Animal Health Research Institute
Assiut Regional Laboratory

SODIUM AND POTASSIUM LEVELS IN IMPORTED FROZEN MACKEREL FISH AND MEAT MARKETED IN ASSIUT CITY

(With 1 Table and 1 Figure)

By

H. H. ESSA

(Received at 25/3/2003)

مستويات عنصري الصوديوم والبوتاسيوم فى أسماك الماكريل واللحوم المجمدة المستوردة بأسواق مدينة أسيوط

حمدي حسين عيسى

تم اجراء هذا البحث لتعيين مستوى عنصري الصوديوم والبوتاسيوم في اسماك الماكريل المجمدة المستوردة وكذلك اللحوم المجمدة المستوردة والتي تم جمعها من أسواق مدينة أسيوط. وقد تم جمع عدد ٩٠ عينة على فترات متفاوتة (٦٠ عينة من اسماك الماكريل المجمدة و ٣٠ عينة من اللحوم المجمدة) باستخدام جهاز الامتصاص الذرىAtomic absorption spectrophotometer. أوضحت نتائج التحليل الإحصائي للعينات المختبرة أن نسب وجود عنصر الصوديوم تتراوح ما بين ١٠،٠٠ -٦١،٤٠ ومتوسط القيمة ٢٣،١٦ (ميكروجرام/جرام وزن جاف) في أسماك الماكريل. بينما تتراوح مابين ٧،٠٧ - ١٥،١٦ ومتوسط القيمة ١٠،٧٣٧ (ميكروجرام/جرام وزن جاف) في اللحوم المجمدة. وأسفرت نتائج التحليل الإحصائي للعينات المختبرة عن وجود عنصر البوتاسيوم بنسبة تتراوح مابين ١٠،٢٧-٣٩،٣١ ومتوسط القيمة ١٨،٤٩ (ميكروجرام/جرام وزن جاف) في اسماك الماكريل بينما تتراوح مابين ٠،١٠٠ -١،١٤٦ ومتوسط القيمة ٠،٩١٠ (ميكروجرام/جرام وزن جاف) في اللحوم المجمدة وقد تم إيضاح الأهمية الصحية لكل عنصر على حدة وتأثير هذه العناصر على صحة الانسان.

SUMMARY

A total of 90 samples (60 imported frozen mackerel fish and 30 frozen meat samples) were collected from different markets at Assiut City. The samples were digested and prepared for measurement the level of sodium and potassium by using the Atomic absorption spectrophotometer. The obtained results revealed that the level of sodium ranged from 10.00 to 61.40 with a mean value of 23.16 and ranged from 7.07 to 15.16 with a mean value of 10.737 µg /g dry basis in

the examined imported frozen mackerel fish and frozen meat samples, respectively. However, the level of potassium ranged from 10.27 to 39.31 with a mean value of 18.49 μg/g dry basis, and ranged from 0.100 to 1.146 with a mean value 0.910 μg/g dry basis of examined imported frozen mackerel fish and frozen meat samples, respectively. Public health significance of sodium and potassium levels in the examined samples was discussed.

Key words: *Sodium, potassium, mackerel, meat.*

INTRODUCTION

Estimation of major elements in food of animal origin such imported frozen mackerel and frozen meat is of importance for the public health, and elevation of these elements in food reflect a hazard to consumers. Many researches published regarding the mineral content of imported frozen mackerel fish and frozen meat, have centered on the absence or presence of heavy metals, with very little attention being given to those minerals deemed essential for normal health (Hackney *et al.,* 1987). Several elements have been introduced into the environment of air, water and surface soil, which ultimately appear in the food chain as they are accumulated in plants and animals. Some of these elements are essential, while others are categorized as toxic metals (Ammerman *et al.,*1977; Doyle and Spaulding, 1978).

Variation in mineral levels in oysters due to processing and environmental factors, may cause problems in compliance (Federal Register, 1982 and Lopez *et al.,* 1983). Cooking fillets had higher sodium and potassium levels than the raw fillets when compared on a wet weight basis. Sodium and potassium were not lost when high fat Spanish mackerel were cooked (Gall *et al.,* 1983). However, in developing countries the sodium and potassium levels in ox meat were 61 and 350 mg/ 100 g wet weight, respectively (FAO, 1992).

Sodium, potassium and chlorine are the three major electrolytes in the body and function to maintain cation-anion balance. Sodium is the major extracellular (outside and between cells) cation, providing greater than 90% of the total cations in the plasma and, whereas potassium (K), the major intracellular (within cells) cations, provides approximatelly 75% of the total cations within the cells (Guyton, 1976; Berliner and Giebisch, 1979). When sodium (Na) intake is inadequate, the body has a remarkable capcity to conserve it, excreting extremely low levels in the

urine. High Na intake triggers greater excretion of Na and Cl by the kidneys and water needs increase. The human kidney may excrete as little as 1 g or as such as 40 g of NaCl per day, depending on intake (Hagsten and Perry, 1976).However, sodium and chlorine, in addition to potassium maintain osmotic pressure and regulate acid-base equilibrium. These electrolytes in body fluid are specifically involved at the cellular level in water metabolism nutrient uptake, and transmission of nerve impulses. Sodium has a major role in the transmission of nerve impulses, and in maintaining proper muscle and heart contractions. Sodium and chlorine help control the passage of nutrients into the cells and waste products out. Insufficient sodium lowers the utilization of digested protein and energy (Grim, 1980). Sodium is important for maintaining osmotic pressure in the body cells, and it is the major mineral responsible for maintaining a neutral pH level in the body tissues and nerve activity. Sodium deficiency may result in corneal lesions in the eye, as well as reproduction is also affected, with males becoming infertile and females having a delayed sexual maturity. Also, potassium affects the osmotic pressure and acid base balance of the body fluids, muscle activity and the digestion of carbohydrates, and it is essential for life (Gillespie, 1987).

Therefore, the elevation of mineral concentrations in animal tissues becomes of major importance with respect to both safety and adequancy for human nutrition, particularly as minerals are more readily available to man in the form of animal products, (Doornenbal and Murray, 1981).

MATERIALS and METHODS

I-Collection of samples:

A total of 90 imported samples including 60 frozen mackerel fish and 30 frozen meat were collected from Assiut City markets for determination of sodium and potassium levels.

II- Laboratory technique

Preparation of samples:

a) Digestion: The digestion of samples was carried out according to the technique outlined by Fahmy (1971) and Gajan and Larry (1972). One gram of dried sample, 5 ml of 50% sulphuric acid and 5 ml of concentrated nitric acid were added in clean dry Kjeldhal flask of 25-300 ml capcity. The flasks were heated gently over a low flame of a minor

burner until clear fumes of nitric and sulphuric acid appear, where the flame was turned off and the flasks allowed to cool. On reheating until the dark brown liquid formed in the flask gradually disappeared. Complete digestion is indicated by colourless of the liquid. Stronger heating was continued for sometime to drive off most of the nitric acid in the flasks. To hasten digestion, it was found better to use only 3 ml of the concentrated acid initially and then the other 2 ml were added after cooling.

b) Dilution: 10 ml Hcl N/10 were dissolved in 90 ml bidistilled water in volumetric glass cylinder to obtain 100 ml. About 50 ml of the prepared solution were added to the digested particles previously heated and cooled in a glass flasks. The mixture was agitated well for thorough mixing.

c) Filteration: The obtained mixture was filtered through a glass funnel containing filter paper, where the filtrate was collected in a glass cylinder. The obtained filtrate for every sample was put in two special glass vials, stoppered and preserved at refrigerator.

d) Measurement: The previously digested and filtrated samples were prepared for measurement the level of sodium and potassium in each sample by using the Atomic absorption spectrophotometer Perkin Elmer 2380.

The estimation of such trace elements under investigation in each examined sample was in μg/g on the basis of dry weight sample.

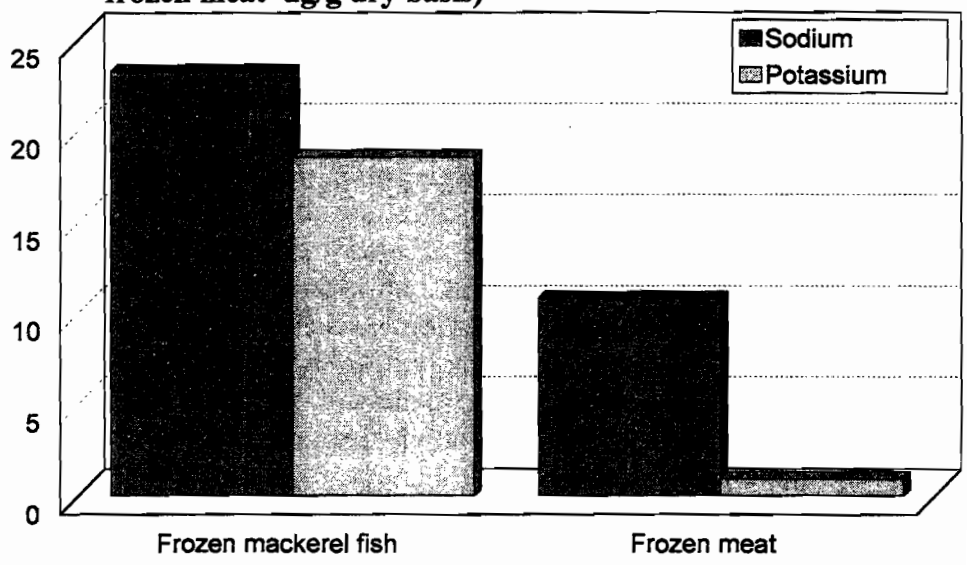
RESULTS

The obtained results recorded in Table 1.

Table 1: Statistical analytical results of sodium and potassium levels in imported frozen mackerel fish and frozen meat (μg/g dry basis)

Parameters	Frozen mackerel fish		Frozen meat	
	Sodium	Potassium	Sodium	Potassium
No. of samples	60	60	30	30
Minimum	10.00	10.27	7.07	0.100
Maximum	61.40	39.31	15.16	1.146
Mean	23.16	18.49	10.737	0.910
S. E.	± 1.51	± 0.85	± 0.336	± 0.033

Fig.1: Sodium and potassium levels in imported mackerel fish and frozen meat ug/g dry basis)



DISCUSSION

Although toxic metals are naturally present in the environment, industrial processes have resulted in an increased concentration of heavy metals in air, water and soil. Subsequently, these metals are taken in by plants and animals and make their way into the food chain. Several elements are known to be essential at low concentration, but at higher levels they are toxic.

The present study revealed that the mean values of sodium and potassium in the examined imported frozen mackerel fish were 23.16 and 18.49 μg/g, while they were 10.737 and 0.910 μg/g in the examined frozen meat on the basis of dry weight, respectively (Table 1). The obtained results were higher than the figures reported by Marchello *et al.* (1984) who mentioned that the sodium and potassium levels in longissimus muscle and ground beef were 0.54 and 3.13 and 0.6 and 2.1 μg/g dry basis respectively.

Higher sodium and potassium levels were recorded by Doornenbal and Murray (1981) who found that the mean values of sodium and potassium levels in the examined longissimus dorsi muscle, semimembranosus muscle and muscle of diaphragm were 494, 469 and

722 and 3750, 3730 and 3090 ppm on the basis of wet weight respectively.

The animal body contains approximately 0.2% of Na. Some of this amount is localized in the skeleton in an insoluble, rather inert form, but by far the larger proportion is found in the extracellular fluids where it undergoes a very active metabolism (Mcdowell, 1992). Chronic intakes of high levels of salt have been reported to raise blood pressure in some people, and low Na, high K diets are often recommended. A massive reduction program would be necessary to implement a large-scale reduction in salt intake (Battarbee and Meneely, 1978). However, salt humans deficiency is characterized by headaches, dizziness, fatigue, nausea, vomiting, muscle cramps, exhausion, collapse and even death.

Salt (NaCl) may be toxic when excessive quantities are ingested and water intake is limited. Sodium chloride toxicosis is characterized by increases in water consumption, anorexia, weight loss, odema, nervosuness, paralysis and death, (Mcdowell, 1992). On the other hand increase in dietary K (as the chloride salt) has been shown to decrease blood pressure in some hypertensive individuals (Luft, 1990). While, low Na and high K diet would decrease the development of cardio vascular disease (Rettig *et al.*, 1988).

REFERENCES

Ammerman, C.B.; Miller, S.M.; Flick, K.R. and Hansard, S.L. (1977): Contaminating elements in mineral supplements and their potential toxicity. A review J. Anim. Sci. 44: 485.

Battarbee, H.D. and Meneely, G.R. (1978): In Hand book Series in nutrition and food, section E. Nutrition Disorders Vol.1 (M. Rechcigl, Jr., ed.), P. 219. CRC press, West Palm Beach, Florida.

Berliner, R.W. and Giebisch, G. (1979): In Best and Taylor's physiological basis of medical practic (10 th Ed.) (J.R. Brodeck, ed.), Williams & Wilkins, Baltimor, Maryland.

Doornenbal, H. and Murray, A. C. (1981): Effects of age, breed, sex and muscle on certain mineral concentrations in cattle. J. Food Sci. 47: 55-58.

Doyle, J.J. and Spaulding, J.E. (1978): Toxic and essential trace elements in meat. A review. J. Anim. Sci. 47: 398.

Fahmy, F. (1971): Studies on factor affecting copper level in Egyptian sheep. Ph.D. Thesis, Vet. Med. Cairo University. Egypt.

FAO (1992): Meat and meat products in human nutrition in developing countries.53, 72.

Federal Register (1982): Food labeling declaration of sodium content of foods and label claims for food on the basis of sodium content. 21 CFR 101 and 105. 47: 26580. U.S. Govern. Print off., Washington, D. C.

Gajan, R.J. and Larry, D. (1972): Determination of lead in fish by Atomic absorption spectrophotometry and by polarography. Development of method. J. Assoc. off Anal. Chem. 55-127.

Gall, K.L.; Otwell, W.S.; Koburger, J.A. and Appledorf, H. (1983): Effect of four cooking methods on the proximate, mineral and fatty acid composition of fish fillets. J. Food Sci., vol.48: 1068-1074.

Grim, E. (1980): In sodium in medicine and health (C.Moses, ed.), P.H. Reese press, Baltimore, Maryland.

Guyton, A.C. (1976): Text book of medical physiology 5th Ed. W.B. Saunders, Philadelphia, Pennsylvania.

Hackney, C.R.; Blede, S.L.; Arbour, P.; Reily, L.; Kilgen, M. and Cole, M. (1987): Variation in the levels of sodium and other minerals of nutritional importance in Louisiana oysters (Crassostree Virginica). J. Food. Sci., 52 (4): 1099-1100.

Hagsten, I. and Perry, T. W. (1976): J. Anim. Sci. 42, 1187.(cited in Mcdoweel,1992).

Gillespie, R.J. (1987): Animal nutrition and feeding. Delmar publishers Inc. 2 Computer Drive West, Box 15-015 Albany, Ny 12212-9985.

Lopez, A.; Ward, D.R. and Williams, H.L. (1983): Essential elements in oysters (Crassostrea Virginica) as affected by processing method. J.Food Sci. 48: 1680.

Luft, F.C. (1990): Present knowledge in nutrition, chapter 26 (M. L.Brown, ed.) p. 233. Nutrition Foundation, Washington, D. C.

Marchello, M.J.; Milone, D.B. and Slanger, W.D. (1984): Selected macro and micro minerals in ground beef and longissimus muscle. Journal of food science 49, 105-106.

Mcdoweel, L.R. (1992): Minerals in animal and human nutrition. Academic press, Inc. 78-97.

Retting, R.; Ganten, D. and Luft, F.C. (1988): Salt and hypertension. Springer Verlag, Berlin, Germany.