PHOSPHORUS, SODIUM, POTASSIUM IN CEREALS AND THEIR PRODUCTS BEEN PRODUCED AND CONSUMED IN GREECE

Submitted by Chatzipavlou Maria

A thesis submitted in partial fulfilment of the requirements for the degree of Master Science in Food Technology

Supervised by: Dr. Bratakos M.

UNIVERSITY OF LINCOLNSHIRE AND HUMBERSIDE
SCHOOL OF APPLIED SCIENCE AND TECHNOLOGY

SEPTEMBER 1996
Στοὺς γόνείς μου
ACKNOWLEDGEMENTS

Firstly, I would like to thank my supervisor Dr. Bratakos, M. for his help during the laboratory work and especially during the last months, while I was writing this thesis. His presence was a solution to the problems I had to tackle constructing my project. He is a very good scientist as well as a very good person and I hope that I was not a difficult student for him.

I would also like to acknowledge the head of Analysis laboratory, Mr. Tzima, for his continuous moral support, as well as the librarians in Humberside University for their invaluable help.

I would like to thanks a very good friend, Tasos Michalakopoulos, for his constant help in this year. I very much appreciate his help.

I also want to refer to Kostas Karalis who was really helpful to me during the months in England and he turned out to be a good friend.

My special thanks to my parents and parents in law for their encouragement and moral help, and especially to my father, for his continuous instigation

Finally, I would like to thanks a special person of my life who was an inspiration for this Masters and it was his invaluable support and help that made this Masters a reality. Deeply from my hurt I would like to say a big thank you to my fiancee Takis Angelopoulos.
CONTENTS

Acknowledgements

Contents i

Summary 1

CHAPTER 1.

1.1 PHOSPHORUS 1

1.1.1 Chemical Properties 1

1.1.2 Forms in Foods 3

1.1.3 Distribution 4

1.1.4 Functions 4

1.1.5 Absorption 5

1.1.6 Phosphate in Health and Disease 7

1.1.7 Dietary sources 10

1.1.8 Recommended Dietary Allowance 11

1.1.9 Deficiency 11

1.1.10 Chemical analysis of Phosphorus 12

1.2 SODIUM 13

1.2.1 Chemical properties 13

1.2.2 Distribution 13

1.2.3 Functions 14

1.2.4 Absorption 15

1.2.5 Dietary sources 16
2.3.1 General principle of flame photometry. 33
2.3.2 Reagents. 34
2.3.3 Material and Apparatus. 34
2.3.4 Preparation of Standard Curve 35
2.4 Flame Photometric Method for K. 37
2.4.1 General principle of flamephotometry. 37
2.4.2 Reagents 37
2.4.3 Material and Apparatus. 38
2.4.4 Preparation of Standard Curve. 38
2.5 Sample Collection and Preparation. 40
2.6 Wet digestion. 41
2.7 Reliability of method. 42

CHAPTER 3. 46

3. Results and discussion. 46
3.1 Results of mineral (Na, K, P) analysis of 31 grain and grain products 46
3.2 Comparison of mineral (Na, K, P) analysis values between analysed samples and other countries 49
3.3 Figures. 55

CHAPTER 4. 59

4. Dietary intake of Phosphorus, Potassium and Sodium of grain and grain products. 59
Phosphorus, sodium and potassium are important to human nutrition. In this work the content of these minerals in cereal grains and products has been determined. Phosphorus is an essential component of nucleic acids, DNA and RNA, and thus makes it necessary growth. Sodium is the most important cation because it dictates the volume of extracellular fluid (ECF) and its concentration affects osmotic concentration of both ECF and intracellular fluid (ICF). Moreover, it keeps the neutrality of the body while it reacts with elements with acidic reactions. Sodium is also essential for glucose absorption and transportation of nutrients through the membranes [Macrae, 1993; Agelikakis, 1990]. Potassium is characterised by its multifunctionality, affecting functions of the cardiovascular digestive, digestive, endocrine, respiratory, renal and neurological systems. It is a cofactor for enzymes involved in carbohydrate storage, energy transaction, cellular growth and others.[Macrae,1993].

Thirty one different grain and grain products, were tested by spectrophotometric molybdovanadate method, for phosphorus content and flame photometric method for sodium and potassium content. All values are expressed in mg/100gr. of food and are given as the arithmetic mean of samples ± standard deviation. Also, it must be mentioned that deionized distilled water, was used for cleaning and preparation of the samples. Mineral (P, Na, K) values of analysed samples of cereal grains and products were compared with literature values of other countries (USA, Finland, India, Malawi, Papua-New Guinea, Australia).
It was found that rich sources of phosphorus are grain seeds and wholemeal bread; of sodium grain seeds and grain products, (mainly due to the bread) and biscuits; of potassium grain seeds, bread made with yeast, grain products with chocolate, frumenty and corn flakes.

The mean daily elements (P, Na, K) intake (gr./adult/day) of total cereal consumption (gr./adult/day) when compared for the two five-year periods, 1980-1985 and 1985-1990, it resumes that there is a slight increase of phosphorus, sodium and potassium intake. Moreover, the average cereal consumption (Kg/year/capita) in Greece, during the period 1951-1985 decreases, whereas there is a slight increase for the last five-year period 1985-1990.

Phosphorus, sodium and potassium intake of flour, cereals, bread, rice, pasta and rusks form the 65.86%, 153% and 27.16% of the RDA and low end of ESADDIs, respectively.