Retention of Minerals in Meat by Polyphosphate Ions

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Polyphosphate ions are added to meat and comminuted meat products to increase colour preservation, tenderness, binding, moisture retention and a decrease in microbial spoilage (Furia,1981)[1]. The levels of phosphate in meat is usually restricted by law because of the increase in water retention. On the other hand, phosphates can complex with metal ions (Halliday 1979)[2] due to their solubility in water. The aim of the experiments was to study the retention of metal ions in processed bovine meat with added phosphate.

Experimental

Portions of bovine carcass (T-bone and chuck steak) were minced separately and mixed for 10 minutes with sodium polyphosphate solutions. The final concentrations were 0.2, 0.3 and 0.5% polyphosphate as P_2O_5.

The samples were cooked by pan frying (200°C for 10 minutes). After drying (105°C,15 hrs) and wet ashing (sulphuric and nitric acid), the mineral content was determined (duplicate) by atomic absorption spectrophotometry.

Results and Discussions

Table 1. Chuck steak mineral retention (mean, n=2)
Added phosphate concentration (%)

Mineral mg/100g	Raw	0	0.2	0.3	0.5
		cooked			
Na	148	124	219	299	414
K	507	480	499	581	687
Fe	39	33	34	36	38
Ca	3.6	2.8	5.8	6.1	7.8
Mg	50	49	51	55	57

Table 2. T-bone Steak - mineral retention (mean, n=2)
Added phosphate concentration (%)

Mineral (mg/100g)	Raw	0	0.2	0.3	0.5
		cooked			
Na	148	120	172	304	416
K	549	541	664	750	711
Fe	32	30	31	34	32
Ca	48.5	39	51	57	52
Mg	53	50	54	62	66

Polyphosphate decreased the amount of exudate and moisture loss during cooking.

There was alarge range of concentrations of minerals in the meat samples. The sodium content varied in a direct relationship to the amount of added sodium polyphosphate (Tables 1 and 2). The control samples of chuck steak with no added polyphosphate lost more sodium potassium and calcium on cooking than the samples with added phosphate. Magnesium and iron remained unchanged.

The differences between raw, no phosphate and added phosphate samples of T-bone were not significant for iron. The majority of the iron is strongly bound to heme in meat tissue, so that unless protein is lost, iron is retained during processing and cooking. There was no significant different ($P > 0.05$) between the two higher levels of phosphate (0.3 and 0.5%) and the retention of calcium and magnesium in T-bone meat. Only calcium and potassium were retained significantly more with 0.5% than 0.3% phosphate in chuck steak ($P < 0.01$).

Many countries, including Australia, have Pure Food Acts which allow the use of polyphosphates at levels of no more than 0.3%[3] (as P_2O_5) and under present conditions this level not only retained the minerals potassium, iron, magnesium and calcium, but also enhanced colour, flavour and juiciness by water retention.

Further experiments would be of interest to study the retention of other water soluble nutrients in phosphate-treated meat such as B-vitamins.

Literature

1. Furia, T.E. "Handbook of Food Additives", 2nd ed. CRC Press, 1981.

2. Halliday, D.A. Process Biochemistry, October 1978, p.6.

3. Cassidy, J.P., Meat Processing, June 1977, p.45.