

EFFECT OF FREEZING AND FRYING ON MINERAL CONTENT OF SIX EGYPTIAN BUFFALO ORGANS.

Prof. Dr. M. Kamal E. Youssef, Prof. Dr. M.K. Farag, Dr. S. Tolba and M.A. Seleim.

Food Sci. and Techn. Depart., Fac. of Agric., Assiut Univ., Assiut, A.R. Egypt.

SUMMARY

This investigation was carried out to study freezing frying effect on the mineral content of six buffalo organs, namely: Liver, Heart, Kidney, Spleen, Tongue and Brain.

Cooper, Zinc, Iron, Manganese, Calcium, Magnesium, Sodium, Potassium and Phosphorus contents in the aforementioned organs were evaluated.

Liver, heart and spleen of buffalo contained higher levels of copper, iron, manganese, magnesium, potassium and phosphorus than the other organs, except brain which contained relatively higher levels of magnesium, potassium and phosphorus than tongue and kidney. Zinc levels in all organs were found to be much higher than other minerals. Spleen and liver were of relatively higher iron content. In general, all studied buffalo organs may be considered as rich sources of iron, phosphorus, zinc, manganese, potassium and copper, while they may be considered as good sources of sodium and magnesium in human diet. Meanwhile they are reckoned as poor sources of calcium. Phosphorus levels were generally higher in liver, brain and spleen. The rate of decrement in sodium and potassium were relatively lower in fried organs. Meanwhile, the other mineral contents in all studied organs were higher in fried organs. The rate of decrement of sodium, potassium and phosphorus was higher than that in other minerals during freeze storage in all studied organs.

INTRODUCTION

Edible offals (variety meats or meat organs) such as brain, kidney, liver, lung and spleen are among meat by-products and can be considered as a nutritionally rich meal as they contain sufficient amounts of high quality animal proteins, minerals and vitamins. Moreover, they are easily digested and their extract provokes the flow of gastric juice. (El-Moudy, 1979).

The influence of various cooking and heating treatments on the minerals content of some food-stuffs typical to the American diet was investigated by Higgs et al. (1972). They found that baking and boiling had little or no effect on the amounts of the minerals in meat by-products.

Minerals are not destroyed during cooking of meat organs, so the method of preparation will affect the mineral content of the meat organs only if drip losses are excessive or cooking water is discarded (McCance and Widdowson, 1960; Adams, 1975; Church and Church, 1975).

Saad El-Din (1979), reported that Camel's heart is generally a poor source of calcium. It is evident that boiling had a little effect on calcium concentration.

Saad El-Din (1979) stated that boiling decreased phosphorus content in camel's heart.

MATERIALS AND METHODS

I- Materials:

Three representative samples from each of the following specified buffalo organs namely: Liver, heart, kidney, spleen, brain and tongue were obtained immediately after slaughtering from Assiut Slaughter house.

The average age of the buffalos from which the samples were withdrawn was the normal commercial age (between 2-2.5 years).

Samples of organs were transferred without delay to the Food Technology Laboratory, Assiut University

II. Methods:

A. Technological methods:

The samples of each organ were divided into four groups. Three groups were placed in polyethylene bags; frozen at -20°C , and further stored at -20°C for 2, 4 and 6 months.

At the end of every freezing period, samples were drawn at random, thawed at room temperature and then analysed.

The fourth group was divided into two parts, and every part was subjected to different treatments as follows:

a) The first part (RAW):

Cut-into small pieces, mixed, chopped twice in a meat chopper, then kept as control in glass containers and stored at $+4^{\circ}\text{C}$ for chemical analysis.

b) The second part:

The samples were sliced (5x2.5x2 cm.) and fried in butter for three different specific periods. The samples were minced, thoroughly mixed, then kept in glass containers and stored at $+4^{\circ}\text{C}$ for chemical analysis.

B. Chemical methods

Mineral content:

Sodium and potassium contents:

Sodium and potassium were determined by a Carl-Zeiss jena flame photometer. The stock electrolyte solution of dry ashing was used according to Jackson (1958).

Phosphorus:

Phosphorus was determined colorimetrically by the ammonium molybdate method as described by Jacobs, (1962).

Calcium:

The versine titration method was used for calcium determination, (Jackson, 1958).

Copper, Iron, Zinc, Manganese and Magnesium:

These minerals were determined using unicam SP 1900 atomic absorption spectrophotometer according to Gorsuch, (1959).

C. Statistical methods:

The data were statistically analysed according to the method described by Steel and Torrie, (1960). According to this method the correlation coefficient (r) between freezing, as an independent variable and boiling as dependent variable is computed on the basis of four data values.

RESULTS AND DISCUSSION

Effect of freezing and frying on mineral's content of buffalo organs:

Tables (1-2) represent the statistical analysis of the average mineral contents of buffalo liver, kidney, heart, spleen, tongue and brain during the frying process.

An over look at these Tables showed that fresh spleen contained higher levels of iron, manganese, calcium and magnesium than other studied organs.

The phosphorus values are generally higher in liver, followed by brain and heart, while, spleen, tongue and kidney contained lowest levels of phosphorus.

The data showed that heart, kidney and spleen had much lower zinc content than the other studied organs. While brain and tongue had much higher zinc content than the latter. Liver might have an intermediate zinc content between tongue and spleen.

On the other hand, liver contained the highest copper and phosphorus levels and the lowest levels of calcium and sodium. While brain had the lowest levels of copper, iron and manganese.

Heart recorded the highest potassium level, while tongue contained the lowest level of phosphorus, potassium, calcium, iron and copper.

During freeze storage periods it is interesting to note that there is a slight decrease of copper, zinc and manganese in all studied organs.

The rate of decrement of sodium, potassium and phosphorus are higher than the other minerals.

It is observed from these results that there is a slight decrease in sodium and potassium contents in all studied organs during frying process, while it could be noticed that all the other studied minerals were increased during frying process.

The increase of minerals' contents during frying may be due to the contamination from the butter and utensils used in frying process, (Aziz, 1976), and to the decrease in the water content of the samples, thus increasing the concentration of these minerals, (Saad El-Din, 1979).

Such results are in agreement with Price, (1970) and John, (1975).

The results tabulated in Table (1), indicated that in the correlation coefficients between freezing and frying of buffalo organs are seen to be almost close to 1. This indicates that freezing and frying are strongly correlated. This means that the mineral contents are strongly affected during frying by freezing.

The population correlation coefficients are tested using the "t-test" (Table 2). It is clear that in all cases the population correlation coefficients are significantly different from zero.

This supports the sample results and generalizes the freezing frying mineral effect to the population.

REFERENCES

- Adams, C.F. (1975). Nutritive value of American Foods. Agriculture Handbook No. 456, USDA, ARS, Washington, D.C.
- Aziz, L.S.; (1976). The determination of some Heavy metals in some Egyptian Foods and the effect of precessing and cooking operations thereon. M.Sc. Faculty of Agric. Alex. Univ.
- Church, C.F. and Church, H.N. (1975). "Food values of portions commonly used" 12th ed. J.B. Lippincott. Co., New York.
- El-Moudy, R.A.E. (1979). Studies on chemical constituents of edible offals. M.V.Sc. (Meat Hygiene) Thesis, Faculty of Vet. Med. Cairo University.
- Gorsuch, T.T. (1959). The destruction of organic matter. *Analyst.*, 48, 135.
- Higgs, D.J., Morris, V.C. and Levander, O.A. (1972). Effect of cooking on selenium content of food. *J. Agric. Food Chem.* 20: 678.
- Jackson, M.L. (1958). Soil chemical Analysis. Constable and Co. L.T.D. London.
- Jacobs, M.B. (1962). The chemical Analysis of foods and food products. D. Van Nostrand Co. Inc., Princeton, New Jersey.
- McCance, R.A. and Widdowson, E.M. (1960). The composition of foods. Medical Research Council Special Report. Series No. 297, London.
- Saad El-Din, A.M. (1979). Biochemical analysis of Egyptian camel's heart and the effect of different cooking processes on its nutritive value. M.Sc. Thesis, Faculty of Science, Al-Azhar Univ. Egypt.
- Steel, R.G.D. and Torrie, J.H. (1960). Principles and procedures of statistics with special reference to the biological sciences. Mc-Graw Hill Book Camp.

Table 1. Correlation Coefficients (r) between Freezing and Frying.

Buffalo organs	Cu	Zn	Iron	Mn	Ca	Mg	Na	K	P
Liver	0.9722	0.9903	0.9828	0.9578	0.9977	0.9733	0.9817	0.9993	0.9977
Kidney	0.9789	0.9907	0.9989	0.9847	0.9975	0.9966	0.9821	0.9803	0.9451
Heart	0.9939	0.9963	0.9920	0.9241	0.9983	0.9920	0.9918	0.9953	0.9920
Spleen	0.9899	0.9999	0.9945	0.9974	0.9982	0.9958	0.9952	0.9943	0.9766
Tongue	0.9972	0.9862	0.9987	0.9775	0.9997	0.9640	0.9967	0.9645	0.9779
Brain	0.9990	0.9926	0.9807	0.9574	0.9999	0.9815	0.9976	0.9962	0.9948

Table 2. Results of "t-test" for significant differences between the means at the 5% level of significance.

Buffalo organs	Cu	Zn	Iron	Mn	Ca	Mg	Na	K	P
Liver	5.87	10.08	7.53	4.71	20.82	5.99	7.29	37.79	20.82
Kidney	6.77	10.30	30.13	7.99	19.96	17.11	7.37	7.02	4.09
Heart	12.75	16.39	11.11	3.42	24.22	11.11	10.98	14.54	11.11
Spleen	9.87	99.99	13.43	19.57	23.54	15.38	14.38	13.19	6.42
Tongue	18.85	8.42	27.71	6.56	57.71	5.13	17.36	5.17	6.61
Brain	31.61	11.56	7.09	4.69	100.01	7.25	20.39	16.18	13.81

Table (3) Freezing-Frying effect on Minerals Content of Buffalo's Liver
(mg./100 g. dry weight).

Treatment of Frying		Cu	Zn	Iron	Mn.	Ca	Mg	Sod.	K	P	
Freeze storage periods (months)	0	Control	2.757	27.52	47.82	2.91	7.44	36.51	484.94	784.31	512.31
		After 7 min.	2.770	27.78	47.80	2.88	7.51	48.30	463.01	768.74	521.16
		After 12 min.	2.813	29.05	48.35	2.92	7.66	49.85	451.36	754.51	540.13
		After 17 min.	2.863	30.55	48.66	3.00	8.16	49.18	440.94	728.79	560.04
	2 months	Control	2.573	25.81	47.51	2.77	4.95	33.71	439.88	688.86	441.51
		After 5 min.	2.587	26.18	47.68	2.87	4.96	46.15	413.18	662.69	545.43
		After 10 min.	2.653	27.74	47.87	2.88	5.08	48.89	403.95	639.72	473.09
		After 15 min.	2.700	29.31	48.19	2.97	5.16	46.12	374.53	626.54	478.90
	4 months	Control	2.497	23.47	46.79	2.59	3.82	31.34	360.22	529.99	381.67
		After 3 min.	2.547	23.57	46.67	2.62	3.88	38.72	341.59	509.21	384.45
		After 8 min.	2.627	24.36	46.73	2.71	3.91	42.41	330.12	482.25	404.40
		After 13 min.	2.657	26.22	46.90	2.80	4.16	41.66	309.12	461.62	423.05
6 months	Control	2.463	20.06	45.51	2.48	3.15	29.40	278.93	401.15	344.06	
	After 2 min.	2.473	19.82	45.80	2.49	3.31	35.20	265.78	382.27	367.64	
	After 7 min.	2.493	22.85	45.88	2.50	3.58	38.27	244.10	356.57	377.33	
	After 12 min.	2.540	24.70	45.94	2.62	3.72	37.26	213.77	344.41	390.81	

Table (4) Freezing-Frying effect on Minerals Content of Buffalo's Kidney
(mg./100 g. dry weight).

Treatment of Frying		Cu	Zn	Iron	Mn.	Ca	Mg	Sod.	K	P	
Freeze storage periods (months)	0	Control	1.360	26.307	25.68	2.797	18.797	25.19	1000.38	762.27	102.35
		After 20 min.	1.377	26.187	25.89	2.897	18.923	40.43	912.44	710.23	112.79
		After 25 min.	1.423	26.977	26.11	2.943	19.230	45.56	799.77	681.46	126.35
		After 30 min.	1.463	27.813	26.28	3.027	19.447	42.46	711.88	624.01	146.12
	2 months	Control	1.330	23.863	25.19	2.670	16.540	22.57	796.47	641.11	87.94
		After 15 min.	1.353	24.213	25.34	2.740	16.673	36.63	645.19	574.25	93.52
		After 20 min.	1.377	26.050	25.43	2.880	17.287	39.19	601.95	597.24	127.27
		After 25 min.	1.423	26.687	25.59	2.920	17.313	38.24	574.34	412.82	153.60
	4 months	Control	1.230	22.167	24.55	2.470	14.280	20.07	708.58	479.05	79.80
		After 15 min.	1.268	22.160	24.67	2.480	14.720	32.01	667.29	411.66	92.75
		After 20 min.	1.337	23.917	24.76	2.510	14.790	36.08	624.94	374.43	100.69
		After 25 min.	1.357	25.153	24.83	2.580	15.450	34.44	589.51	340.03	116.93
6 months	Control	1.217	19.923	23.75	2.260	11.603	18.51	676.36	237.74	66.79	
	After 10 min.	1.247	20.073	23.84	2.320	12.033	28.07	594.58	211.36	74.66	
	After 15 min.	1.270	21.350	23.90	2.380	12.120	32.14	510.59	199.93	86.93	
	After 20 min.	1.320	23.800	23.99	2.430	12.280	30.63	473.50	175.20	104.59	

Table (5) Freezing-Frying effect on Minerals Content of Buffalo's Heart
(mg./100 g. dry weight).

Treatment of Frying		Cu	Zn	Iron	Mn.	Ca	Mg	Sod.	K	P	
Freeze storage periods (months)	0	Control	1.817	18.167	37.64	2.17	11.867	45.22	515.61	943.27	192.92
		After 30 min.	1.833	18.176	37.80	2.23	11.863	45.61	493.39	886.27	197.16
		After 35 min.	1.843	19.863	37.92	2.28	12.009	47.34	467.19	801.61	223.48
		After 40 min.	1.863	21.623	38.16	2.35	12.178	46.14	429.02	754.05	229.00
	2 months	Control	1.717	16.817	35.47	1.99	9.907	43.58	336.13	798.49	180.59
		After 25 min.	1.750	17.043	35.77	2.15	10.583	43.71	329.74	678.91	194.35
		After 30 min.	1.767	18.367	36.53	2.25	10.680	46.35	317.20	604.84	215.15
		After 35 min.	1.790	19.780	37.51	2.31	10.813	44.09	294.57	541.83	231.59
	4 months	Control	1.670	14.997	34.05	1.87	8.763	43.05	229.40	552.73	152.89
		After 20 min.	1.680	15.080	34.69	1.87	8.784	43.72	223.90	509.23	163.80
		After 25 min.	1.713	16.037	34.72	1.97	8.810	45.89	216.94	484.26	177.51
		After 30 min.	1.767	17.030	34.75	2.10	9.229	43.86	200.58	410.45	186.22
6 months	Control	1.633	12.747	31.76	1.76	7.435	42.44	190.30	381.35	117.69	
	After 17 min.	1.670	12.760	32.63	1.82	7.616	43.50	181.14	308.10	122.76	
	After 22 min.	1.710	14.640	32.68	1.86	7.684	44.81	172.69	287.21	147.46	
	After 27 min.	1.737	14.930	32.84	1.91	7.798	43.78	155.91	214.61	155.10	

Table (6) Freezing-Frying effect on Minerals Content of Buffalo's Spleen
(mg./100 dry weight).

Treatment of Frying		Cu	Zn	Iron	Mn.	Ca	Mg	Sod.	K	P	
Freeze storage periods (months)	0	Control	1.530	26.72	51.53	3.38	20.42	45.51	683.84	736.80	338.77
		After 35 min.	1.550	26.42	52.18	3.53	20.73	56.56	630.71	687.70	356.56
		After 40 min.	1.563	27.65	52.24	3.56	20.99	59.15	599.89	629.94	376.06
		After 45 min.	1.587	28.62	52.50	3.65	21.24	57.40	564.83	599.89	399.04
	2 months	Control	1.413	24.18	50.40	3.15	17.69	41.39	620.75	599.39	287.30
		After 30 min.	1.433	24.32	50.57	3.29	17.97	53.03	573.18	509.08	280.57
		After 35 min.	1.450	25.02	50.78	3.37	18.35	56.03	516.40	464.34	283.65
		After 40 min.	1.493	26.25	51.04	3.42	18.98	53.20	484.32	435.69	314.28
	4 months	Control	1.380	21.75	49.29	2.92	14.31	37.60	488.83	459.67	223.57
		After 25 min.	1.373	21.95	49.50	2.93	14.50	48.97	404.21	411.62	240.03
		After 30 min.	1.403	23.00	49.91	3.04	14.64	52.46	381.22	392.66	261.32
		After 35 min.	1.453	24.39	50.10	3.21	15.15	49.88	369.85	354.21	267.46
6 months	Control	1.330	18.78	49.26	2.88	13.19	35.24	365.67	380.30	184.51	
	After 20 min.	1.357	19.49	49.41	2.91	13.53	45.61	329.08	337.61	193.47	
	After 25 min.	1.387	20.28	49.71	2.99	13.61	49.03	294.37	298.16	215.45	
	After 30 min.	1.427	21.69	49.94	3.17	13.77	46.95	265.21	279.50	242.37	

Table (7) Freezing-Frying Effect on Mineral Content of Buffalo's Tongue
(mg./100 g. dry weight).

Treatment of Frying		Cu	Zn	Iron	Mn.	Ca	Mg	Sod.	K	P	
Freeze storage periods (months)	0	Control	1.357	31.387	21.32	3.07	8.00	29.70	781.06	516.96	150.82
		After 40 min.	1.397	31.760	21.33	3.17	8.11	30.68	701.57	492.77	156.88
		After 45 min.	1.450	34.393	21.44	3.28	8.16	34.19	674.09	464.02	170.10
		After 50 min.	1.493	35.133	21.49	3.41	8.23	32.17	632.01	431.53	193.16
	2 months	Control	1.327	28.103	20.13	2.83	6.57	28.14	545.42	417.73	100.70
		After 35 min.	1.373	28.140	20.32	2.86	6.61	28.96	501.37	398.98	103.84
		After 40 min.	1.400	28.543	20.41	2.94	6.93	30.68	489.25	367.03	135.74
		After 45 min.	1.430	29.093	20.45	3.02	7.01	29.03	427.35	329.94	149.74
	4 months	Control	1.287	26.353	19.39	2.58	5.27	25.88	320.93	373.31	89.81
		After 30 min.	1.313	26.530	19.45	2.62	5.38	26.64	303.05	343.90	99.13
		After 35 min.	1.347	27.620	19.51	2.65	5.48	29.72	291.23	317.01	122.41
		After 40 min.	1.397	27.883	19.69	2.71	5.63	28.32	277.76	298.73	135.93
6 months	Control	1.247	23.987	18.25	2.34	3.92	23.71	219.44	275.76	70.89	
	After 25 min.	1.270	24.107	18.37	2.36	3.88	24.93	194.65	253.82	77.44	
	After 30 min.	1.313	25.263	18.51	2.45	4.33	28.23	182.91	239.36	78.49	
	After 35 min.	1.343	25.697	18.61	2.51	4.63	26.37	160.51	204.78	92.85	

Table (8) Freezing-Frying Effect on Minerals Content of Buffalo's Brain
(mg./100 g. dry weight).

Treatment of Frying		Cu	Zn	Iron	Mn.	Ca	Mg	Sod.	K	P	
Freeze storage periods (months)	0	Control	0.998	36.257	18.81	1.280	8.457	34.87	877.54	579.41	395.75
		After 3 min.	1.004	36.577	18.80	1.290	8.472	46.64	846.76	539.46	402.62
		After 8 min.	1.023	37.860	18.86	1.350	8.949	49.72	810.99	509.90	416.73
		After 13 min.	1.050	38.697	18.89	1.420	9.235	47.79	792.19	471.63	440.01
	2 months	Control	0.893	33.867	17.63	1.170	7.168	32.59	608.08	391.36	328.85
		After 2 min.	0.904	34.780	17.68	1.250	7.243	44.25	580.39	376.21	349.57
		After 7 min.	0.916	35.903	17.76	1.330	7.291	46.98	556.44	352.95	366.82
		After 12 min.	0.938	36.160	17.81	1.380	7.997	45.74	513.08	340.42	382.66
	4 months	Control	0.875	31.100	16.66	0.949	5.414	29.86	538.84	301.85	293.84
		After 2 min.	0.886	30.900	17.43	0.986	5.487	40.77	512.35	283.85	302.67
		After 7 min.	0.894	32.300	17.50	1.038	5.537	45.01	481.16	270.57	323.69
		After 12 min.	0.908	34.230	17.55	1.393	5.975	42.20	462.36	250.18	385.91
6 months	Control	0.839	28.080	15.80	0.831	3.818	28.18	389.49	235.26	258.52	
	After 1 min.	0.856	28.563	16.58	0.849	3.863	37.12	365.76	214.17	277.91	
	After 6 min.	0.867	30.797	16.65	0.889	3.957	40.23	341.30	203.99	286.68	
	After 11 min.	0.875	32.793	16.69	0.950	4.119	38.26	315.30	191.61	318.75	