that the TBA value of beefburger ranged from 0.14 mg malonaldehyde/kg (sample 4) to 0.69 mg malonaldehyde/kg (sample 1). TBA of samples 1 and 3 (0.60 and 0.69) was higher significantly ($P<0.05$) than those of samples 2, 4 and 5 (0.18, 0.14 and 0.20 mg malonaldehyde/kg). Statistical analysis did not indicate any significant differences ($P>0.05$) between 1 and 3 and between samples 2, 4 and 5 for TBA value.

The pH values of beefburger ranged from 5.69 (sample 2) to 6.28 (sample 3). From data in **Table** (9) it could be noticed that the pH value was higher significantly ($P<0.05$) in sample 3 followed by samples 4 and 1 (6.14 and 6.08) and lower significantly in samples 2 and 5 (5.69 and 5.94). The high pH values could be largely attributed to the liberation of ammonia according to Van Buren *et al.* (1972) and Agosine *et al.* (1989). The results obtained of chemical freshness tests parameters of beefburger samples are in agreement with those reported by El-AKary (1986).

4.2.3. Minerals composition:

Data presented in **Table** (10) indicate that minerals content of locally manufactured beefburger samples.

In view of the fact that the aim of this part of study was nutritional evaluation of locally beefburger to serve as potential source for human food. The present study comprised the analysis of nine essential mineral elements, five macroelements: sodium (Na), potassium (K), phosphorus (P), magnesium (Mg) and calcium (Ca) and four microelements: iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn) as present in beefburger.

Each sample was characterized by having higher concentration of one or more mineral element than the other samples. For example sample 1 was characterized by having higher concentration of Na, P and Zn; sample 2 was characterized by having higher concentration of Mg and Cu; sample 4 was characterized by having higher concentration of Ca and Fe and sample 5 was characterized by having higher concentration of K and Mn than the other tested samples.

From the point of availability of mineral elements in different beefburger samples, minerals were ranked in a decreasing order of abundance, as Na, K, Ca, P, Mg, Fe, Zn, Cu and Mn in samples 1, 3 and 4; in sample 2 were K, Na, Ca, P, Mg, Fe, Zn, Cu and Mn, while in sample 5 were K, Na, Ca, P, Mg, Fe, Zn, Cu and Mn, respectively.

It is clear that most different beefburger samples contained appreciable amounts of Mg, Ca, P, Fe, Zn and Cu compared to many other food sources. Beefburger samples could be considered as a rich source of Ca, as their calcium average content is 515 mg/100g which is higher than Cow's milk Ca content which reported to contain 72 mg/100g (Pellet and Shadarevian, 1970). The present data in **Table** (10) indicated that calcium content ranged from 118.34 mg/100g (sample 2) to 159.57 mg/100g (sample 4).

Average concentration of Mg in different beefburger samples (212.2 mg/100g) is quite higher than those found in human milk or cow's milk, 4 and 12 mg/100g, respectively (NAS, 1974). Data in **Table** (10) indicate that Mg content in beefburger samples ranged from 31.91 mg/100g (sample 4) to 113.61 mg/100g (sample 2).

Phosphorus content of different beefburger samples ranged from 89.65 mg/100g (sample 2) to 124.24 mg/100g (sample 1). Iron content

Table (10): Minerals content of locally manufactured beefburger obtained from different locations of Egypt. (mg/100g on wet weight basis).

Elements	Samples				
	1	2	3	4	5
Macroelements:					
Na	843.75	713.11	728.19	837.77	678.23
K	375.00	590.16	469.80	390.96	602.78
P	124.24	89.65	95.23	112.34	102.24
Mg	35.71	113.61	26.85	31.91	100.48
Ca	148.81	118.34	141.68	159.57	119.62
Microelements:					
Fe	2.57	1.89	1.50	3.13	1.95
Zn	3.57	3.05	1.59	2.66	1.62
Cu	0.18	0.69	0.20	0.45	0.32
Mn	0.33	0.47	0.25	0.37	0.48
Ash content%	3.64	3.60	3.20	2.90	2.63

of different beefburger samples ranged from 1.5 mg/100g (sample 3) to 3.13 mg/100g (sample 4).

The present elementary analysis (**Table** 10) showed that Zinc level ranged from 1.59 mg/100g (sample 3) to3.57 mg/100g (sample 1), all beefburger samples are within the limit set up by Harold *et al.* (1981) who mentioned that the permitted zinc in food is 50 mg/kg. Harold *et al.* (1981) mentioned that the permitted copper in food is 20 mg/kg. This amount of permitted metal is very high compared to copper content found in most samples of beefburger, which were within the limits given by Harold *et al.* (1981). Copper content of different beefburger samples ranged from 0.18 mg/100g (sample 1), to 0.69 mg/100g (sample 2).

Manganese content of different beefburger samples ranged from 0.25 mg/100g (sample 3) to 0.48 mg/100g (sample 5). This result obtained is in agreement with those reported by Greenfield *et al.*, (1981) and Miles *et al.*, (1984).

4.2.4.Microbiological examination:

Data presented in **Table** (11) show total bacterial count (TBC) cfu/g, coliform bacteria group count colonies/g and mould and yeast counts of locally manufactured beefburger obtained from different locations of Egypt.

Generally, the growth of microorganisms in beefburger depends on many factors such as moisture content, pH, nitrite, the initial load, storage temperature and time, marketing and handling conditions beside the type of microorganisms.

It could be noticed that a wide variation in total bacterial count between different samples of beefburger collected from different sources which reflect a different degrees of contamination. Total bacterial count ranged from $2.57x10^3$ cfu/g (sample 2) to $5.6x10^5$ colonies/g (sample 3). Such a big variation in microbial contamination between samples may be attributed to raw materials, hygienic condition during processing and storage condition as well as the level of nitrite and nitrate which may be incorporated in each sample. Sample 2 showed the least degree of contamination ($2.6x10^3$ colonies/g) which could be attributed to the high nitrite content and low pH value as a bacteriostatic agent. On the other hand, sample 3 showed the highest microbial load ($5.6x10^5$ colonies/g) which may be also due to the low nitrite content and high pH value.

The results obtained indicate that the bacterial count present in all locally beefburger samples (except for sample 3) was within the limits specified by the E.S.S. (1991) which reported that the total bacterial count of beefburger should not exceed 10^5 colonies/g.

Generally, and according to the recommended limit of the total bacterial count in fresh hamburger, 10^7 (Fowler *et al.* 1977) our samples considered microbiologically safe and fresh.These results obtained are in agreement with those reported by El-Ford (1936); Duitschaever *et al.* (1977); Karim (1977); El-Akary (1986); El-Shreif *et al.* (1991) Kosic *et al.* (1991) and Fathi *et al.* (1992).

Data presented in **Table** (11) indicate that the count of coliform bacteria group of locally beefburger samples obtained from different locations of Egypt ranged from $1.5x10^3$ colonies/g (sample 2) to $1.6x10^4$ colonies/g (sample 3). The results obtained indicate that the

Table (11): Microbiological examination (total bacterial, coliform group and mould and yeast counts/g) of locally manufactured beefburger obtained from different locations of Egypt.

	Samples				
	1	2	3	4	5
Aerobic plate count cfu/g	4.4×10^4	2.6×10^3	5.6×10^5	4.0×10^4	5.6×10^4
Log survivors	4.64	3.41	5.75	4.6	4.75
Coliform group cfu/g	5.5×10^3	1.5×10^3	1.6×10^4	3.1×10^3	9.2×10^3
Log survivors	3.74	3.18	4.20	3.49	3.96
Mould & yeast cfu/g	1.9×10^5	4.6×10^3	3.6×10^5	5.4×10^4	2.4×10^5
Log survivors	5.28	3.66	5.56	4.76	5.38

coliform bacteria group in all samples of beefburger greatly exceeded the count of coliform bacteria specified by the E.S.S. (1991) which stated that the coliform bacteria count of beefburger should not to exceed 10^3 colonies/g. The presence of coliform bacteria and the detection of high counts of this microorganisms in locally produced beefburger are indications of the unsanitary conditions practiced during the preparation, the storage and the marketing of such product. These results are in agreement with those reported by Darwish *et al.* (1986)

It could be noticed that there was a wide variation in mould and yeast counts between different samples. Mould and yeast counts ranged from 4.6 x 10^3 colonies/g (sample 2) to 2.4x10^5 colonies/g (sample 4). Samples 1 and 2 showed the least degree of contamination by the mould and yeast (5.8x10^4 and 4.6x10^3 colonies/g, respectively), which could be attributed to the high nitrite content. On the other hand, samples 3, 4 and 5 showed the highest degree of contamination (1.6x10^5, 2.4x10^5 and 1.9x10^5 colonies/g, respectively).

4.2.5. Fatty acid composition:

Data presented in **Table** (12) show the fatty acids composition in the different beefburger samples, while the evaluation of the fatty acids composition is shown in **Table** (13).

It could be noticed that the major fatty acids for samples 1 and 4 were oleic ($C_{18:1}$), stearic ($C_{18:0}$) and palmitic ($C_{16:0}$), while the major fatty acids of samples 2, 3 and 5 were oleic ($C_{18:1}$), palmitic ($C_{16:0}$) and stearic ($C_{18:0}$). Therefore the dominant fatty acid for all samples was

the oleic ($C_{18:1}$) showing higher level for samples 2 and 3 followed by 4, 1 and 5. Nevertheless, all samples were higher in total saturated fatty acids except sample 1 which was higher in total unsaturated fatty acids.

Palmitic acid ($C_{16:0}$) constituted the major saturated fatty acid of samples 2, 3 and 5 which contained 21.48, 31.86 and 21.07%, respectively, while it constituted the second major saturated fatty acid of samples 1 and 4 which contained 16.27 and 20.15%, respectively. Stearic acid ($C_{18:0}$) constituted the major saturated fatty acid of samples 1 and 4 which contained 20.50 and 22.49%, respectively, while it constituted the second major saturated fatty acid of samples 2, 3 and 5 which contained 19.65, 13.25 and 19.93%, respectively.

Oleic acid ($C_{18:1}$) constituted the major unsaturated fatty acid in all samples of beefburger which had 27.57, 33.97, 32.63, 28.11 and 27.18% of samples 1, 2, 3, 4 and 5, respectively. Palmitoleic acid ($C_{16:1}$) constituted the second major unsaturated fatty acid in all samples which contained 15.78, 8.66, 6.20, 12.52 and 14.10% of samples 1, 2, 3, 4 and 5, respectively. Lenoleic acid ($C_{18:2}$) constituted the third major unsaturated fatty acid in all samples 1, 2, 3, 4 and 5 which contained 8.04, 4.75, 3.60, 4.42 and 4.46%, respectively.

From results in **Table** (13) the total lipids of samples 2, 3, 4 and 5 seems to be saturated which contained 52.11, 57.59, 54.25 and 52.74%, respectively, while sample 1 seems to be unsaturated which contained 52.38%. Total monoenoic fatty acids were higher in samples 1 and 2 (44.34 and 43.13%) followed by samples 5 and 4 (42.25 and 41.33%) then sample 3 (38.83%), respectively. On the other hand, total dienoic fatty acids were higher in sample 1 (8.04%) followed by

Table (12): Fatty acids (FA) composition of locally manufactured beefburger obtained from different locations of Egypt.

Fatty acids	Samples				
	1	2	3	4	5
C10:0	-	-	-	-	0.08
C12:0	0.28	0.17	-	0.20	0.24
C14:0	3.85	3.66	4.00	5.27	3.97
C15:0	2.05	1.33	1.14	2.41	1.82
C16:0	16.27	21.48	31.86	20.15	21.07
C16:1	15.78	8.66	6.20	12.52	14.10
C17:0	2.02	1.55	0.57	1.52	1.42
C18:0	20.50	19.65	13.25	22.49	19.93
C18:1	27.57	33.97	32.63	28.11	27.18
C18:2	8.04	4.75	3.60	4.42	4.46
C18:3	-	-	-	-	0.55
C20:0	0.66	-	0.77	0.40	-
C22:0	1.99	4.27	6.00	1.81	4.21
C22:1	0.99	0.50	-	0.70	0.97

Table (13): Evaluation of the fatty acids (FA) composition of locally manufactured beefburger obtained from different locations of Egypt.

	Samples				
	1	2	3	4	5
Total monoenoic FA %	44.34	43.13	38.83	41.33	42.25
Total dienoic FA %	8.04	4.75	3.60	4.42	4.46
Total trienoic FA %	-	-	-	-	0.55
Total essential FA %	8.04	4.75	3.60	4.42	5.01
Total unsaturated FA %	52.38	47.88	42.43	45.75	47.26
Total saturated FA %	47.62	52.11	57.59	54.25	52.74
Ks	1.10	0.92	0.74	0.84	0.90
Du	0.60	0.53	0.46	0.50	0.53

The degree of total lipids unsaturation was evaluated by calculation of Ks and Du values as follows:-

Ks = Total unsaturated fatty acids/ Total saturated fatty acids.

Du = 1 (monounsaturated FA/100) + 2 (diunsaturated FA/100) + 3 (triunsaturated FA/100)

samples 2, 5 and 4 (4.75, 4.46 and 4.42%) then sample 3 (3.60%), respectively. Therefore, the nutritional value, based on the level of total essential fatty acids was higher for sample 1 compared with the other samples.

4.2.6. Organoleptic evaluation:

Sensory evaluation was used to test the consumer preference in respect to the effect of processing techniques of different factories on the quality attributes of all beefburger products.

The sensory properties of the beefburger product were evaluated in terms of flavor (35 degrees), texture (30 degrees), color (20 degrees) and appearance (15 degrees) according to El-Akary, (1986).

The average of the obtained scores for ten panelists were tabulated in **Table** (14). Analysis of variance was carried out that data were treated as complete randomization design. Least significant differences (L.S.D.) were calculated and tabulated in the same **Table**. Least significant difference test indicated that there was no significant difference ($p > 0.05$) between samples 3 and 5 from the stand point view of flavor, color and appearance. Their average scores were 31.30, 16.50 and 13.60 and 30.95, 17.15 and 13.10 for samples 3 and 5, respectively. Statistical analysis did not indicate any significant differences ($p > 0.05$) between samples 2 and 4 for flavor and color. Average scores of flavor, color and appearance were significant higher ($P < 0.05$) of samples 3 and 5 than those of the other tested samples.

Statistical analysis indicated also that there were no significant differences ($P > 0.05$) between samples 1 and 4 from the stand point

view of color and appearance. Their average scores were 15.05 and 14.05 and 11.95 and 11.60 for samples 1 and 4, respectively.

Statistical analysis indicated that there were no significant differences ($P > 0.05$) between samples 1 and 3 and 1 and 5 for texture.

With respect to overall acceptability there were no significant differences ($P > 0.05$) between samples 3 and 5 which obtained the higher significantly scores ($P < 0.05$) (87.70 and 85.85) than those of the other samples 1, 2 and 4 which obtained 80.40, 71.00 and 74.5 scores of overall acceptability.

From results obtained of sensory evaluation it can be concluded that samples 3 and 5 of beefburger product were the best samples in the sensory evaluation by all panelists. These results of sensory evaluation are in agreement with those obtained by El-Akary, (1986).

Table (14): Organoleptic evaluation of locally manufactured beefburger obtained from different location of Egypt.

Characteristics	Samples					L.S.D.
Scores	1	2	3	4	5	
Flavor /35	27.65^{b}	25.25^{c}	31.30^{a}	25.75^{c}	30.95^{a}	1.26
Texture /30	25.55^{ab}	21.60^{d}	26.30^{a}	23.00^{c}	24.65^{b}	1.05
Color /20	15.05^{b}	14.05^{c}	16.50^{a}	14.15^{bc}	17.15^{a}	0.98
Appearance /15	11.95^{b}	10.10^{c}	13.60^{a}	11.60^{b}	13.10^{a}	0.83
Acceptability /100	80.40^{b}	71.00^{d}	87.70^{a}	74.50^{c}	85.85^{a}	2.45

* Average of 10 panelists.

a-d There is no significant differences between any two means have the same letter within certain components.

Part III

4.3. Ground meat:

4.3.1. Chemical composition:

Data presented in **Table** (15) show the proximate chemical composition of different ground meat samples obtained from Cairo, Benha and Zagazig.

The moisture content ranged from 51.56% (sample 2) to 70.69% (sample 5). Moisture content of samples 1, 2, 3 and 4 (64.28, 51.56, 68.62 and 67.44%) did not exceed the limits specified by the E.S.S. (1991) which stated that the moisture content of net ground meat should not exceed 70% in the final product. Moisture content of sample 5 was higher significantly ($P>0.05$) than those of the other samples and higher than that specified by E.S.S. (1991), while sample 2 had the lowest significantly ($P>0.05$) in moisture content (51.56%) than those of the other samples and the lower than that set up by the E.S.S. (1991). This decrease in moisture content may be due to addition the meat substituents. These results were assured by those obtained by Lotfi *et al.* (1978), Patel *et al.* (1980), Nofal (1981), Marchello *et al.* (1984) and Liu *et al.* (1991).

From **Table** (15) it could be noticed that the protein content ranged from 14.90% (sample 2) to 18.31% (sample 4). Protein content of sample 4 was within the limits specified by the E.S.S. (1991) which stated that the protein content must not be less than 18%. Protein content of sample 4 was higher significantly ($P<0.05$) than those of the other samples, while protein content of samples 2, (14.90%) was lower significantly ($P<0.05$) than those of the other samples and lower than that set up by the E.S.S. (1991. These results obtained are in

agreement with those reported by Lotfi *et al.* (1978), Marchello *et al.* (1984), Liu *et al.* (1991) and Williams *et al* (1994).

The fat content of ground meat ranged from 10.36% (sample 5) to 27.24% (sample 2), which did not exceed the limit specified by the E.S.S. (1991) which mentioned that the fat content of ground meat should not exceed 20% in the final product, except the sample 2 which was higher in fat content than that set up by the E.S.S. (1991). Statistical analysis did not indicate any significant differences ($P<0.05$) between samples 3, 4 and 5 for fat content. These results are in agreement with those reported by Lotfi *et al.* (1978), Patel *et al.* (1980), Marchello *et al.* (1984), Liu *et al.* (1991) and Williams *et al.* (1994).

Ash content of ground meat ranged from 1.46% (sample 5) to 1.84% (sample 4). Ash content of sample 5 was within the limits specified by the E.S.S. (1991) which stated that total ash content must not exceed 1.5% in the final product of ground meat. Sample 4 was higher significantly ($P<0.05$) in ash content than those of samples 2, 3 and 5. Data in **Table** (15) indicate that there were no significant differences in ash content of samples 1, 2, 3 and 5 which contained 1.66, 1.59, 1.55 and 1.46%, and between samples 1 and 4 which contained 1.66 and 1.84%,respectively. Sodium chloride ranged from 0.11% (sample 1) to 0.19% (sample 3), which did not exceed the limits specified by the E.S.S. (1991) which stated that the sodium chloride of ground meat shall not exceed 1%. Statistical analysis did not indicate any significant differences ($P>0.05$) between all samples for sodium chloride. These results are in agreement with those reported by Lotfi *et al.* (1978) and Kenawy (1984).

The carbohydrate content of ground meat ranged from 0.57% (sample 1) to 4.71% (sample 2). Carbohydrate content of sample 2 was higher significantly ($P<0.05$) than those of other samples. This increase of carbohydrate content may be due to the addition of meat substitutes. Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 3, 4 and 5 and between samples 1 and 5 for carbohydrate content. Energy values ranged from 163.2 calories (sample 5) to 323.6 calories (sample 2). Energy values of sample 2 were higher significantly ($P<0.05$) than those of other samples. This increase of energy values in sample 2 could be attributed to the high fat and carbohydrate contents. Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 3, 4 and 5 for energy values.

From data presented in **Table** (15) it could be noticed that the sodium nitrite was presence in all samples of locally produced ground meat. The residual amount of sodium nitrite ranged from 17.7 ppm (sample 1) to 76.7 ppm (sample 3). These results indicate that sample 3 contained higher significantly ($P <0.05$) of sodium nitrite content (76.7 ppm) than those of the other samples.

Statistical analysis did not indicate any significant differences ($P >0.05$) between samples 2 and 5 for sodium nitrite content which contained 33.5 and 44.3 ppm, respectively. Statistical analysis indicated also that there was no significant differences ($P >0.05$) between samples 1, 2 and 4 which contained 17.7, 33.5 and 27.8 ppm, respectively.

Table (15): Proximate chemical composition of locally manufacture ground meat obtained from different locations of Egypt (on wet weight basis).

Components	Samples					L.S.D.	E.S.S.
	1	2	3	4	5		
Moisture %	64.28	51.56	68.62	67.44	70.69	1.88	70.0 Max.
Protein %	17.37^{b}	14.90^{c}	16.91^{b}	18.31^{a}	16.56^{b}	0.89	18.0 Min.
Fat %	16.13^{b}	27.24^{a}	11.39^{c}	10.80^{c}	10.36^{c}	1.46	20.0 Max.
Ash %	1.66^{ab}	1.59^{b}	1.55^{b}	1.84^{a}	1.46^{b}	0.21	1.5 Max.
NaCl %	0.11^{c}	0.14^{bc}	0.19^{a}	0.13^{c}	0.17^{ab}	0.003	1.0 Max.
Carbohydrate%*	0.56^{c}	4.71^{a}	1.52^{b}	1.61^{b}	0.92^{bc}	0.78	---
Energy K Calories	216.9^{b}	323.6^{a}	176.3^{c}	176.9^{c}	163.2^{c}	14.58	---
$NaNO_2$ (ppm)	17.7^{c}	33.5^{bc}	76.7^{a}	27.8^{c}	44.3^{b}	16.4	---

a-c There is no significant differences between any two means have the same letter within certain components.

E. S. S. Egyptian Standard Specification, (1991).

* Calculated by difference.

4.3.2. Freshness tests parameters:

Data presented in **Table** (16) show the values recorded for freshness tests parameters, namely total volatile nitrogen (TVN), ammonia (NH_3), trimethylamine (TMA), thiobarbituric acid (TBA) and pH value of different ground meat samples.

TVN of ground meat ranged from 11.43 mg/100g (sample 2) to 16.98 mg/100g (sample 5), which did not exceed the limits specified by the E.S.S. (1991) which stated that the total volatile nitrogen of ground meat must not exceed 20 mg/100g. TVN of sample 5 was higher significantly ($P<0.05$) than those of samples 2 and 3, while it was lower significantly ($P<0.05$) sample 3 than those of samples 4 and 5.

Ammonia content of ground meat ranged from 2.8 mg/100g (sample 1) to 4.20 mg/100g (sample 2) which had the highest significantly ($P<0.05$) ammonia content than the other samples. Statistical analysis did not indicate any significant differences ($P>0.05$) between samples 2, 3, 4 and 5 and between samples 1, 3, 4 and 5 for ammonia content. TMA of ground meat ranged from 0.98 mg/100g (sample 2) to 2.92 mg/100g (sample 3). It is clear that there was no significant differences in TMA of all samples of ground meat.

From **Table** (16) it could be noticed that the TBA values of ground meat ranged from 0.79 (mg maloalehyde/kg) (sample 1) to 1.74 mg (malonaldehyde/kg) (sample 2), which did not exceed the limit specified by the E.S.S. (1991) which stated that the TBA value of ground meat should not exceed 0.9 mg malonaldehyde/kg sample. Statistical analysis did not indicate any significant differences ($P>0.05$) between all samples for TBA values.

Table (16): Chemical freshness tests of locally manufactured ground meat obtained from different locations of Egypt. (on wet weight basis).

Components	Samples					L.S.D.
	1	2	3	4	5	
T.V.N. mg/100g	14.70^{abc}	11.43^{bc}	13.67^{c}	15.34^{ab}	16.98^{a}	3.29
Ammonia mg/100g	2.80^{b}	4.20^{a}	3.50^{ab}	3.50^{ab}	3.50^{ab}	0.88
T.M.A. mg/100g	1.98^{a}	0.98^{a}	2.92^{a}	1.28^{a}	2.57^{a}	3.24
T.B.A. mg /kg	0.79^{a}	1.74^{a}	1.09^{a}	1.64^{a}	1.18^{a}	1.88
pH value	5.53^{c}	5.89^{a}	5.76^{b}	5.70^{b}	5.57^{b}	0.11

a-c There is no significant differences between any two means have the same letter within certain components.

T.V.N. Total volatile nitrogen.

T.M.A. Trimethyl amine.

T.B.A. Thiobarbituric acid (as malonaldehyde)

The pH values of ground meat ranged from 5.53 (sample 1) to 5.89 (sample 2). From data in **Table** (16) it could be noticed that the pH value was higher significantly ($P<0.05$) of sample 2 followed by samples 3 and 4 (5.76 and 5.70) and lower significantly ($P<0.05$) of samples 1 and 5 (5.53 and 5.57). The high pH value of sample 2 could be attributed to the high content of ammonia.

4.3.3. Minerals content composition:

Data presented in **Table** (17) show minerals content of different locally manufactured ground meat obtained from Cairo, Benha and Zagazig. In view of the fact that the aim of this part of study is nutritional evaluation of locally ground meat to serve as potential source for human food. This part of study comprised the analysis of nine essential mineral elements, five macroelements: sodium (Na), potassium (K), phosphorus (P), magnesium (Mg) and calcium (Ca) and four microelements: iron (Fe), zinc (Zn), copper (Cu)and Manganese (Mn) as present in ground meat.

Each sample was characterized by having higher concentration of one or more mineral element than the other samples. For example sample 1 was characterized by having higher concentration of Mg, Ca and Zn, sample 2 was characterized by having higher concentration of Cu, sample 3 was characterized by having higher concentration of P, sample 4 was characterized by having higher concentration of K and sample 5 was characterized by having higher concentration of Na, Fe, and Mn than the other samples.

Table (17): Minerals content of locally manufactured ground meat obtained from different locations of Egypt. (mg/100 g wet weight basis).

Elements	Samples				
	1	2	3	4	5
Macroelements:					
Na	145.54	147.99	156.94	159.78	256.10
K	277.23	211.41	298.93	380.43	341.46
P	133.42	122.92	187.90	141.09	107.93
Mg	178.22	120.81	149.47	43.48	73.17
Ca	165.02	100.67	106.76	144.93	103.25
Microelements					
Fe	2.63	2.69	3.54	5.31	7.73
Zn	3.25	1.86	2.73	2.47	2.77
Cu	0.22	0.38	0.17	0.32	0.20
Mn	0.20	0.30	0.14	0.65	1.06
Ash content%	1.66	1.59	1.54	1.84	1.56

From the point of availability of mineral contents in different ground meat samples, minerals were ranked in a decreasing order of abundance as Na, K, p, Mg, Ca, Fe, Zn, Cu and Mn in samples 1, 3 and 5; in sample 2 were Na, P, K, Mg, Ca, Zn, Fe, Cu and Mn, while in sample 4 were Na, K, P, Ca, Mg, Fe, Zn, Cu and Mn, respectively.

Sodium content of ground meat samples ranged from 145.54 mg/100g (sample 1) to 256.10 mg/100g (sample 5), while potassium content ranged from 211.41 mg/100g (sample 2) to 380.43 mg/100g (sample 4).

It is clear that ground meat samples contained appreciable amounts of Mg, Ca, P, Fe, Zn and Cu compared to many other food sources. Ground meat samples could be considered as a rich source of Ca that their Ca average content is 188.4 mg/100g which is higher than cow's milk Ca content which reported by 72 mg/100g (Pellet and Shadarevian, 1970). The present data in **Table** (17) indicated that Ca content ranged from 100.67 mg/100g (sample 2) to 165.02 mg/100g (sample 1).

Magnesium content ranged from 43.48 mg/100g (sample 4) to 178.22 mg/100g (sample 1). Average concentration of Mg in different ground meat samples (198.2 mg/100g) is quite higher than those found in human milk or cow s milk, 4 and 12 mg/100g, respectively (NAS, 1974).

Phosphorus content ranged from 107.93 mg/100g (sample 5) to 187.9 mg/100g (sample 3). Iron content of ground meat samples ranged from 2.63 mg/100g (sample 1) to 7.73 mg/100g (sample 5).

The present elementary analysis (**Table** 17) showed that Zn level ranged from1.86 mg/100g (sample 2) to 3.25 mg/100g (sample

1) all ground meat samples were which are within the limit set up by Harold *et al.* (1981) who mentioned that the permitted zinc content in food is 50 mg/kg. Copper content of ground meat samples ranged from 0.17 mg/100g (sample 3) to 0.38 mg/100g (sample 2). Copper content of all ground meat samples are within the limit set up by Harold *et al.* (1981) who mentioned that, the permitted copper content in food is 20 mg/kg. Manganese content ranged from 0.14 mg/100g (sample 3) to 1.06 mg/100g (sample 5). These results obtained are in agreement with those reported by Holden *et al.*, (1986).

4.3.4. Microbiological examination:

Data presented in **Table** (18) show total bacterial count (TBC) (colonies/g), coliform bacteria group count (colonies/g) and mould and yeast counts (colonies/g) of locally manufactured ground meat obtained from different locations of Egypt.

The microbiological quality of this product well depends upon the meat used for grinding, sanitary conditions during preparation and time and temperature of storage. Total bacterial count of ground meat ranged from $7.4x10^4$ colonies/g (sample 3) to $6.03x10^5$ colonies/g (sample 1). From this results indicate that sample 3 and 5 showed the least degree of contamination ($7.4x10^4$ and $8.6x10^4$, respectively) which could be attributed to the high nitrite content and low pH value as a bacteriostatic agent. On the other hand, samples 1, 2 and 4 showed the highest microbial contamination ($6.03x10^5$, $1.3x10^5$ and $1.5x10^5$ colonies/g, respectively) may be also due to low nitrite content and high ph value.

The results obtained indicate that the total bacterial count present in all samples of locally manufactured ground meat was within the limits specified by the E.S.S. (1991) which reported that the total bacterial count of ground meat shall not to exceed 10^6 colonies/g.

Anon. (1975) proposed 10^6 microorganisms/g, Pivinik *et al.* (1976) recommended a limit of 10^7 till $5x10^7$ for ground beef. These results obtained are in agreement with those reported by Rao (1970), El-Mswiler *et al.* (1976); Duitschaever *et al.* (1977) and Foster *et al.* (1978).

It could be noticed that a big variation in counts of coliform bacteria group between different samples of ground meat collected from different sources which reflect a different degrees of contamination.

From the data in **Table** (18) indicate that count of coliform bacteria group of locally ground meat samples obtained from different locations of Egypt ranged from $2.9x10^3$ colonies/g (sample 3) to $4.4x10^4$ colonies/g (sample 1). Samples 3 and 2 showed the least degree of contamination which could be attributed to the high nitrite content. On the other hand, sample 1 showed the highest microbial contamination which may be also due to the low nitrite content. The presence of coliform bacteria and its high counts in locally ground meat are indications of unsanitary conditions practiced during the preparation, the storage temperature and the marketing of such the product. These results are in agreement with those reported by Rao (1970), Patano and Caserio (1980).

Table (18): Microbiological examination (total bacteria, coliform group and mould and yeast counts/g) of locally manufactured ground meat obtained from different locations of Egypt.

	Samples				
	1	2	3	4	5
Aerobic plate count cfu/g	$6.0x10^5$	$1.3x10^5$	$7.4x10^4$	$1.5x10^5$	$8.6x10^4$
Log survivors	5.78	5.11	4.87	5.18	4.93
Coliform group cfu/g	$4.4x10^4$	$5.3x10^3$	$2.9x10^3$	$7.9x10^3$	$3.96x10^4$
Log survivors	4.64	3.72	3.46	3.90	3.59
Mould & yeast cfu/g	$1.3x10^5$	$1.94x10^4$	$1.5x10^4$	$3.7x10^4$	$1.84x10^5$
Log survivors	5.11	5.28	4.18	4.56	5.26

Mould and yeast are of omnipresent distribution and regarded more or less a source of contamination of meat and meat products which lead to spoilage and/or of food borne mycotoxicosis.

It could be noticed that a big variation in mould and yeast counts between different samples of locally ground meat collected from different sources. Mould and yeast counts ranged from $1.5x10^4$ colonies/g (sample 3) to $1.3x10^5$ colonies/g (sample 1).Samples 2, 3 and 4 showed the least comparable degree of contamination by the mould and yeast which could be attributed to the high content of nitrite and low pH value. On the other hand, samples 1 and 5 showed the highest degree of contamination by the mould and yeast which may be also due to low nitrite content and high pH value. These results are in agreement with those reported by Hitokoto *et al.* (1972) and Abd El-Rahman *et al.* (1984).

4.3.5. Fatty acids composition:

Data presented in **Table** (19) show the fatty acids composition in different ground meat samples, while evaluation of the fatty acids composition is shown in **Table** (20).

It could be considered that the major fatty acids for samples 1 and 4 were oleic ($C_{18:1}$), stearic ($C_{18:0}$) and palmitic ($C_{16:0}$), while the major fatty acids of samples 2, 3 and 5 were oleic ($C_{18:1}$), palmitic ($C_{16:0}$) and stearic ($C_{18:0}$). Therefore, the dominant fatty acid for all samples was the oleic acid ($C_{18:1}$) showing higher level for samples 2 and 1 followed by samples 3, 4 and 5. Nevertheless in all samples were higher in total saturated fatty acids.

Palmitic acid ($C_{16:0}$) constituted the major saturated fatty acid of samples 2, 3 and 5 which contained 24.86, 20.58 and 21.87%, respectively, while it constituted the second major saturated fatty acid of samples 1 and 4 which contained 20.62 and 16.02%, respectively. On the other hand stearic acid ($C_{18:0}$) constituted the major saturated fatty acid of samples 1 and 4 which contained 21.32 and 21.78%, respectively, while it constituted the second major saturated fatty acid of samples 2, 3 and 5 which contained 18.80, 19.53 and 19.95%, respectively.

Oleic acid ($C_{18:1}$) constituted the major unsaturated fatty acid in all samples of ground meat which has 33.20, 35.62, 30.18, 29.87 and 29.35% for samples 1, 2, 3, 4 and 5, respectively. Palmitoleic acid ($C_{16:1}$) constituted the second major unsaturated fatty acid in all samples which has 9.35, 9.86, 11.42, 10.37 and 12.31% for samples 1, 2, 3, 4 and 5, respectively. While, Lenoleic acid ($C_{18:2}$) constituted the third major unsaturated fatty acid for all samples 1, 2, 3, 4 and 5 which constituted 3.98, 3.01, 3.94, 6.98 and 3.33%, respectively.

Results in **Table** (20) indicate that the total lipids of all samples of ground meat seems to be saturated, which constituted 51.46, 50.78, 53.45, 51.30 and 55.03% for samples 1, 2, 3, 4 and 5, respectively. Total monoenoic fatty acids were higher in sample 2 (46.20%) followed by samples 1, 3 and 5 (43.81, 42.38 and 41.66% then sample 4 (41.39%), respectively). On the other hand, total dienoic fatty acids were higher in sample 4 (6.98%) followed by samples 1, 3 and 5"(3.98, 3.94 and 3.33%, respectively) then sample 2 (3.01%), respectively. Therefore, the nutritional value, based on the level of

Table (19): Fatty acids (FA) composition of locally manufactured ground meat obtained from different locations of Egypt.

Fatty acid %	Samples				
	1	2	3	4	5
C10:0	-	-	-	0.16	-
C12:0	-	-	0.22	0.16	1.15
C14:0	3.37	4.45	3.79	5.17	3.71
C15:0	1.05	1.23	1.70	2.44	1.44
C16:0	20.62	24.86	20.58	16.02	21.87
C16:1	9.35	9.86	11.42	10.37	12.31
C17:0	0.98	1.44	1.31	1.49	0.96
C18:0	21.32	18.80	19.53	21.78	19.95
C18:1	33.20	35.62	30.18	29.87	29.35
C18:2	3.98	3.01	3.94	6.98	3.33
C18:3	0.75	-	0.24	0.33	-
C20:0	-	-	0.88	0.94	0.58
C20:1	1.26	0.72	0.78	1.15	-
C22:0	4.12	-	5.44	3.14	5.37

Table (20): Evaluation of fatty acids (FA) composition of locally manufactured ground meat obtained from different locations of Egypt.

	Samples				
	1	2	3	4	5
Total monoenoic FA %	43.81	46.20	42.38	41.39	41.66
Total dienoic FA %	3.98	3.01	3.94	6.98	3.33
Total trienoic FA %	0.75	-	0.24	0.33	-
Total essential FA %	4.73	3.01	4.18	7.31	3.33
Total unsaturated FA %	48.54	49.21	46.56	48.70	44.99
Total saturated FA %	51.46	50.78	53.45	51.30	55.03
Ks	0.94	0.97	0.87	0.95	0.82
Du	0.54	0.52	0.51	0.56	0.48

The degree of total lipids unsaturation was evaluated by calculation of Ks and Du values as follows:

Ks = Total unsaturated fatty acids/Total saturated fatty acids.

Du = 1 (monounsaturated FA/100) + 2 (diunsaturated FA/100) + 3 (triunsaturated FA/100).

total essential fatty acids were higher in sample 4 (7.31%) compared with the other samples.

4.3.6. Organoleptic evaluation:

Sensory evaluation was used to test the consumer preference in respect to the effect of processing techniques of different factories on the quality attributes of all ground meat products.

The sensory properties of the ground meat product were evaluated in terms juiciness (20 degrees), tenderness (20 degrees), flavor (20 degrees), connective tissue amount (20 degrees) and mouth coating (20 degrees) according to Kregel *et al.*, (1986).

The average of the obtained scores for ten panelists were presented in **Table** (21). Analysis of variance was carried out that data were treated as complete randomization design. Least significant differences (L.S.D.) were calculated and tabulated in the same **Table**. Least significant difference test indicated that there is no significant difference ($P>0.05$) between samples 3 and 5 from the stand point view of tenderness, flavor, connective tissue amount and mouth coating. There average scores were 13.35, 16.20, 16.60 and 5.60 and 13.00, 16.70. 17.10 and 5.75 for samples 3 and 5, respectively. Statistical analysis did not indicated any significant differences ($P >0.05$) between samples 4 and 5 for juiceness and tenderness.

Statistical analysis indicated also that there is no significant differences ($P >0.05$) between samples 1 and 4 from the stand point view of flavor and mouth coating.

Average scores of flavor and connective tissue amount were significant higher ($P <0.05$) of samples 3 and 5 than those of the other

samples. Statistical analysis indicated also that there is no significant differences ($P > 0.05$) between samples 2 and 5 from the stand point view of mouth coating (6.40 and 5.75) which was significant higher ($P < 0.05$) in sample 2 than those of the other samples.

With respect to overall acceptability there was no significant differences ($P < 0.05$) between samples 3 and 5 which obtained the higher significantly scores ($P > 0.05$) 65.95 and 64.80 than those of the other samples which contained 60.25, 61.27 and 56.8 scores for overall acceptability of samples 1, 2 and 4, respectively. Statistical analysis did not indicate any significant differences ($P > 0.05$) between samples 1 and 2 for overall acceptability.