ABOUT IJNAM

The International Journal of Nutrition and Metabolism (IJNAM) is published monthly (one volume per year) by Academic Journals.

International Journal of Nutrition and Metabolism (IJNAM) is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as Thermic effect of food, Anthropogenic metabolism, calorimetry, flavonoids etc.

Submission of Manuscript

Submit manuscripts as e-mail attachment to the Editorial Office at: ijnam@academicjournals.org. A manuscript number will be mailed to the corresponding author shortly after submission.

The International Journal of Nutrition and Metabolism will only accept manuscripts submitted as e-mail attachments.

Please read the Instructions for Authors before submitting your manuscript. The manuscript files should be given the last name of the first author.
Editors

Dr. Mohamed Fawzy Ramadan Hassanien,
Biochemistry Department,
Faculty of Agriculture,
Zagazig University,
Egypt.

Dr. Ahmed Mohamed El-Waziry,
Alexandria University,
Faculty of Agriculture,
Dept. of Animal Production,
Egypt.

Prof. Bechan Sharma,
Visiting Professor of Biochemistry,
Christopher S. Bond Life Science Center,
Department of Microbiology and Immunology,
University of Missouri-Columbia,
1210 Rollins Street,
Columbia 65201,
USA.

Prof. Malay Chatterjee,
Jadavpur University, Kolkata,
India.

Dr. Wei Wang,
School of Public Health and Family Medicine,
Capital Medical University,
China.

Dr. Kedar Nath Mohanta,
ICAR Research Complex for Goa,
Goa.

Dr. Birinchi Kumar Sarma,
Banaras Hindu University,
Varanasi,
India.
Editorial Board

Prof. Alonzo A. Gabriel
University of the Philippines,
Diliman, Quezon City
Philippines.

Dr. Michael Elliott
Washington University in St. Louis,
USA.

Prof. Satyesh Chandra Roy,
University of Calcutta,
India.

Dr. Hena Yasmin
University of Swaziland,
Swaziland.

Dr. Neveen B. Talaat
Department of Plant Physiology,
Faculty of Agriculture,
Cairo University,
Egypt.

Dr. V. Sivajothi
karpagam college of pharmacy
othakkalmandapam, coimbatore,
Tamilnadu,
India.

Dr. M. Manjoro Nee Mwale,
University of Fort Hare,
South Africa.

Dr. Adewumi, Gbenga Adedeji,
University Of Lagos, Akoka,
Lagos,
Nigeria.

Dr. Iheanyi O. Okonko,
University of Ibadan,
Ibadan,
Nigeria.

Dr. Ashok Kumar Tiwari,
Indian Institute of Chemical Technology,
India.

Dr. Mukund Adsul,
National Chemical Laboratory, Pune,
India.

Dr. Fengdi Ji,
Beijing Institute of Food & Brewing,
China.

Dr. Charles Tortoe,
CSIR-Food Research Institute,
Ghana.

Dr. Mridula Devi,
Food Grains and Oilseeds Processing Division,
Central Institute of Post Harvest Engineering and Technology (CIPEHT),
Ludhiana-141 004, (Punjab),
India.

Dr. Faiyaz Ahmed,
DOS in Food Science and Nutrition,
University of Mysore,
India.

Dr. Samie A,
University of Venda,
South Africa.

Dr. Giampaolo Papi,
Department of Internal Medicine,
Azienda USL Modena,
Italy.

Ahmad Taher Azar,
Institution Modern Science and Arts University (MSA),
6th of October City,
Egypt.

Dr. T. Poongodi Vijayakumar,
Department of Food Science,
Periyar University,
Salem, Tamil Nadu,
India.

Dr. Radhakrishnan Ramaraj,
University of Arizona,
Cedars Sinai Hospital 1501 N Campbell Avenue Tucson, AZ 85724,
United States.

Dr. Chaman Farzana,
Mount Carmel college, Bangalore,
India.

Dr. Hesham Mahyoub Al-Mekhlafi,
University of Malaya,
Malaysia.

Dr. Amal Ahmed Ali Abdul-Aziz,
National Research Center,
Textile Devision,
Egypt.
Instructions for Author

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

The cover letter should include the corresponding author's full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author's surname, as an attachment.

Article Types
Three types of manuscripts may be submitted:

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly.

Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process
All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Authors cannot nominate reviewers. Only reviewers randomly selected from our database with specialization in the subject area will be contacted to evaluate the manuscripts. The process will be blind review.

Decisions will be made as rapidly as possible, and the journal strives to return reviewers’ comments to authors as fast as possible. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the UNAM to publish manuscripts within 12 weeks after submission.

Regular articles
All portions of the manuscript must be typed double-spaced and all pages numbered starting from the title page.

The Title should be a brief phrase describing the contents of the paper. The Title Page should include the authors' full names and affiliations, the name of the corresponding author along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The Abstract should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 10 key words that will provide indexing references should be listed.

A list of non-standard Abbreviations should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Authors should use the solidus presentation (mg/ml). Standard abbreviations (such as ATP and DNA) need not be defined.

The Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.
**Results** should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors’ experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section.

The **Discussion** should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The **Acknowledgments** of people, grants, funds, etc should be brief.

**Tables** should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

**Figure legends** should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or Powerpoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

**References**: In the text, a reference identified by means of an author’s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author’s name should be mentioned, followed by ‘et al’. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ‘a’ and ‘b’ after the date to distinguish the works.

Examples:

Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001)

References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

Examples:


Short Communications

Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 100 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.
Fees and Charges: Authors are required to pay a $550 handling fee. Publication of an article in the International Journal of Nutrition and Metabolism is not contingent upon the author's ability to pay the charges. Neither is acceptance to pay the handling fee a guarantee that the paper will be accepted for publication. Authors may still request (in advance) that the editorial office waive some of the handling fee under special circumstances.

Copyright: © 2014, Academic Journals
All rights Reserved. In accessing this journal, you agree that you will access the contents for your own personal use but not for any commercial use. Any use and or copies of this Journal in whole or in part must include the customary bibliographic citation, including author attribution, date and article title.

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

Disclaimer of Warranties

In no event shall Academic Journals be liable for any special, incidental, indirect, or consequential damages of any kind arising out of or in connection with the use of the articles or other material derived from the IJNAM, whether or not advised of the possibility of damage, and on any theory of liability.

This publication is provided “as is” without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications does not imply endorsement of that product or publication. While every effort is made by Academic Journals to see that no inaccurate or misleading data, opinion or statements appear in this publication, they wish to make it clear that the data and opinions appearing in the articles and advertisements herein are the responsibility of the contributor or advertiser concerned. Academic Journals makes no warranty of any kind, either express or implied, regarding the quality, accuracy, availability, or validity of the data or information in this publication or of any other publication to which it may be linked.
ARTICLES

Research Articles

**Triglyceride lowering by chromium picolinate in type 2 diabetic people**  
Elizabeth Joseph, Robert DiSilvestro and Esperanza J. Carcache de Blanco  
Page 24

**Malnutrition in Albania, related problems and flour fortification as a solution**  
Pellumb Pipero, Gazmend Bejtja, Klodian Rjepaj, Ehadu Mersini, Mario Pipero and Alban Ylli  
Page 29
Short Communication

Triglyceride lowering by chromium picolinate in type 2 diabetic people

Elizabeth Joseph¹, Robert DiSilvestro¹* and Esperanza J. Carcache de Blanco²

¹Human Nutrition, The Ohio State University, Columbus, OH, USA.
²Pharmacy Practice and Administration, The Ohio State University, Columbus, OH, USA.

Received 20 July, 2012; Accepted 29 December, 2014

In some studies in diabetic people, chromium picolinate supplementation has lowered readings for both plasma triglycerides and blood sugar. In the present study, relatively low dose supplementation (200 µg chromium) did not lower blood sugar readings, but did lower triglyceride values in people with the following characteristics: type 2 diabetes, moderately elevated blood sugar, and not using insulin therapy. These results support the supposition that chromium picolinate can affect triglyceride concentrations independently of effects on carbohydrate metabolism.

Key words: Chromium, diabetes, triglycerides.

INTRODUCTION

Chromium (Cr) is a trace element that can affect carbohydrate, lipid, and protein metabolism (Anderson, 1998a; Evans, 1989). Cr supplementation can affect blood glucose, total cholesterol, HDL and triglycerides in some circumstances (Abdollahi et al., 2013; Anderson et al., 1997; Cefalu and Hu, 2004; Heimbach and Anderson, 2005; Morris et al., 1999). This has led to classifying Cr as an essential nutrient (Anderson, 1998b), though others have suggested that Cr acts only as a drug in some unhealthy situations (Vincent, 2013). One argument against the essential nutrient role has been a lack of consistent positive effects of Cr supplementation in healthy people (Masharani et al., 2012). A counter argument states that Cr supplementation will not have such effects in all healthy people, but only in people with at least a moderate Cr deficiency. However, no accurate method for evaluating Cr status has been verified (DiSilvestro, 2005).

In people with diabetes, Cr supplementation has produced a decrease in fasting blood glucose values (Abdollahi et al., 2013; Bahijiri et al., 2000; Geohas et al., 2007; Pei et al., 2006; Rabinovitz et al., 2004). However, in other studies, Cr fails to affect blood glucose values (Abdollahi et al., 2013; Lee and Reasner, 1994; Preuss et al., 2000; Uusitupa et al., 1983). If Cr does indeed function as an essential nutrient, these variations could arise due to variations in the subjects’ Cr status. If Cr acts solely as a drug, then the variations would depend on other factors. There have also been studies examining the effect of Cr on triglyceride levels in humans. A number of studies show a decrease in triglyceride values while also showing improved glucose control (Bahijiri et
Subjects Biomedical Institutional Review Board. All subjects signed an Institutional Review Board (IRB) approved consent form. Adult males and non pregnant females were recruited from in and around Columbus, Ohio and Wooster/Canton, Ohio. Subjects fit the following inclusion criteria:

1. Age 40-60 years old,
2. Physician confirmed type 2 diabetes.
3. Glycosylated hemoglobin (HbA1c) greater than 7.0%,
4. Fasting plasma glucose between 7.6 and 10 mmol/L,
5. No use of insulin,
6. Body mass index (BMI) between 25 and 35,
7. Non-smoking,
8. No intake history of Cr supplementation within the last 3 months,
9. No major health problems other than type 2 diabetes.

Conformance to these criteria was based on answers to an eligibility questionnaire.

Research design
Subjects were randomly assigned to one of two groups:

1. Placebo (starch capsules).
2. Cr picolinate (200 µg Cr/day/1 capsule) supplied by Kelatron Corporation of Ogden, UT, USA.

Neither the subjects nor the person giving the supplements knew the group assignment. Subjects were instructed to maintain their previous dietary and exercise practices during participation. Subjects consumed the assigned product for 8 weeks and had blood samples taken before and after the supplementation period. Each sampling followed an overnight fast.

Blood analysis
Blood was collected by venipuncture into heparinized tubes. The tubes were centrifuged for approximately 10 min at 3000 rpm. Plasma was removed and stored at -70°C. Plasma glucose and triglycerides was assessed using the Roche Cobas C111 Clinical Chemistry Analyzer (Indianapolis, Indiana, USA).

RESULTS
Subject characteristics are noted in Table 1. Neither Cr supplementation nor placebo affected plasma glucose readings (Table 1). Cr supplementation, but not placebo, lowered plasma triglyceride values (Figure 1). The mean change in triglyceride values for the Cr group was significantly different than the change in the placebo group (Figure 2). In fact, in the placebo group, the mean value increased. Power values for the Cr matched samples, as well as the change comparison between groups, were over 0.99 for p < 0.05, two sided test. Plasma cholesterol values [total, high density lipoprotein (HDL) and low density lipoprotein (LDL)] were unchanged by either placebo or Cr (data not shown).

---

### Table 1. Subject characteristics.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Placebo</th>
<th>Chromium picolinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>6 M and 6 F</td>
<td>5 M and 5 F</td>
</tr>
<tr>
<td>Age</td>
<td>56 ± 3</td>
<td>56 ± 4</td>
</tr>
<tr>
<td>BMI</td>
<td>35 ± 1</td>
<td>31 ± 1</td>
</tr>
<tr>
<td>Pre glu</td>
<td>123 ± 8</td>
<td>133 ± 10</td>
</tr>
<tr>
<td>Post glu</td>
<td>147 ± 13</td>
<td>132 ± 7</td>
</tr>
<tr>
<td>Pre Tg</td>
<td>117 ± 7.6</td>
<td>121 ± 7.6</td>
</tr>
<tr>
<td>Post Tg</td>
<td>129 ± 9.6</td>
<td>106 ± 5.7</td>
</tr>
</tbody>
</table>

al., 2000; Geohas et al., 2007; Rabinovitz et al., 2004). These results reinforce an earlier proposed concept that Cr effects on lipid metabolism are mediated by effects on carbohydrate metabolism (Mertz, 1993). In contrast to this concept, in one human study, blood glucose readings are unchanged, but triglyceride values decrease (Lee and Reasner, 1994). Such a result suggests that Cr could affect lipid metabolism through either drug or nutritional mechanisms that go beyond modulation of carbohydrate metabolism. In this study lowering triglyceride but not glucose values, the study subjects had the following characteristics:

a) Mainly a US Hispanic population,
b) Diabetic people with fairly high fasting glucose values,
c) People using insulin injections and/or oral glucose-lowering drugs.

It needs to be determined if in other types of subjects, Cr supplementation can lower triglyceride concentrations without lowering glucose levels. Moreover, such additional studies should modify one protocol detail of the previous study. That study only compared post supplement values to post placebo values. New studies should also look at changes pre-to post-treatment with Cr or placebo. The present study did this for type 2 diabetic subjects who had the following characteristics:

a) Live in the central Ohio area,
b) Have just moderately elevated glucose levels,
c) Do not take insulin injections.

This new study examined the same dose, intervention time, and Cr complex as the previous work where Cr affected readings for triglycerides, but not blood sugar (Lee and Reasner, 1994).

**MATERIALS AND METHODS**

**Subjects**

The protocol was approved by The Ohio State University Human...
Figure 1. Plasma triglyceride values pre- and post-treatment (8 wk) with placebo or chromium picolinate (Cr). Data are mg/dl plasma ± SEM.
*Significantly different from pre-treatment values (P < 0.05, paired t test).

Figure 2. Change in plasma triglyceride values after placebo or chromium (Cr) supplementation. Data are the difference post- minus pre-treatment in mg/dl plasma ± SEM.
*Significantly different from placebo by unpaired t-test (p = 0.01).
DISCUSSION

A number of studies in diabetic subjects have reported that Cr supplementation improves glucose status and decreases plasma triglycerides (Bahijiri et al., 2000; Geohas et al., 2007; Rabinovitz et al., 2004). However, not all studies on Cr supplementation in diabetic subjects show an effect on glucose status. Most of these studies do not look at triglyceride readings. On the other hand, one study has shown a decrease in triglyceride values without a change in blood glucose values (Lee and Reasner, 1994). This study was done in a US Hispanic type 2 diabetic population with fairly high fasting glucose values. Some of the subjects in the study had enough problem with controlling blood sugar that they were using insulin injections to try to treat the problem. The present study demonstrated that in subjects with moderately elevated blood glucose, and who were not using insulin injections, Cr supplementation can lower triglyceride concentrations without lowering glucose levels. The subjects studied here were recruited from a typical USA mid-western diabetic population. Thus, the results of this study expand on the previous study. Taken together, the two studies indicate that Cr supplementation can impact lipid metabolism via mechanisms not directly related to carbohydrate metabolism.

Since plasma cholesterol concentrations were not changed by Cr, Cr would seem to affect this aspect of lipid metabolism via different mechanisms than the effects of triglyceride metabolism. Any Cr effects on cholesterol may be tied more directly to the effects on carbohydrate metabolism, which appeared to not occur in the present study. It is not yet certain why Cr supplementation impacts blood glucose related parameters in some studies but not others (DiSilvestro, 2005). Cr dose does not appear to be the only factor, though the dose used in the present study falls in the lower end of what has been used in diabetes studies (DiSilvestro, 2005). In the present study, the mean percent decrease in triglyceride values in the Cr picolinate group was not especially large (15%). However, in this study group, the mean initial triglyceride value was not extremely high. A larger decrease might occur when diabetics have a high starting blood triglyceride level. It is also possible that a higher Cr dose than used here might produce a bigger response.

It is not yet possible to determine whether the Cr dose used here worked by correcting some degree of deficiency or via a pharmacological effect. Unfortunately, a good means of assessing Cr status has not yet emerged (DiSilvestro, 2005). The present study’s dose, 200 µg/day, is the upper end of what was established in 1989 as the estimated safe and adequate daily dietary intake range for Cr (National Research Council, Food and Nutrition Board, 1989). On the other hand, as noted earlier, this dose falls at the lowest end of what typically has been employed in diabetes studies (DiSilvestro, 2005). It is difficult to relate the current study’s dose to a dietary Cr requirement for four reasons. One, no recommended dietary allowance has been established yet for healthy people (Institute of Medicine, Food and Nutrition Board, 2001). Two, the possibility that diabetes raises Cr needs has not been ruled in or out yet. Third, if some degree of Cr deficiency does commonly exist in people with type 2 diabetes, a corrective action may temporarily require giving a dose above the normal requirement. Four, Cr has been suggested to not even be an essential nutrient for humans (Vincent, 2013).

Lipidemia in diabetic populations presents a major risk for heart disease (Vijayaraghavan, 2010). Controlling triglyceride level with an inexpensive Cr supplement could decrease this risk. The current study showed that a Cr effect on triglycerides can occur without affecting blood glucose values, and without extreme conditions such as very high triglyceride readings or extremely poor glucose control.

ACKNOWLEDGEMENTS

The authors thank Karen Myers, RN, for logistical arrangements for the blood draws done in Wooster.

Conflict of interest

The authors declare that there are no conflicts of interest.

REFERENCES


Short Communication

Malnutrition in Albania, related problems and flour fortification as a solution

Pellumb Pipero¹*, Gazmend Bejtja², Klodian Rjepaj², Ehadu Mersini⁴, Mario Pipero⁵ and Alban Ylli⁶

¹Faculty of Medicine, University Hospital Center “M. Theresa”, Tirana, Albania.
²Ministry of Health of Albania, Albania.
⁴Faculty of Public Health, University of Debrecen, Hungary.
⁵Institute of Public Health, Tirana, Albania.

Received 29 August, 2014; Accepted 9 January, 2015

Micronutrient deficiencies are caused mainly by an inadequate intake of vitamins and minerals, as a consequence of an unbalanced diet composed mostly of carbohydrates in the conditions of poverty, the inability to take a variety of nutrients, the lack of knowledge on the most appropriate feeding practices and the relatively high incidence of infectious diseases. From a public health perspective, the importance of these deficiencies depends on the magnitude of their impact on health, especially among pregnant women, infants and children, given the consequences in the development of the fetus, in the growth of the child, the resistance to infections and the work performance later during the adult life. According the Albanian Demographic Health Survey (ADHS) 2008 to 2009, conducted jointly by the Albanian Institute of Public Health (IPH) and the National Institute of Statistics (INSTAT), the nutrition status of the Albanian population indicates amongst many other characteristic, that anemia prevalence is highest among children living in mountainous areas, coastal areas and rural areas, respectively. In addition, 19% of women have anemia with the highest prevalence in breastfeeding women and those living in rural areas. Therefore this study aims at evaluating the cost-effective analysis of interventions targeting malnutrition in Albania and how to improve them especially through flour fortification.

Key words: Malnutrition, micronutrients, vitamins, minerals, deficiency, fortification, Albania.

INTRODUCTION

Malnutrition, including undernutrition and overnutrition, and the interconnected physical and mental development, is a worldwide concern, still more pronounced in the developing countries. As such, nutrition is indispensably the cornerstone of the development agenda both at local policy level and international aid and cooperation level.

The elaboration of the thesis for further actions is based on analysis of the public health situation in the country, available scientific evidence, expert opinions and recommendations supported and endorsed by World
Health Organization (WHO), United Nations International Children Education Fund (UNICEF), Food and Agricultural Organization (FAO), Food Fortification Initiative (FFI), and a cost-effective analysis of the interventions targeting malnutrition in Albania. It reflects the position of the public health experts and is addressed to the food industry, the flour industry and all policymakers and decision-makers involved in designing and implementing a Programme of Flour Fortification in Albania (Jack, 2010; Oakley and Tulchinsky, 2010). The core recommendations stand on the type and the quantities of vitamins and minerals that should be added intentionally to the flour derived from wheat, in order to raise the intake of micronutrients and reduce the prevalence of micronutrient-related deficiencies in the population, considering it as a public health intervention (Jack, 2010; Stevens et al., 2011).

METHODOLOGY

Data from baseline assessments, follow-up assessments and evaluations within the framework of the National Project “Reducing malnutrition among children in Albania”, supported jointly by United Nation Agencies (UNICEF, FAO, WHO), were used in the elaboration of the thesis. Following the findings of the Albanian Demographic Health Survey (ADHS) 2008 to 2009 and the public health profile of the country, indicating that residents in mountainous and rural areas suffer more than residents in other areas of the country from anemia, wasting, stunting, mental disorders, immunodeficiency, infectious diseases, late stages of various diseases, further exploring studies were conducted during 2010, to better understand the reasons and the situation of anemia in the rural and mountainous regions of Kukes and Shkodra and two suburban areas of Tirana (the capital city).

RESULTS

Iron deficiency anemia

1. This includes 30% of children less than five years of age had anemia. The anemia prevalence was higher among children under five years of age living in the suburban areas of Tirana.
2. 29% of school age children had anemia. The highest level of anemia among school children was found among children in the northwestern region of Shkodra (42.9%).
3. 42.6% of women of reproductive age had anemia. The highest level of anemia among women of reproductive age was found in the northern region of Kukes (57.1%).

Neural tube defects, as a consequence of the lack or insufficiency of the intake of folic acid before and during the first weeks of pregnancy, are manifested as spina bifida, anencephaly, or encephalocele:

1. The incidence at country level: 1.07 cases per 1000 live births.
2. The incidence in Tirana: 2.1 cases per 1000 live births.
3. The proportional mortality from neural tube defects: 17% of the total deaths among population 0 to 1 years of age (Jack, 2010).

DISCUSSION

Taking into consideration the findings of the aforesaid studies and based on the WHO classification of the magnitude of anemia, considering anemia levels 5 to 19.9% as an intermediate public health problem, and anemia level 20 to 39.9% as a serious public health problem, a group of Albanian public health professionals and clinicians concluded that malnutrition related to micronutrient deficiencies should be considered a public health problem in Albania and that an action plan is paramount. According to the Document of Consensus of Copenhagen (2008), some of the most cost-effective measures for reducing malnutrition are:

1. Fortification of food with microelements such as iron, iodine, etc.
2. Supplements of micronutrient to children such as Vitamin A, zinc, etc.
4. Nutrition programs at community level.
5. Parasite control programs as school level.

A cost-effectiveness study conducted under the National Project “Reducing malnutrition among children in Albania” showed that the economic impact of malnutrition in the country accounts for 107 million USD or 1% of gross domestic product (GDP). Around 2/3 of the population could be protected from the effects of iron and folic acid deficiencies through the implementation of a programme of flour fortification. The cost of the fortifying premix is calculated at 2 USD for 1 ton of flour (0.2 Albanian Lek*/kg) and the cost per person at 0.07 Albanian Lek/person/day.

Flour fortification is considered as one of the most successful long-term strategies for the elimination of iron, folic acid, and vitamin B12 deficiencies and their related health consequences, because of the following strategic advantages:

1. It is consumed by all social economic strata of the population, including low-income groups which are more likely of being at risk of malnutrition;
2. It is not costly and provides one of the most cost-effective means for covering large populations at risk;
3. It can be distributed throughout the country, accessible by target groups;
4. It is consumed daily and in constant quantities contributing to one’s physiologic needs for micronutrients;
5. It can be processed in large quantities, allowing for the controlled fortification;
6. It does not change the organoleptic qualities of flour, such as appearance, taste, color;
7. It is stable despite the minimal interaction with the fortification micronutrients, preserving the right concentration of nutrients following further processes and cooking;
8. It is safe because the low dose of micronutrients cannot lead to any accidental overdose of the fortification micronutrients;
9. It is socially acceptable because it doesn’t require any change in the dietary habits;
10. It is sustainable because it is a market-based strategy.

Flour fortification is based on fundamental public health principles aiming at the effective and safe prevention of mineral and vitamin deficiencies within a population. The world experience tells us that 65 countries in the world have in place obligatory flour fortification legislation with at least two micronutrients: iron and folic acid. The selection of flour fortification micronutrients is based on the compromise between reasonable cost, fortificant bioavailability and the acceptance of any organoleptic changes, assuring the safety of the product.

The following recommendations focus on selected micronutrients whose intake is deficient by the Albanian population and that offer the possibility for inclusion in a national flour fortification programme (MOH-MDGIF-UN, 2011; John, 1998).

### Iron

Iron is essential for the physical and mental health of the pregnant women and children as well as for the physical activity and the work productivity at all ages. The timely treatment of iron deficiency is associated with health improvements and a 20% increase of the work productivity at national level (WHO, 2009). There is solid scientific evidence on the daily-recommended supplementary quantity of iron that is associated with an improvement of the iron sufficiency at the population level. Based on the individual daily flour consumption, there are 4 regimens of flour fortification. Iron as NaFeEDTA is recommended for the fortification of the flour that is rich in phytates because it is 2 to 3 times more bioavailable compared to other iron compounds. It does not accelerate the process of the flour turning rancid if stored for a long time. Based on the consensus statement of the joint group of experts of WHO, FAO, UNICEF, Global Alliance for Improved Nutrition (GAIN), The Micronutrient Initiative (MI) and FFI and based on:

1. The average flour consumption rate in the Albanian population: 360 gram per person per day;
2. The flour extraction rate: high (about 70%);
3. The fortification formulation: NaFeEDTA.

The average dose of the supplemented iron is recommended at 15 ppm.

### Folic acid

Folic acid is one of the most important micronutrients needed for the development of the human being. The intake of sufficient quantities of folic acid by pregnant women prior to conception reduces by 50% the number of neural tube defects at infants. Actually, around 22,000 neural tube defects are prevented through the flour fortification with folic acid. Based on the consensus statement of the joint group of experts of WHO, FAO, UNICEF, GAIN-MI and FFI, folic acid as foliate form is recommended for flour fortification and the average dose of the supplemented folic acid is 1.0 ppm.

### Vitamin B12 (cobalamin)

Cereal does not contain vitamin B12, which is present only in animal products. Vitamin B12 deficiency is encountered at all ages in developing countries and mostly among the elderly population. The deficiency of vitamin B12 can lead to anemia, neurological disorders, cognitive disorders, negative pregnancy outcomes and damages of the bone mineralization among other consequences. Evidence shows that vitamin B12 deficiency exists in Europe and the supplementation in small quantities of it can prevent the deficiency. An obligatory flour fortification system in Europe can eliminate the vitamin B12 deficiency existence in the continent. Cyanocobalamin is the formulation recommended for vitamin B12 deficiency flour fortification and average dose of the supplemented vitamin B12 is 0.008 ppm. The following table (Table 1) represents a summary of the average level of the recommended micronutrients for flour fortification.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Flour extraction Rate</th>
<th>Composition</th>
<th>The quantity of the nutrient to be added (ppm) based on the daily flour consumption per person (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>High</td>
<td>NaFeEDTA</td>
<td>&gt;300 g/day</td>
</tr>
<tr>
<td>Folic acid</td>
<td>Low or high</td>
<td>Folic acid</td>
<td>1.0</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>Low or high</td>
<td>Cyanocobalamin</td>
<td>0.008</td>
</tr>
</tbody>
</table>
for flour fortification based on the flour extraction rate, the composition of the fortification substance and the daily consumption per person.

The type of flour proposed for fortification

Based on the Albania assessment of milling industry for the purpose of wheat, the average annual flour consumption in Albania is 460,000 tons (432,000 tons processed in the country and 27,000 tons imported). The principal types of wheat flour processed in the country are 00, 40, 45, 50, 60 and 70, which are the ones that are recommended for fortification (Oakley and Tulchinsky, 2010; WHO, 2009; Winkels et al., 2008).

Conclusion

The malnutrition of children and women at reproductive age in Albania, and the related effects on health, as a result of the insufficiency of micronutrients in the daily diet such as iron, folic acid and vitamin B12, is considered a serious public health problem in Albania. Flour fortification is one of the principal long-term strategies for reducing micronutrient deficiency at the population level, leading to subsequent health improvement. At the same time, this intervention provides a unique opportunity to the milling industry for expanding its market and increasing its profits, playing a key role to the improvement of the nutrition and health of the population.

Conflict of interest

The authors declare that there are no conflicts of interest.

REFERENCES


Stevens VL, McCullough ML, Sun J, Jacobs EJ, Campbell PT, Gapstur SM (2011). High levels of Folate from supplements and fortification are not associated with increased risk of colorectal cancer. Gastroenterology 141(1):98-105.

