

Report on the

**Technical consultation on the fortification of
flour with multiple micronutrients**

Kuwait
28–30 May 2007



**World Health
Organization**

Regional Office for the Eastern Mediterranean

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1. INTRODUCTION

A technical consultation on the fortification of flour with multiple micronutrients was organized by the World Health Organization (WHO) Regional Office for the Eastern Mediterranean, in collaboration with the Ministry of Health, Kuwait, and the Council of Health Ministers of the Gulf Cooperation Council (GCC), from 28 to 30 May 2007 in Kuwait. Participants from Afghanistan, Bahrain, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Morocco, Oman, Qatar, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates and Yemen attended the meeting. In addition, representatives from the Centers for Disease Control and Prevention (CDC), Atlanta, the Micronutrient Initiative, Canada, the World Food Programme (WFP), the United Nations Children's Fund (UNICEF) and the International Atomic Energy Agency (IAEA) were also present at the consultation. The objectives of the consultation were to:

- review current knowledge, including benefits, limitations and indications of multiple micronutrient fortification of wheat flour;
- review the regional experiences in the fortification of wheat flour; and explore increased coverage of fortified wheat flour with additional micronutrients;
- overcome constraints in the effective implementation of national flour fortification programmes;
- agree on possible standardization in the procurement of fortificants, milling equipment and the monitoring and evaluation of fortification programmes; and
- reach a consensus on the regional fortification standards.

The message of Dr Hussein A Gezairy, WHO Regional Director for the Eastern Mediterranean, was delivered by Dr Jihane Tawilah, WHO Representative, Oman. Dr Gezairy said that fortification of flour had been recognized as a powerful intervention for helping to achieve an important public health nutrition objective. The conventional rationale was that it countered inherent nutrient deficiencies in the food supply which could eventually lead to widespread and significant prevalence of clinical and pathological complications of such deficiencies in certain population groups. Such an intervention involved adding one or several nutrients to wheat flour, in the process exposing large population groups who consumed the fortified flour to these extra amounts of nutrients in their diets. However, as fortification of a staple food item, such as wheat flour, affected significant segments of the population, this simple act assumed a political dimension and policy-makers had to address a number of scientific, cultural, economic and political challenges in translating technical suggestions into policies and actions with far-reaching impact for the population impact.

As a large-scale public health problem, micronutrient deficiencies had continued to occupy the attention, as well as the vital national resources, of the health policy-planners of the Member States of the Region. While the addition of iodine to edible salt had gone a long way in combating iodine deficiency disorders, there had been less

success in the control of anaemia which persisted among population groups of certain socioeconomic strata. Over a decade ago, a technical review of the anaemia situation in the Region suggested the inclusion of wheat flour fortification as an additional intervention to overcome anaemia arising from iron and folic acid deficiencies among the population.

Dr Gezairy noted that from the very inception of this nutrition intervention, the WHO Regional Office, in compliance with its mandate of making the best technical information available to the Member States, had provided input in the adoption and subsequent spread of wheat flour fortification among its Member States. During this period, the Regional Office had organized technical consultations and training workshops at the regional level and worked with its partners in addressing technical issues at the national level. Currently, an estimated 60% of the Region's Member States had introduced fortification of wheat flour with iron and folic acid and in some instances, with additional micronutrients.

Dr Gezairy said that the last regional forum to review the accomplishments in flour fortification was convened in 2001. Since then the flour fortification interventions had developed additional dimensions and characteristics, most notable of which had been the inclusion of a wide range of micronutrients in the fortification process. With this expansion, both the intervention itself and the ever-widening inclusion of fortificants, a number of technical and ethical queries had also emerged, examples of which were the epidemiological basis of recommending multiple fortificants, safe and effective types and standards of fortificants, economics of fortification and the availability of appropriate monitoring and evaluation techniques.

The Chairmanship was shared on a rotating basis. The agenda, programme and list of participants are included as Annexes 1, 2 and 3, respectively.

2. TECHNICAL PRESENTATIONS

2.1 Overview of flour fortification activities in the Middle East and North Africa Region (MENA)

Venkatesh Mannar, Annie Wesley, Kunal Bagchi

The countries of the Eastern Mediterranean Region and the Middle East and North Africa Region (MENA), extending from Morocco to Pakistan, range from among the world's most affluent to some of the least economically developed with the lowest incomes. While one third of the countries enjoy a gross domestic product of more than US\$ 10 000 per capita per year, more than half report GDP of less than US\$ 4500 per capita per year. According to a World Bank review, a range of socioeconomic factors work to threaten the nutrition and health status of populations throughout the Region and in countries of the MENA Region.

Anaemia and folic acid deficiencies represent a significant public health threat in all countries of the Region. Iron deficiency and anaemia are found to cut across all socioeconomic levels. Based on the prevalence of anaemia for various risk groups and population data, the Region suffers an estimated 136 million cases of anaemia among children and working age adult men and women—nearly 30% of the Region's total population. Estimates of the Vitamin and mineral deficiency damage assessment report compiled by MI and UNICEF indicate that the Region annually suffers 200 000 maternal and perinatal deaths and nearly US\$ 2.2 billion in depressed productivity.

Wheat flour fortification is considered a realistic intervention to reduce micronutrient deficiencies due to the following factors:

- Bread has been a staple food of life for people of the Eastern Mediterranean Region for centuries;
- Bread consumption is nearly universal in the Region and about double the global average, (60 kg/person/year to more than 170 kg/person/year) cutting across all socioeconomic segments;
- This level of consumption is sufficient to deliver an additional 8–25 mg/day of iron to the average consumer.
- With some exceptions, the milling industry is large-scale, centralized, and relatively sophisticated in technology in many countries making the installation and quality assuring of fortification processes relatively simple and inexpensive.

At a joint WHO Regional Office and UNICEF consultation convened in Tehran in 1995, flour fortification was recommended as one of the six complementary strategies to control iron deficiency anaemia in the Region. During the consultation, after detailed deliberations, flour fortification was considered a cost-effective and likely an extremely effective regional public health intervention. Further work and research on economic, technical and operational feasibility of flour fortification by MI and WHO led to the convening of a technical workshop in Muscat, Oman, in 1996, which built consensus around the significant potential role for flour fortification and suggested regional guidelines for addition of specific levels of iron and folic acid. As a result, Member States began serious consideration of introducing fortification of flour with Oman initiating a national flour fortification programme.

In view of these encouraging developments, WHO/UNICEF/MI/International Life Sciences Institute (ILS) co-sponsored a follow-up workshop on “Fortification of flour for control of micronutrient deficiencies in the Eastern Mediterranean, Middle East and North Africa’ in Beirut, Lebanon, in 1998. The participants of this workshop included managers of national nutrition programmes, food regulatory officials and representatives from the flour milling industry. At this workshop, the Executive Director of the MI announced the establishment of a Micronutrient Initiative Fund to assist countries in addressing obstacles to the implementation of flour fortification with iron and folic acid. Countries implementing fortification presented their experiences, constraints and developed 2-year action plans. The consensus report of

this meeting included the following key statements: flour fortification with iron has proved to be an effective strategy for the prevention of iron deficiency anaemia, as part of an appropriate mix of strategies which includes dietary diversification, supplementation, food fortification and other public health measures; and national standards and regulations for wheat flour should be amended to allow for fortification with micronutrients, including fortification level of 30 ppm iron from ferrous sulfate or 60 ppm from elemental iron plus 1.5 ppm folic acid.

Acceleration of flour fortification was carried out via a range of channels including MI/WHO Regional Office joint activities to conduct advocacy and communications and provide technical assistance; financial support to country programmes through grants administered by WHO Regional Office as the “MI Fund;” financial support for country programmes administered directly from MI offices through UNICEF, WFP and other partners; direct technical assistance to country programmes; supporting and leveraging partnerships with other institutions providing resources and technical assistance to enable flour fortification in the Region.

There is no reason to believe that flour fortification will have any significant adverse impact on individuals suffering from thalassemia; and flour fortification will have a significant and beneficial effect on the 150 to 300 million people in countries of the Region who suffer from iron deficiency and its anaemia, including those with thalassemia minor. This strong policy support was highly significant because traditionally there has been a groundswell of mistrust in the Region about anything being added to food, and especially to bread, the ‘food of the masses’.

To facilitate Member States to implement flour fortification, technical assistance in milling, quality assurance, communications and programme planning was provided. This included at least 36 national missions to 14 countries of the Region and played a key role in establishing national programmes in the member countries of the GCC and Jordan during 1999–2001. A major training exercise was held in Dubai in October, 2003 and was participated in by many countries from the Region. Based on the need, further programmatic support was provided to Afghanistan, Islamic Republic of Iran, Pakistan and Yemen.

Calculations indicate about 6.8 million metric tons of flour was fortified in 13 countries during 2006 on a national or partial basis, with an ongoing premix cost of US\$ 6.35 million dollars. Approximately 75% of this is estimated to be financed by the national governments or by the market place. Domestic financing is through a range of government and market channels. The 6.8 million metric tons of fortified flour was sufficient to cover 82 million consumers, about one-quarter of whom were projected to be suffering from iron deficiency anaemia or iron deficiency. (Projected proportion of fortified flour is based on information provided by millers to MI).

While the fortification of nearly 7 million metric tons of flour annually is a significant achievement, it represents only about 16% total milling volume or

population coverage. Assuming continued expansion of flour fortification, the potential for fortified flour for 2010 looks promising. An analysis suggests that there is a potential for a four- to fivefold increase to result in 31 million metric tons of flour to be fortified annually by 2010. These projections will enable fortified flour to reach approximately 315 million consumers. Recognizing flour as a good vehicle for micronutrients, some countries have also expanded to multiple nutrients while maintaining the minimum guidelines for iron and folic acid.

2.2 Food fortification with micronutrients for the control of vitamin and mineral deficiencies

Dr Bruno de Benoist, Coordinator, Micronutrients, WHO Geneva

Over the last 20 years, there has been increasing recognition of the importance of vitamin and mineral deficiencies as a public health problem. Such micronutrient deficiencies are widespread in developing and developed countries where pregnant women and young children are more vulnerable. Micronutrient deficiencies contribute significantly to the global burden of diseases estimated at 7.3% and have an economic impact on national productivity and loss of human capital. WHO and UNICEF have pledged to eliminate vitamin A and iodine deficiencies and reduce the prevalence of iron deficiency anaemia by one third by 2010. To achieve this, the international community have been mobilized and increased collaboration has been established with the private sector. Worldwide, the three most common forms of vitamin and mineral deficiencies are iron, iodine and vitamin A deficiencies.

Other vitamins and minerals also make a substantial contribution to the global burden of disease, although the scale and impact of these deficiencies are more difficult to quantify because of the lack of data on prevalence and the fact that adverse effects on health are sometimes non-specific, and the public health implications less well understood. Some vitamin and mineral deficiencies are known to be of public health importance in specific situations: zinc in pregnancy and childhood; folate in pregnancy; vitamin D in young children; vitamins B, PP, C in refugees and displaced people. Most often, nutrient deficiency is not isolated but associated with multiple mineral and vitamin deficiency, especially in pregnant women and young children. Iron, zinc and vitamin A are among the first 10 risk factors contributing to the burden of diseases in developing countries. Measures to control vitamin and mineral deficiencies should combine interventions to improve nutrient intake; dietary approaches; supplementation; fortification and bio -fortification; and public health measures, in practice, the current strategies focus on: supplementation.

WHO and the Food and Agriculture Organization of the United Nations (FAO) have recently developed guidelines to assist Member States to design, implement, monitor and evaluate a food fortification programme with vitamins and minerals so that it is effective, safe and sustainable.

Food fortification is a public health approach to the correction of vitamin and mineral deficiencies. Fortification involves the addition of vitamins and minerals to commonly eaten foods, beverages or condiments. Fortification covers restoration, which means restoring nutrients removed by milling or processing and substitution, which involves the addition of nutrients to a substitute product to the level in the food that the product is designed to resemble, e.g. vitamin A in margarine, vitamins and minerals of breast milk in infant milk formula.

Food fortification is justified where there is a demonstrated need for increasing the intake of an essential nutrient in one or more population groups. This may be in the form of actual clinical or subclinical evidence of deficiency indicating low levels of intake of nutrients, or possible deficiencies likely to develop because of changes taking place in food habits" (Codex Alimentarius, 1994). The overall goal is to increase the vitamin and mineral intake of an acceptable proportion of the population to an adequate level, without causing an unacceptable risk of excessive intake. In practice, the goal is to provide $\approx 97.5\%$ of individuals in a population with an intake that meets their requirement for specific vitamin and mineral intake which means that only 2.5% of the population should have a usual intake less than the estimated average requirement (EAR) and none should have excessive intake, e. g. exceeding tolerable upper intake levels (UL).

To calculate the fortification level by EAR, there is a cut-point method which involves: measuring prevalence of inadequate nutrient intakes in specific population subgroups; identifying subgroups at greatest risk of inadequate intakes of specific vitamin and minerals; measuring usual distribution of intakes of intended food vehicles in at-risk population subgroups; and simulating the effect on intake of adding different levels of vitamin and minerals to the food vehicle. The goal is to aim for 2.5% of intakes $< \text{EAR}$; and $\approx \text{none} > \text{UL}$. The choice of food vehicles should be widely and regularly consumed and the amount consumed must be compatible with fortification level and should not result in adverse effects. Central processing for fortifying flour with premix is ideal, as the turnover is rapid with fewer organoleptic problems and affordable packaging.

The fortificants chosen should not have unacceptable sensory problems, they should be stable, their interactions with food and other nutrients need to be checked, they should not have a high cost affecting affordability and must be adequately absorbed. There are several forms of national food laws, legislation or regulations are considerations when regulating mandatory or voluntary fortification. Specifications will include how to write the specifications; ranges of appropriate vitamins and minerals concentration; specific chemical compounds used and controls on health claims and labelling. Trade considerations will be within the national and international context.

Fortification is a promising approach which has demonstrated how effective it is in preventing vitamin and mineral deficiencies. However, it has limitations as it does

not substitute for a good quality diet; may not reach the most disadvantaged groups living on the margins of a market economy; and many staples considered for fortification are home produced. Technological constraints are due to adverse sensory effects on the food vehicle, potential toxicity, interactions among vitamin and minerals if multiple fortification and may contribute to unhealthy consumption levels of some food vehicles e.g. salt, sugar.

2.3 Key issues governing stability, absorption and the impact of multiple micronutrient fortification of wheat flour

Dr Richard Hurrell, Human Nutrition Laboratory, Swiss Federal Institute, Switzerland

WHO recommends for the choice of iron (Fe) compound to be used in the fortification of wheat flour low-extraction wheat flour and high-extraction wheat flour. For low-extraction (white) wheat flour, dry ferrous sulfate/ferrous fumarate/electrolytic iron (x twice amount)/encapsulated ferrous sulfate or encapsulated ferrous fumarate is recommended. For high-extraction wheat flour, sodium iron EDTA/encapsulated ferrous sulfate (x twice amount) or encapsulated ferrous fumarate (x twice amount) is recommended.

There are three issues to the fortification of wheat flour: stability, absorption and impact. With regard to stability, ferrous sulphate and ferrous fumarate may cause rancidity or colour change. Stability will also depend on the quality of the flour, the quality of the iron compound used, storage time, humidity, temperature and humidity. Encapsulated elemental iron is recommended. The level of fortification is also critical and the WHO/CDC guidelines should be followed. To demonstrate efficacy, WHO recommends the measurement of serum ferritin, C-reactive protein, haemoglobin and transferrin receptor.

WHO guidelines for defining iron level involves four steps. The first step requires the measurement of daily intake of iron, particularly among the at-risk groups. During the second step, the current probability of inadequacy is estimated. For the third step, the daily consumption of food vehicle to be fortified is measured. In some instances, more than one food vehicle may be needed. For the fourth and the final step, the fortification level to achieve the desired probability of adequacy is defined.

To define the level of iron fortification, WHO recommends certain steps, indicated below.

- Calculate fortification Fe necessary to decrease the prevalence of inadequate intakes to <2.5%. For example, for menstruating women consuming 10% bioavailability in the diet = 15mg Fe/day.
- Measure daily consumption of chosen food vehicles: example: 300g/day wheat flour (sole vehicle).

- Add fortification Fe to daily food vehicle consumption considering bioavailability of iron compound: 50 ppm ferrous sulphate/25 ppm NaFeEDTA/100 ppm electrolytic Fe.
- Check for technological, safety and cost aspects (may need more than one food vehicle).

The following conclusions can be drawn from the available data. With regard to stability, iron is the only micronutrient to cause sensory problems. Encapsulated ferrous sulphate or ferrous fumarate or elemental iron powders improve stability. There is need to evaluate encapsulated ferrous sulphate and ferrous fumarate of size < 100 µm.

On the subject of absorption, bioavailability of iron has received considerable attention while the bioavailability characteristics of zinc compounds have not been evaluated adequately. Electrolytic Fe is the only elemental Fe recommended at 2 x FS amount while H-reduced Fe (2 x FS) remains another alternative. Phytates reduce iron and zinc absorption while sodium iron-EDTA overcomes phytates inhibition of Fe absorption and as such, is recommended for whole grain flour of low extraction. However, more evaluation information on the absorption of EDTA and zinc is required.

The impact of vitamins and calcium on the overall impact of flour fortification is generally accepted. Although the addition of folate to flour decreases the incidence of neural tube defects and elevated plasma homocysteine levels, there are some safety issues that have to be explored carefully. Although the recommended iron compounds are efficacious, there are no studies on the impact of wheat flour fortified with iron and zinc at the current recommended levels. In geographical areas that have high prevalence of infections, efficacy of micronutrients added to flour needs more evaluation.

2.4 Cuernavaca report: wheat flour fortification—current knowledge and practical applications

Mr Ibrahim Parvanta, CDC, Atlanta, USA

The objectives of the Cuernavaca workshop, which was organized in Cuernavaca in Mexico from 1 to 3 December 2004, were to review and summarize knowledge about the efficacy and effectiveness of current iron and folic acid fortification practices with wheat flour; assess new research findings and technical developments that hold promise for improving the efficacy and effectiveness of wheat flour fortification in the future; review technical and cost barriers to implementing iron and folic acid fortification; identify strategies for overcoming these barriers; and provide clear, practical and economically feasible recommendations that can be implemented with the current knowledge and technology.

Wheat flour fortification is a feasible, affordable and effective strategy to reduce the prevalence of iron deficiency. Using iron fortificants with adequate relative biological value to fortify wheat flour at appropriate levels of iron is safe and iron fortification programmes should be guided by tracking the iron status of the population. It was agreed that further research was needed to identify and define optimal approaches for iron fortification of flour.

With regards to folic acid, it was agreed that folic acid prevents 50%–70% of neural tube defects and may also reduce other birth defects; eliminates folate deficiency anaemia, decreases homocysteine levels and reduces stroke, heart disease and some cancers. Available evidence did not support the masking of vitamin B₁₂ deficiency by folic acid following fortification.

Recent proliferation of premix producers and traders with limited technical capacity has resulted in the availability of products of questionable quality, including raw materials and final premix. This is compounded by the lack of uniform quality assurance/quality control to be applied to new manufacturers; lack of clear regulatory guidance regarding type and quantity of nutrients to include in fortificants and lack of information/experiences on the shelf-life of different compounds in premixes, flours and flour products.

The overall cost of fortification is very small relative to the cost of production of flour or flour products and could be passed on to the consumers, although in some cases, the incremental cost of fortification may be perceived as significant and an obstacle to the flour industry, especially when there is unfair competition and lack of “a level playing field”, governmental controls prevent price increases, specifications of expensive mix of fortificants mandated by regulations, cash flow pressure due to time lag from purchase of premix to receipt of customer payment and lack of information to enable effective negotiation with premix suppliers.

2.5 Fortification issues in emergency/humanitarian crisis situations: improving the micronutrient content of WFP’s food basket

Dr Anne Callanan, Senior Programme Adviser, World Food Programme Regional Bureau, Cairo, Egypt

A basic standard ration provided by WFP comprises cereals, pulses, oil, sugar and salt. An understanding that energy adequacy does not equate to nutritional adequacy has been seen in outbreaks of micronutrient deficiencies in emergency-affected populations. The common types of micronutrient deficiencies found in emergencies are those due to ascorbic acid (vitamin C), scurvy; niacin (vitamin B3), pellagra; thiamin (vitamin B1), beriberi. These conditions may be associated with situations where people are dependent for their food needs on an inadequate general ration and have no other sources of food. Since the late nineties, the WFP requires mandatory fortification of edible salt with iodine; vegetable oil with vitamin A and D;

high-energy biscuits; fortified blended food, e.g. CSB, UNIMIX; wheat flour with iron.

The core programme goal for 2004–2007 is to contribute to meeting the targets of the Millennium Development Goals (MDGs) through food-assisted interventions that save lives; protect livelihoods; support improved nutrition and health of children, mothers and other vulnerable people; support education and establish national food-assistance programmes. The policy on micronutrient fortification comprises the inclusion of micronutrients in needs assessment and ration planning; delivering fortified foods on an increasing scale; promoting/using locally-produced and fortified commodities; advocating the importance of micronutrient deficiencies; carrying out and documenting baseline/impact studies; and developing capacity-building and partnerships.

The assessment for risk factors leading to micronutrient deficiencies consists of micronutrients that are lacking in the ration; micronutrient deficiencies that are endemic in this area or among this population; local availability of rich sources of particular micronutrient deficiencies and population groups that have access to such sources; and the development of locally-appropriate strategies.

Approaches towards further improvement of the micronutrient content of the food basket consist of increasing fortification of staples; use of multi-micronutrient powders (home-fortification), particularly in emergencies; improvement of fortified blended foods, especially for those under 2 years of age; development of a special product for the management of moderate acute malnutrition. The challenges to an effective fortification programme are deciding on fortification levels, ensuring quality assurance, scale and choice of partners for implementation, nongovernmental organizations and the availability of funds.

2.6 Multiple micronutrient fortification: milling considerations and cost implications

Quentin Johnson, Technical Adviser, Micronutrient Initiative

Multiple micronutrient flour fortification is a reality in many countries around the world. Some examples are all countries in the Western Hemisphere; Morocco, Ghana, Guinea, Malawi, Nigeria and South Africa in the African continent and Afghanistan, CARK countries, Fiji, Indonesia, Jordan in the Middle East and Asia.

All countries in the Western Hemisphere use a combination of micronutrients including B₁, B₂, B₃ vitamins, folic acid and iron and zinc for minerals. In Venezuela, vitamin A is used to enrich wheat and maize flour. Vitamin A is used to enrich wheat and maize flour in Ghana, Malawi, Nigeria South Africa and Uganda. For countries in the Middle East, a combination of B₁, B₂, B₃ vitamins and folic acid and iron and zinc is used. Vitamin A is also added in the fortificants in Afghanistan and Jordan.

There are three components to milling considerations: technical, regulatory and economic costs. Technical issues comprise premix, milling equipment, the fortification process and quality control/quality assurance. With regard to premix, multiple micronutrient premixes are already available where storage and handling conditions are same for all types of premixes. There is the potential interaction between ferrous sulphate and vitamin A.

In general, the commonly used micro-feeders and existing collection conveyers can be used for all premixes. The only constraint may be the variation between the maximum delivery dosage of feeder for simple premix (low addition rate) to multiple micronutrient mix (higher addition rate). This may require some modifications in the size of the discharge screw and/or increased gear ratios. To ensure adequate regulatory status, mandatory requirements are essential due to higher premix costs and non-compliance. It is essential that governments should provide tax relief on premixes and equipment, including value added tax (governments are not always willing to adjust VAT).

With regard to quality control and quality assurance, the Spot Test can be used as a quality control tool assuming that all iron sources are similar to current practice. In addition to the availability of certificate of analysis of premix from the supplier, regional or national laboratory testing capability must exist for all micronutrients used in the premix. Quality control and quality assurance at industry level can increase significantly from US\$ 20 for Fe and folic acid to over US\$ 200 for full profile. In addition, conducting regular programme monitoring, industry and impact measurement plus adequate enforcement including analysis, will all add to the overall cost. The other cost implications are who will pay for the cost of fortification, and the ability of the consumer to pay; the levels of premixes must be affordable to the consumers, industry and government; and the possibility of transferring the additional costs to the consumers.

2.7 Multiple micronutrient fortification: milling considerations and cost implications – the regional perspective

Ms Ibtehal Al-Salem, Kuwait Flour Mills, Kuwait

The idea of fortifying white flour was started in 1999 when representatives from the Ministry of Health met with all partners and raised the recommendation of WHO of fortifying wheat flour with iron and folic acid. This was followed by changes in the Kuwaiti and GCC standard specifications for flour and the production of fortified flour by the single flour mill in Kuwait, Kuwait Flour Mills, from July 2001.

Kuwait Flour Mills and Bakeries is a government company producing flour, breads, biscuits, pasta, vegetable oil and animal feed products. It has four mills, eight Arabic bread bakeries and one central European bakery. The premix in use now provides 60 mg H-reduced Fe and 1.5 mg folic acid when using 100 gm of the premix per 1 ton of wheat flour.

For quality control and to ensure that the correct level of iron is maintained in the flour at all times, flour samples are collected on a daily basis from the production line and packing bins and are tested using an atomic absorption spectrophotometer. In addition, the Kuwait municipality also carries out its own inspection taking random samples and testing at the central laboratory of the Ministry of Health. Kuwait Flour Mills has been collaborating with the Kuwait Institute of Scientific Research regarding the stability of iron in flour and baked products and in a short study on women of childbearing age to evaluate the efficacy of iron fortification.

In conclusion, the fortification programme has not reduced iron deficiency among the vulnerable population in Kuwait in spite of being in operation for the past six years. A number of reasons may be attributed to this situation. There are no national level data to indicate the situation before the fortification programme was started and where it stands at present; the population continues to maintain eating habits that may not be considered healthy; many people do not consume bread or other products prepared with fortified flour and the type and level of iron fortificant may be inappropriate. The recently concluded study on the efficacy of iron fortification should provide some answers to overcome this situation.

2.8 Stable isotope techniques in the development of food fortification strategies

Dr Lena Davidsson, Nutritional and Health-Related Environmental Studies Section, Division of Human Health, International Atomic Energy Agency, Vienna, Austria

Bioavailability of iron compounds is an important consideration in the development of food fortification strategies as iron compounds can be characterized based on solubility in water and dilute acid (dilute acid representing gastric juice). Examples are water soluble compounds: ferrous sulfate (poorly soluble in water but soluble in dilute acid); ferrous fumarate (poorly soluble in dilute acid and water insoluble); elemental Fe powders and ferric pyrophosphate.

Fe must be solubilized to be absorbed; thus Fe compounds soluble in water would be expected to be readily absorbed and therefore having a high potential impact on the Fe status of consumers (e.g. Fe sulfate) while water insoluble compounds would be expected to be much less well absorbed and to have much less impact on Fe status. Compounds soluble in dilute acid would be expected to be readily absorbed and to have a good impact on the Fe status in consumers with adequate gastric acid secretion, e.g. iron fumarate. A water soluble compound should be used when possible. However, Fe is a reactive element and soluble compounds can provoke unacceptable organoleptic changes when added to foods (color, odour, etc.). Studies of bioavailability are needed to evaluate different compounds in humans; a stable isotope technique can be used, based on incorporation of ^{58}Fe and/or ^{57}Fe into red blood cell. As stable isotopes are used, there is no radiation hazard so infants and children can be included.

It is important to use paired comparisons (double isotope technique) as Fe status influences fractional Fe absorption, i.e. each individual acts as his/her own control. It is important to use Fe sulfate as a reference compound (100% relative absorption) to compare different Fe compounds and to evaluate the influence of inhibitors and enhancers. For example, the potent effects of dephytinization and addition of ascorbic acid (infant soy formula) have been well demonstrated. When vitamin C cannot be added (losses during processing of foods, storage etc), NaEDTA can be used to enhance Fe absorption from Fe sulfate (it does not work with Fe fumarate), as determined from studies conducted in Peru and Guatemala.

NaFeEDTA is a water-soluble compound with high relative bioavailability (sign higher than Fe sulfate) when used to fortify inhibitory meals (high in phytic acid, e.g. study in Guatemala); useful fortificant for high-extraction flour for example. It is important to produce labelled compounds with similar physico-chemical properties as a commercial fortificant and should be done in collaboration with commercial suppliers. It must be tested for solubility, particle size, etc. before human studies. It has been shown that there is a three times higher absorption from Fe fumarate as compared to Fe pyrophosphate in infants from a study conducted in Warsaw, Poland. It has also been shown that there is no difference between Fe sulfate and Fe fumarate absorption in adults (study in Zurich). In Bangladeshi children (2–5 years) Fe fumarate was only approximately 30% as well absorbed as Fe sulfate (no difference between Hp and non-Hp infected children); there is a lower gastric acid secretion in young children than in adults. There is no change after treatment of infected children (study in Dhaka).

In conclusion, stable isotope studies are needed to optimize food fortification strategies. Bioavailability from different compounds (measured in appropriate age groups and not extrapolated from adults to children for non-water soluble compounds) and the influence of dietary inhibitors/enhancers should also be evaluated.

2.9 Monitoring and evaluating flour fortification programmes: some key considerations

Mr Ibrahim Parvanta, CDC, Atlanta, USA

Programme monitoring is defined as continuous collection, analysis and interpretation of (quantitative and qualitative) data, and use of the information to identify problems for correction, or to help sustain successful activities within a programme. Programme evaluation is the assessment of the effectiveness and impact of the programme on the target population, to provide evidence that the programme is reaching its goals.

Monitoring can translate objectives into performance indicators based on expected results; report progress to managers and alert them to problems, in order to implement timely remedial actions and help sustain successful activities. Monitoring at instances can also be used for programme evaluation. Evaluation on the other hand,

analyses if, and why, intended impacts were or were not achieved; explores unintended results and informs practice, decision-making and policy.

The attributes of a monitoring/surveillance system are simplicity; flexibility; data quality; sensitivity; reflectiveness/representativeness; timeliness; stability; and acceptability. An ideal programme monitoring and evaluation system will comprise a baseline survey followed by a sufficient length of time for programme management and depending on the nutrient(s) involved and the indicators, concluding with an impact survey. The strength of an on-going monitoring system is its ability to show trends over time and a monitoring system need not “answer” all questions or reasons for findings related to the process or effectiveness of a fortification programme. Additional answers as to “why” can be obtained through additional investigations (qualitative and quantitative) as needed.

If at all possible, incorporate data collection into existing data collection systems and develop new or independent systems only if necessary. There may be some need to collect programme monitoring and effectiveness data from more than one data collection system (triangulation of information). A monitoring system need not always be based on statistically representative data; important data and information can be “reflective” of actual trends in process and effectiveness indicators.

The considerations for designing a food fortification monitoring system are that sufficient quantity of quality fortified product must be accessible to the population; the population must have regular and on-going access to fortified product (local production plus imports) to show impact. It is also necessary that at least 80%–90% of the population have access to fortified food over time in order to readily assess any impact. Another factor to keep in mind is that coverage rates may not be similar across the country, especially during the early stages of the fortification programme, or when the programme is not mandatory.

The considerations for monitoring the effectiveness of flour fortification are that women of childbearing age are the highest risk population group likely to nutritionally benefit from flour fortification. Reduction in the incidence of neural tube defects is likely to be a more “powerful” indicator of effectiveness of folic acid fortification than improved serum folate levels. Folic acid fortification may also decrease stroke mortality among adults which could be tracked through existing vital statistics data. Serum ferritin is the best effectiveness indicator of impact/change on iron status.

When the enrichment of bread with niacin was carried out in Mississippi to control pellagra, a gradual reduction in mortality and morbidity rates were noticed. However, with the mandatory fortification of flour beginning in 1945, a radical drop in the morbidity rate from pellagra was noticed. Both morbidity and mortality declined to such a low level that pellagra was considered eliminated from the United States of America. In Oman, between 1996, the time when the flour fortification

programme was started and 2004, when a national micronutrient assessment was made, anaemia in women during the first trimester declined from 40% to mid-30%; comparatively, the reduction in the incidence of neural tube defects was dramatic, with over a 50% reduction in the incidence rate.

2.10 Proposal to develop revisions to the current WHO Regional Office guidelines for the fortification of flour

Quentin Johnson Annie Wesley, Ranum

The current WHO regional guidelines for flour fortification were developed at the 1998 Beirut regional workshop on flour fortification. Since that time there have been major developments with the field of flour fortification relative to new micronutrients compounds, such as sodium iron EDTA; the growing recognition of zinc deficiency; the development of regional standards for the countries within the GCC; the advancement of flour fortification activities in many countries in other regions of the world and the release of WHO guidelines for food fortification. The following points can be considered as general guidelines while planning flour fortification with multiple nutrients with specific reference to the Region:

- For any fortification of white flour (defined as low extraction flour with an ash content in the flour of less than 0.8% made by roller mills):
 - Folic acid should always be included.
 - Iron and zinc should be included for iron-deficient countries.
 - Riboflavin should be strongly considered for inclusion.
 - Thiamin should be included for rice eating populations and highly considered for all other populations.
 - Niacin should be included for maize-eating populations and considered for all other populations. (The natural niacin equivalent (NE) level in wheat flour is actually quite high due to its tryptophan content. Niacin addition can also be an important cost factor.)
 - Vitamin B₆ and vitamin B₁₂ addition should be considered.
 - Vitamin A addition should be considered if there are no other reasonable food vehicles for vitamin A in the country (i.e. vegetable oil, margarine, milk products, sugar) that can make up the dietary deficit.
 - Vitamin D addition can be considered where social customs or other reasons prevent infants and children from being exposed to sunlight, and where evidence of vitamin D deficiency exists.
 - Calcium fortification should always be included as a voluntary option.
- Iron: ferrous sulphate or electrolytic iron for low-extraction flour and NaFeEDTA for countries where high-extraction flour (ash content > 0.8%) is used in poorly-fermented breads (such as flat breads, tandoor, nan and chapattis).

Vegetable oil is the most cost-effective vehicle for vitamin A fortification. In most countries in the Region vegetable oil is widely available. However, in Afghanistan and Palestine, where the availability of vegetable oil and the per capita consumption of vegetable oil is very low the use of flour as the food vehicle is considered to be justified. The use of ferrous sulphate with vitamin A in flour fortification is not recommended when the flour may be subject to extremes of heat and humidity. In that case ferrous fumarate and electrolytic iron is preferred.

Recent decisions to recommend folic acid fortification in Australia, New Zealand and the United Kingdom (UK) have taken into account potential B₁₂ deficiency masking due to folic acid. However, the decision to proceed has been based on risk assessments on the relative risk of both deficiencies. In countries where there is low animal protein intake the addition of B₁₂ may be required. Recent scientific studies have shown the vitamin D deficiency may be more widespread than previously thought. Usually, vitamin D is manufactured by the body through skin exposure to the sun. However, with the advent of increased sunscreen usage vitamin D deficiencies have been noted. In the Region, women may be more at risk of vitamin D deficiency.

3. COUNTRY PRESENTATIONS

3.1 Status of flour fortification in Afghanistan

Dr Ahmed Wali Delawar, Ministry of Health, Afghanistan

A national micronutrient survey carried out by the Ministry of Health in collaboration with UNICEF, CDC and Tufts University, USA, in 2004, reported that 38% of children between the ages of 6 and 59 months, 25% of women of childbearing age and 7% of men between the ages of 18 and 60 years were anaemic. The prevalence of iron deficiency anaemia in children between the ages of 6 and 59 months was reported at 72%, in women of childbearing age (48%) and in adult men (18%). The prevalence of anaemia among pre-school age children was consistently reported to be high, starting with 33% for infants between 6 and 11 months of age; between 12 and 23 months of age (60%); between 24 and 35 months (49%); between 36 and 47 months (37%) and for children between the ages of 48 and 59 months (18%).

The fortification of flour in Afghanistan was initiated in 2004 with the support of WFP, in collaboration with other UN and international organizations. The project was a small-scale pilot involving 10 mills in Kabul and 10 flour mills in Badashkhan provinces, with a production rate of 20 MT/day at each location. A larger scale project was started in 2006, with the support of the WFP and the private sector, which involved five large flour mills at Kabul, Mazar, Kudoz and Herat, with production capacities of 160 MT/day in Kabul; 100 MT/day in Kudoz; 60 MT/day in Mazar and 150 MT/day in Herat. An estimated 600 000 persons per day receive fortified flour from these mills. A total of five mills and three food companies are voluntarily involved in the fortification programme. The Ministry of Health and the WFP provide

necessary technical support, premixes, micro-feeder and manual mixers. No flour fortification standard or legislation exists and there is no system in place for the enforcement of legislation. The Ministry of Health requires support from national and international partners.

One ton of premix is purchased at US\$ 8000. With an average household consuming 100 kg of flour per month at an estimated amount of US\$ 28 (500 gm of flour per person per day), it requires US\$ 0.25 to fortify 100 kg of flour. The rural population consumes flour produced by small-scale mills that number in the thousands. All these flour mills cannot be covered by the national flour fortification programme; 80% of the wheat flour consumed in the country is imported from neighbouring countries and this flour is not fortified.

International organizations are currently providing support to the flour fortification programme. Eventually, the fortification programme will become an integral part of national efforts. A national flour fortification strategy is in place and efforts are under way to involve more flour mills in the programme. A logo to identify fortified flour has been developed and mills fortifying flour are encouraged to use it. The public health laboratory of the Ministry of Health has been equipped with instruments and supplies to enable it to perform quality control and assurance activities.

3.2 Status of flour fortification in Bahrain

Dr Zohair S Al-Dallal, Nutrition Consultant, Ministry of Health, Bahrain

The prevalence of anaemia has been estimated at 51.3% among women in the reproductive age group (2003); 33.5% in pregnant women (1996); at 48.3% among children under 5 years of age (1997) and 58.2% among infants (2001). The prevalence of iron deficiency anaemia has been estimated at 24.5% among women in the reproductive age group (2003); at 40% among pregnant women (1996); 29.4% in infants (2001) and at 26.7% in children under 5 years of age (1997).

The flour fortification programme (with iron and folic acid) was implemented in Bahrain in November 2001. There is only one milling plant in the country, the Bahrain Flour Mill Company (BFMC). Wheat consumed in Bahrain is imported mainly from Canada, Australia, Argentina, Kazakhstan and the Russian Federation and all flour is subsidized by the Government. A national level study on the prevalence of anaemia and iron deficiency anaemia was carried out six months after the implementation of the flour fortification programme was considered to provide the baseline information. Flour is fortified with elemental iron at 60 ppm and folic acid at 1.5 ppm. There are three types of flour available in Bahrain: 0, 1 and 2. Type 0 (75% extraction) and type 1 (80% extraction) are fortified; type 2 (85% extraction) is not fortified. The Ministry of Commerce provides funds for the procurement of the commercial premix from the USA.

Internal monitoring of the flour fortification programme applies the principles of good manufacturing practice and Hazard Analysis and Critical Control Point (HACCP) at the BFMC. Quality control and quality assurance are maintained internally by the management of BFMC. Two full-time employees are responsible for following the fortification process within the BFMC and the inspection process on a daily basis. The Ministry of Health carries out external monitoring twice a month by public health inspectors. Regular unarranged visits are made to the BFMC for the collection of samples and the inspection of flour available in the market, including bakeries and fast food restaurants. Random samples of fortified flour are sent to the nutrition section by BFMC once a month for analysis of the level of iron as a double check. Strong cooperation and collaboration between the BFMC and the nutrition section of the Ministry of Health in monitoring the flour fortification programme (regular reports and records) exist. A nutritionist is assigned to check with the BFMC regarding all aspects of fortification and is entirely responsible for national micronutrient programmes and has the full authority to monitor the fortification programme.

The technical auditing for imported flour to Bahrain was satisfactorily implemented following a ministerial decree by HE, the Minister of Commerce in 2002, banning the importation of unfortified flour to the country. All fortified flour is labelled and packed according to determined standards issued by the Ministry of Health and the Ministry of Commerce. Health inspectors are responsible for checking the packed flour available in the market, as well as at the BFMC, and report directly to the nutrition section of the Ministry of Health.

Fortified flour is accessible to all the population including the targeted age groups in the country (mainly in the form of all types of bread). Fortified flour (bread) is purchased and consumed twice/day by the majority of the Bahraini population. It has been estimated that the amount of iron in the flour provides adequate amounts of the daily iron requirements as protection (acceptable quality). Recent data indicate that the consumption of iron among the elderly population is low, while women in the reproductive age group consume adequate amounts of fortified flour (bread). Among school students, consumption of iron is low, especially among females. For infants above the age of six months and young children, fortified infant's cereals are expected to provide the required amount of iron. As no reliable data are available for children under 2 years of age, the consumption of bread and other fortified foods will be investigated via focus group discussions and personal interviews with the parents in this age group.

With regard to the overall consumption of micronutrients, available data indicate that while the consumption of iron from animal sources and vitamin C among adult Bahrainis is high, the same is not true for B vitamins, particularly females between the ages of 40 and 59 years, who consume less. All pregnant women are routinely checked for haemoglobin during the first visit and then subsequent visits to maternal and child health centres. Pregnant women receive free iron supplementation,

a programme that was started in 1980. For infants and children, routine screening of haemoglobin at the age of 9 months and older, is provided to children at all health centres. As part of the micronutrient deficiencies control and prevention programme, additional interventions such as the social marketing of fortified flour, advocacy and awareness of anaemia at consumer level and campaigns on specific themes are organized regularly.

The Government, as represented by the Ministry of Health and Commerce along with BFMC, takes the necessary action to sustain the flour fortification programme through technical, financial, social and managerial support at various levels. A proposal was submitted to the Ministry of Health to carry out a monitoring study in 2008 on the impact of the flour fortification programme on iron deficiency anaemia status and another proposal was submitted to carry out a national micronutrients survey in 2009.

3.3 Status of flour fortification in Egypt

Dr Azza Gohar, National Nutrition Institute, Cairo, Egypt

Egypt is one of the countries that face a double burden of malnutrition, where under-nutrition (especially among children) coexists with over-nutrition (especially among adults). Data from various sources indicate in 1978, the prevalence of iron deficiency anaemia was approximately 39% in preschool age children, declining to 28% in 2000 and then increasing to 50% by 2005. Similarly, the prevalence of iron deficiency anaemia among pregnant, lactating and women of childbearing age has shown continuous increase between 1978 and 2004, estimated at 45%, 60% and 30%, respectively.

Data from studies conducted over different years show that between 1988 and 1998, the prevalence of iron deficiency anaemia in children between 6 and 12 years age did not change much at approximately 40%. For children between 11 and 19 years of age, the prevalence of iron deficiency anaemia between 1988 and 1998 remained at approximately 30%. Data from various studies conducted between 1995 and 2001 show that 25% of children between 11 and 19 years suffered from vitamin A deficiency, while the prevalence rates among children between 6 months and 6 years and 6 and 11 years are at 10%.

Among other deficiencies, zinc deficiency was reported at 15.5% among primary school children with more prevalence among boys in rural sites (1998) and 8.5% of adolescents and 5.6% of adults had a low serum zinc level with no gender or area-based differences (2004). With regard to selenium status, 8.8% of primary school children, 26.0% of adolescents and 25.0% of adults were reported to have low serum selenium levels. 22.0% of adolescents and 10% of adults had low serum magnesium levels. More than 20% of adolescents and nearly a third of the adult population studied had low serum calcium. Rural areas reported higher deficiency levels, particularly among adults when compared to the adult population in urban areas.

At present, the Ministry of Health and Population is engaged in implementing three main national programmes for the prevention and control of deficiencies in iron, iodine and vitamin A, namely the national programme for the prevention and control of iron deficiency anaemia, iodine deficiency disorders and vitamin A deficiency disorders.

The present flour fortification programme targets 80% of the total population (75 million) of whom women of reproductive age account for 16.5 million; the poor 11 million and children between the ages of 11 and 19 years approximately 31 million. *Baladi* bread was chosen as the fortification vehicle for the following reasons: it is the major dietary staple in Egypt and consumed by all segments of the population. Bread is highly valued, acceptable and affordable; it is subsidized by the Government, centrally processed thereby facilitating government regulation; and there is government and political support for the project.

3.4 Status of flour fortification in the Islamic Republic of Iran

Dr Seyyed Morteza Safavi, Director General, Nutrition Department, Ministry of Health and Medical Education, Islamic Republic of Iran

The main micronutrient deficiencies in the Islamic Republic of Iran are iron, zinc, vitamins A and D, riboflavin and calcium. The national integrated micronutrient survey conducted in 2001 included the measurement of haemoglobin, serum ferritin, serum vitamin A, zinc and vitamin D for children between 15 and 23 months of age and below 6 years, adolescent girls in the age group 14–20 years, adolescent boys 15–20 years, pregnant women, adult females between the ages of 50 and 60 and adult men between the ages of 45 and 60.

The prevalence of overall anaemia in females declined from a high of 35% in the age group 15–23 months to approximately 20% from school age and remains around this figure right through pregnancy to middle age. Iron deficiency anaemia similarly declines from approximately 15% at 15–23 months of age to remain between 5% and 10% throughout adolescence, pregnancy and middle age. In contrast, iron stores show significant fluctuation, declining from 30% in 15–23 months of age to 15% at school age and then rising to a high of over 40% in pregnancy, declining to approximately 15% by middle age.

Based on the results of the two national surveys, flour fortification was considered as part of a strategy, in addition to iron supplementation, food diversification and public health measures to combat iron deficiency anaemia in the country. Fortification of flour has certain advantages, delivery can be consistently maintained to the target population, a low intake of iron is considered safe, minimum behavioural change is required, the cost to the consumer is affordable and fortification brought in several sectors that had never been involved in the protection of population health into the intervention process.

In 1996, a small-scale flour fortification project was conducted in one of the districts of Isfahan province for a period of 6 months. The results indicated an increase in the haemoglobin level of the population. Later, flour fortification was extended to the Bousheyr province in 2001 with the support of WHO and the MI. Between 2002 and 2004, fortification of flour was extended to four other provinces with support provided by the national government, UNICEF and the MI. The goal of the fortification strategy had been to reduce iron deficiency and its anaemia in the target population and to study the feasibility of flour fortification, its quality assurance and acceptance by the consumer. A national food/flour fortification plan was developed in 2004–2006 as part of a World Bank-funded project jointly implemented by the Ministry of Health and Medical Education and WHO.

Quality control of fortified flour in Islamic Republic of Iran includes the laboratories of the flour mills, where semi-quantitative spot tests are carried out at least three times a day. At the government food laboratories, semi-quantitative spot tests are combined with quantitative (spectrophotometer) tests on all factory samples and also on samples collected on a random basis. The standard spot test for iron consists of the addition of ferric iron to flour which then reacts with thiocyanide (KSCN) reagent to form red spots. This method only shows ferric iron. However, if iron is added in the ferrous form, the sample needs to be oxidized with hydrogen peroxide to convert the ferrous to ferric iron before analysis. For the quality control of the premix, chemical tests are carried out to determine the ash and moisture content as well as assays protein, carbohydrate, fat, ferrous sulfate and folic acid. The microbiological tests comprise total aerobic, tests for mould and yeast, *Escherichia coli*, *Salmonella*, *Staphylococcus aureus* and *Pseudomonas aerogenosa*.

The strength of the national flour fortification programme is derived from strong political commitment, financial support from the Government, involvement of trained health and relevant technical personnel from several governmental sectors, involvement of the private flour milling sector and acceptance of fortified bread by the community. In summary, 18 provinces have started fortification of wheat flour with iron and folic acid which is providing fortified flour to 22 million Iranians. The programme has been able to achieve the local production of premix and increase the number of national pharmaceutical companies in this venture. The micro-feeders are also produced locally. The Government approved funds in May 2007 for the introduction of the flour fortification programme at the national level. The weakness of the programme lies in the continued use of sodium bicarbonate instead of yeast for making bread, which leaves high levels of phytates in bread; and ensuring improved quality of wheat and flour for the purpose of fortification.

3.5 Status of flour fortification in Iraq

Dr Ala Shalon Hussein, Nutrition Research Institute, Iraq

A technical meeting to plan the national wheat flour fortification was organized in 2004 and attended by national representatives from the Ministries of Health, Trade

and Education, in addition to UNICEF and WHO. The meeting concluded with the agreement to add 42% ferrous sulphate and 0.75% folic acid as premix to wheat flour for fortification. UNICEF procured and distributed 256 feeders and installation was carried out in 80% of the flour mills across the country. The first shipment of 160 MT and the second shipment of 150 MT were distributed adequately over a six-month period. As part of the fortification activity, 10 engineers were trained in the installation and maintenance of micro-feeders and 10 laboratory technicians in quality assurance and quality control in Amman, Jordan. The reagents for quality control and assurance were provided by WHO Iraq. The flour fortification project was successfully launched in August 2006 and it is expected that the prevalence of iron deficiency anaemia will be reduced from the current 50% to less than 10%.

Monitoring at the central and the peripheral levels takes place by laboratory technicians from the Ministries of Health and Trade. Five different ministries were involved in the fortification programme. Monitoring included both spot tests and quantitative tests and was supported with equipment and reagents from UNICEF. Awareness and advocacy seminars and Information, Education and Communication (IEC) materials were supported and provided also by UNICEF. Although the Ministry of Trade had envisaged procuring the premix through its own budget for 2007, the Ministry of Finance was not successful in allocating sufficient funds in addition to related administrative constraints. UNICEF agreed to cover the deficit with the provision of 180 MTs until the end of 2007.

A number of challenges to an effective flour fortification programme remain in Iraq. The continuing insecurity in all parts of Iraq along with technical problems such as the shortage of equipment and training of staff, private flour mills that are not part of the fortification programme, the uncertainty about the supply of premix and the constant maintenance of the feeders interfere in the smooth introduction of the flour fortification programme.

3.6 Status of flour fortification in Jordan

Dr Adnan Ishaq, Head of Nutrition Department, Amman, Jordan

A national micronutrient survey conducted in 1996 reported that the prevalence of anaemia was 35% in pregnant and lactating women and 28% among women of reproductive age. A subsequent survey in 2002 reported that 32.2% of women of child-bearing age suffered from anaemia while 22.5% were iron deficient. The same survey reported that 20.1% of children under 5 years of age were anaemic. A survey conducted in 1999 reported that around 20% of school children were anaemic. A survey in 2002 reported that 15.1% of children below 5 years of age suffered from iron deficiency while a 2003 study reported that 47% of school-age children (6–17 years) suffered from vitamin A deficiency disorders.

Based on the national data on iron deficiency anaemia in Jordan, the national health authorities concluded that iron deficiency anaemia existed as a public health

problem. A national programme to fortify flour was launched in early 2002 based on the fact that bread made from wheat flour and formed part of every meal in Jordan. A national flour fortification committee was formed to facilitate the process of programme development, coordination and implementation and comprised public sector industries and civil society. A national technical committee was created to train, develop and monitor the performance of the flour mills as well as analyse samples as required.

An estimated amount of 503 727 MT of wheat flour is consumed in Jordan per year while a daily average consumption of bread is between 250 and 400 gm. The premix consists of ferrous sulphate and folic acid, added to the regular 200gm/MT, which provides 30 ppm of ferrous sulphate and 1.5 ppm folic acid. The premix has been produced locally since 2003. There are 10 mills in Jordan distributed in five governorates, with five mills located in Amman. Most of the flour mills are technically sophisticated and have readily adopted micro-feeders and fortification technology.

Several activities have been conducted on the operational aspect of flour fortification. A focus group on 2000 persons concluded that fortification of bread with iron produced no change in taste, smell or colour. The database on the anaemia profile in women of the childbearing age has been maintained since 2002. A national flour fortification monitoring system was launched with the involvement of different sectors. A national flour fortification communication strategy has been developed, in addition to the development of communication materials. Awareness/advocacy campaigns have been launched for policy-makers, millers and community leaders on the beneficial effect of fortifying flour.

The Ministry of Health provided seed money (270 000 Jordanian Dollars (JD)) to purchase the premix from the government annual budget and an annual budget of 1 million JD is retained by the Ministry for the purchase of premix. Since 2006, the Higher Committee of Nutrition had approved a new formula for premix (vitamins and minerals) to fortify flour. A pre-trial for fortified flour with vitamins and minerals was conducted at the end of 2004. No difference was perceived between bread fortified with iron and folic acid and bread fortified with vitamins and minerals with regard to taste, colour and smell.

3.7 Status of flour fortification in Kuwait

Dr Nawal Al Hammad, Nutrition Department, Kuwait

Although community-based food intake data are not available, a small-scale study assessing the daily consumption of fruit and vegetables among Kuwaitis by using a food frequency questionnaire reported that the consumption of fruit was 2.8 servings/day while the consumption of vegetables was 3.2/day; and intake for both fruit and vegetables was below the recommended 5 servings/day.

According to the Kuwait nutrition surveillance system, 23% of preschool children, 22% of adolescent girls and 24% of women of childbearing age are anaemic. Data from 2002 to 2005 show that the prevalence of anaemia in females from 6 months to 20 years of age has remained static during this period. Similarly, the prevalence of anaemia among adult Kuwaiti males and females has also remained unchanged between 2001 and 2005.

Fortification of staple foods was considered the cheapest, efficient and effective way to supply large populations with essential micronutrients and for combating anaemia and reducing iron deficiency anaemia. Fortification of flour with iron was recommended as the primary strategy. Flour fortification is mandatory at the national level in Kuwait as per the GCC standard and specification regulations for wheat flour and as per Ministerial Decree No. (2000/24). The national wheat flour fortification was initiated in 2001 by fortifying wheat flour with (H-reduced iron) at 60mg/kg and with folic acid (1.5 mg/kg).

In order to evaluate the efficacy of iron fortificants in wheat flour in women of childbearing age in Kuwait, in 2006, a double-blind study was started among 380 women students (age 18–24 years) from the Faculty of Women, Kuwait University and Nursing School. The women were tested for haemoglobin, serum ferritin, C-reactive protein and zinc protoporphyrin. The findings will soon be available.

Although no exact data on the prevalence of vitamin D are available in Kuwait, clinical observations and personal communication of pediatricians and public health experts indicate concern about the prevalence of vitamin D deficiency disorders. As a preventive public health measure, milk is fortified with vitamins A and D.

No community-based data on iodine deficiency disorders are available in Kuwait. A pilot study conducted in 2004 on the prevalence of iodine deficiency disorder reported that less than 5% of the population demonstrated this deficiency. Additional research is necessary to validate such findings. The iodization of salt was started in 1997 and it is now mandatory that salt of 1 kg weight or less (household size) must be fortified with iodine (Kuwaiti Standards, 2003).

Population level data on the prevalence of vitamin A deficiency disorders are not available. A single study conducted among newborn infants their mothers reported no evidence of vitamin A deficiency disorder.

In conclusion, reduced bioavailability of iron from the diet is leading to iron deficiency and its anaemia and is a leading cause of anaemia among the general population. Fortifying flour with iron of high bioavailability will be a cost-effective and efficient tool for prevention. There is not enough data on other micronutrients deficiencies such as vitamins A and D, calcium and iodine in Kuwait.

3.8 Status of flour fortification in Morocco

Dr Mustapha Mahfoudi, Ministry of Health, Morocco

A number of micronutrient deficiencies have been reported from Morocco. A national survey conducted in 1995 reported that 35% of children aged between 6 months and 5 years; 33% of women of childbearing age and 45% of pregnant women suffered from iron deficiency anaemia. A study in 1991 identified 2.5% of children to be suffering from radiological rickets, while in 1996, 41% of children aged 6 months to 6 years were found to be suffering from vitamin A deficiency, with 3.2% children severely affected. A national survey in 1993 reported that 22% of children aged 6–12 years had goiter (iodine deficiency disorders) of various degrees.

The national objectives for the control and prevention of micronutrient deficiencies to be achieved by 2015 are: the reduction of iron deficiency anaemia by one third (in comparison with 1995 data of anaemia survey); control of vitamin A deficiency; elimination of iodine deficiency disorders; emphasising prevention against rickets and national vitamin D coverage (2 doses) > 90% of target population will be increased and maintained. Overall, the strategy for the control of micronutrient deficiency control is integrated, global and multisectoral. It also enjoys the support of several international and bilateral organizations. The components of the national micronutrient deficiency control strategy are: supplementation; fortification; nutritional education; and public health interventions.

With regard to the fortification of oil and fats with vitamin A and D, five oil mills have received the logo identifying 'enriched food' and 95% of oil on the market is fortified. As per 2006 data, 91% of households are using enriched oil. The target for 2007 will include an additional five oil mill. Current production of edible oil in Morocco is approximately 380 000 tonnes while oil fortified with vitamins A and D3 is approximately 332 000 tonnes.

In the programme for the fortification of flour with iron, the Government is responsible for setting up the general policy of fortification and ensuring compliance to the regulations of fortification and the availability of fortified flour in the market. The Government also sets up the standards and specifications for premix; risk analysis of fortified flour and of premix; materials to be used; conditions for production, packaging, storage and distribution; and enforcement of regulation and legislation relating to flour fortification.

Several constraints are encountered by the flour milling industry. The subsidy to flour and government supervision is considered a barrier against further progress by the milling sector. The Government's contribution to the transportation of wheat and flour ceased in June 2000 and flour millers were asked to reflect these costs into the price of all open products. A recent study on the knowledge and attitude of the population showed that about 50% of women knew about the 'fortified food' logo;

about 50% of women knew about fortified food and about 50% of women consumed fortified food.

3.9 Status of flour fortification in Oman

Saleh Al-Zadjali and Deena Alasfoor, Oman

Oman Flower Mills Company (OFMC) started the fortification of flour in 1998 using electrolytic iron and folic acid with the composition of electrolytic iron at 60 mg/kg (60 gm per tonne) and folic acid at 2 mg/kg (2 gm per tonne). The cost of fortification per tonne of flour was estimated at US\$ 0.35. The future plan for the flour fortification programme consists of preparing the initial draft of the technical regulation (update of Ministerial Decision No. 88/97) by cooperation with the Ministry of Health; studying the draft in the Omani Codex Committee (involvement of public and private sectors); notifying World Trade Organization members and allowing 60 days for comments; and enforcing the technical regulation.

Sources used for fortification shall be permitted to be used in foodstuffs and food graded items while the amount and name of nutrients used in fortification shall be declared on the label. Import, production and marketing of non-compliant flour shall be banned and the system will be reviewed with concerned bodies every five years.

Fortification will not be implemented on whole wheat flour (96%–100% extractions) because whole cereal grains contain phytic acid which forms insoluble compounds with minerals, such as iron. Insoluble compounds make minerals unavailable for absorption by the body and addition of minerals such as iron to atta flour would reduce the benefit because of the iron being bound by phytic acid and making it unavailable for absorption.

3.10 Flour fortification in Sudan

Dr Amani Abdelmoniem Mahmoud, National Nutrition Directorate, Primary Health Care General Directorate, Federal Ministry of Health, Sudan

The level of malnutrition in children under 5 years of age differs between different states. The global acute malnutrition rate is estimated at 18.2%, while severe malnutrition is reported to be 3.5%. The variation in the prevalence rates for malnutrition in children can be attributed to unstable food security, civil conflicts and drought. While exact information on the prevalence of vitamin A deficiency disorders is not available, children under 5 years of age and postpartum mothers are provided with vitamin A supplementation through national immunization days. The coverage of vitamin A supplementation for children under 5 years of age is estimated at 76.2% and in postpartum women at 18.6%. The prevalence of iodine deficiency disorders is estimated at 22% among the general population and 22% of school-age children are reported to have goiter (FMoH 1999).

Anaemia remains a major public health issue. The common causes of anaemia in Sudan are: low dietary intake, poor absorption due to inhibiting dietary factors, such as phytates and tannins, coexisting parasitic infections (bilharzias, intestinal worms and endemic malaria). Food fortification in Sudan commenced with the iodization of edible salt, later extended to the fortification of wheat flour with the technical input of the MI. A memorandum of understanding between MFA partners was signed to support the fortification agenda. A food fortification declaration was presented at a national press conference. Instructions for flour fortification, salt iodization and sugar were issued by the Ministry of Industry to the food producing sectors.

There are several challenges to an effective flour fortification programme in Sudan. An estimated 50% of the country's population consume wheat flour while 25% consume sorghum and 15% millet. As such, almost half of the population will not benefit from the flour fortification programme. A number of small-scale flour millers also operate within the country, particularly in the rural and remote areas. Their input will be necessary to ensure that fortified flour is available to all segments of the population. The additional costs for fortifying flour have to be taken into account in future, particularly if a decision is made to add other fortificants. Several areas of Sudan are in conflict and post-conflict situations. The environments in these areas are currently not conducive for the effective introduction of flour fortification.

3.11 Situation of flour fortification in the Syrian Arab Republic

Dr Samir Arous and Dr Mahmoud Bouzo, Ministry of Health, Syrian Arab Republic

In 1997, a study conducted by the Ministry of Health on iron deficiency anaemia in the Syrian Arab Republic reported a prevalence of 27.4% in children under 5 years of age and 40.6% in women of childbearing age. A new national study is under way. In 1998, based on serum retinol, a prevalence of 8.7% vitamin A deficiency was reported among the general population. In order to limit/reduce the prevalence of vitamin A deficiency, the Ministry of Health introduced the distribution of vitamin A capsules to infants between 6 and 14 months of age in association with the measles vaccination.

The prevalence of iodine deficiency disorders among schoolchildren was reported as a moderate level of deficiency (12.9%) and mild (27.29%); approximately 59.29% of the population was reported to be iodine sufficient. The strategy of flour fortification, as adopted by the Ministry of Health, would be implemented in three phases: as a pilot project in the El Salamieh district of Hama province from 2004; in high-risk areas of the country by 2007 and as a national project between 2010 and 2011. The objectives of the flour fortification programme are to introduce flour fortification in 75% of flour at mills operated by the Ministry of Economy and Trade; and to evaluate the impact in terms of Hb and ferritin and bread consumption after 2.5 years of fortified bread consumption.

A technical training workshop to test production, quality assurance and communications systems was organized to ensure coordinated activity and reporting among the production and laboratory departments in the El Salamieh Mill and the Ministry of Trade's central laboratory and the Ministry of Health in Damascus. While spot tests on flour samples are performed on fortified flour during each production shift, two samples are delivered on a monthly basis to the Ministry of Health's central laboratory in Damascus for quantitative analysis.

UNICEF Syrian Arab Republic provided two micro-feeders while WHO purchased about 21 tons premix (20 ppm ferrous sulfate and 1.5 ppm folic acid). The standard fortificant used consists of 20 ppm ferrous sulphate and 1.5 ppm folic acid and is applied for wheat flour with an extraction rate between 72.5% and 82%. The fortified bread is subsidized and distributed through the distribution system in the governorate.

3.12 Prevention of anaemia in Tunisia

Dr Chouch Mohamed, Dr Ben Farhat Essia and Dr Garbouj Munira, Primary Health Care, Tunisia

Anaemia is a public health problem in Tunisia and the prevalence of iron deficiency, the main cause of anaemia, is estimated at 50%. Although the economic and social developments in Tunisia have contributed to a significant reduction in the prevalence of common nutrition problems, the persistence of anaemia exerts a heavy toll on the health of women of childbearing age, pregnant and lactating women and young children.

The national nutrition survey conducted in 1975 and then in 1996/1997 reported that 38% of children between 6 months and 2 years of age; 25.9% of women of childbearing age; 32.2% of pregnant and 30% of lactating women were anaemic. Although the prevalence of anaemia was more or less uniform in distribution across Tunisia, the prevalence rate was high in regions at the south of the country. The national strategy to prevent anaemia is mainly through the safe motherhood programme which promotes birth spacing; and health education and systematic oral iron supplementation of pregnant and lactating women. Iron is distributed free to pregnant women visiting public health facilities.

Although fortification of flour with iron and folic acid has been discussed widely in Tunisia, no decision has yet been taken to introduce such a programme. The national health authorities are interested to learn about the experiences of other Member States that have introduced iron fortification of flour and have achieved reductions in the prevalence of iron deficiency.

3.13 Status of flour fortification in Yemen

Dr Dhekra Annuzaili, Mr Yaseen Al-Asbahi, Mr Abdulelah Sultan, Yemen

The following strategies are in place for the control of micronutrient deficiencies: flour fortification/iron supplementation, salt iodization, oil fortification with vitamin A supplementation during national immunization days.

A national task force for micronutrients was established in 2004. During the same year, the international agency GAIN provided a grant to Yemen to be administered through UNICEF. The national flour fortification standard was adopted and made mandatory in 2005 and the wheat flour fortification programme was launched in 2006, in the presence of high-level officials, international organizations, nongovernmental organizations and other dignitaries. The national premix consisted of elemental iron at 60 ppm in the form of electrolytic iron and folic acid at 1.5 ppm.

The five privately-owned flour mills in the country are well equipped and have agreed to install the micro-feeders and also purchase the premix. Millers are responsible for the production of wheat flour as per the established standards and specification. The five flour mills account for the production of 70%–80% of the national flour requirement. Overall importation of wheat flour has decreased from 1 000 000 tonnes in 2001 to <100 000 tonnes in 2006.

Future activities will comprise continuing support to the development of the national nutrition strategy; strengthening the monitoring of national micronutrients fortification programmes and considering the inclusion of additional micronutrients to flour, e.g.: zinc.

4. GROUP WORK

4.1 Group work 1. Technical and milling issues: standards, quality assurance and enforcement

Participants acknowledge the role and recognize the cooperation of the milling industry in the Region to implement flour fortification in many countries to date. Countries in the Region should continue to follow the existing WHO regional guidelines for flour fortification and the 2006 guidelines on food fortification with micronutrients published by WHO headquarters. The group also thought that each country should have a national nutrition policy and strategy, which includes food fortification as well as other interventions, such as health and nutrition education, supplementation, dietary diversification and de-worming. It was further recommended ferrous sulphate or ferrous fumarate should be used for low-extraction flours while electrolytic iron could be used if technical reasons warranted it; NaEDTA was recommended for whole grain and high-extraction flours.

For the evaluation of flour fortification programmes in the Region, the selection of biochemical indicators to measure iron status should be based on the WHO/CDC guidelines, namely haemoglobin, ferritin and C-reactive protein. Any adjustment to flour fortification levels and standards should be based on the 2006 WHO guidelines for bioavailability levels in diet, and dietary habits and intakes using surveys, including household expenditure surveys. On the whole, flour fortification levels should be based on nutritional, technical (milling and baking) and policy considerations.

The concept and feasibility of multiple micronutrient fortification of flour was accepted by the group with the obligatory base consisting of iron, folic acid and zinc. Zinc levels have to be determined based on deficiency/dietary needs. Optional vitamins and minerals should include the vitamin B group, vitamin D, and calcium; vitamin E is recommended for oil but can be added to flour if oil is not readily accessible.

The local/regional production of multiple micronutrients should be encouraged. The tender specifications should be developed taking into consideration the technical, nutritional and dietary practices in the Region while the storage and usage conditions must reflect regional climatic factors.

The selection of feeders and the operation of feeders should be the responsibility of the millers. Regional experiences to date have shown that millers who fortify are able to properly control the process and as such, they should be encouraged to do so. In the start-up phase focus on quality control and quality assurance should be on the milling sector to ensure proper implementation of the start-up phase.

4.2 Group work 2. Communication and advocacy strategy for flour fortification

A flour fortification programme is designed to combat iron deficiency anaemia among adults and young children; and is a milestone towards achieving the targets of the MDGs and the WHO goals for 2010, which include a reduction of iron deficiency anaemia by one third. The general objectives are to reduce micronutrient deficiencies.

The following recommendations were made to Member States and WHO by the group.

- Create a flour fortification workplan/strategy for advocacy, communication and education depending on the context and needs of each country.
- Convene regular meetings of concerned parties to share the country's progress and plans of action for the monitoring and evaluation of flour fortification.
- Strengthen intersectoral coordination of flour fortification through establishing national and regional flour fortification committees and alliances. Develop a regional logo for fortified flour.

- Translate CDCynergy into Arabic and French and support the training of CDCynergy among Member States of the Region.
- Support (technical and financial) for communication and advocacy about flour fortification is requested from UN agencies, international nongovernmental organizations and communications experts to continue developing communication strategies in different countries in the Region. Support should also be requested from local nongovernmental community organizations to provide advocacy and raise public awareness to promote flour fortification.
- Follow country procedures to develop legislation or regulations regarding flour fortification.
- Define specifications and standards for flour fortification through technical regulations.

To WHO

- Draft a letter from the WHO Regional Director for the Eastern Mediterranean to each ministry of health in the Region, the GCC and the Secretariat of the League of Arab States about the importance of flour fortification and the need for each ministry of health to support flour fortification with vitamins and minerals.
- Request regular reports of the progress of flour fortification from Member States. A regional progress report should be disseminated back to the ministers of health.
- Include flour fortification on the agenda of the next session of the Regional Committee for the Eastern Mediterranean and Health Ministers' meeting of the GCC.

5. CONCLUSIONS

Anaemia remains a major public health problem in the Eastern Mediterranean Region. The general pattern has been to equate overall anaemia with that of iron deficiency. However, there are multiple factors contributing to anaemia which have to be taken into consideration when designing intervention programmes, including the flour fortification programme. Fortification of wheat flour has been recognized as a key intervention for the control of iron deficiency anaemia by Member States of the Region and 15 Member States have introduced fortification of wheat flour, mostly with iron and folate.

Available data indicating the impact of consuming fortified flour on the anaemia status of populations where fortification has been introduced for some time, are mixed, and at times, inconclusive. Participants concluded that each Member State will need to review its current flour fortification strategy with a focus on food consumption patterns of different population groups, the types and levels of iron and folate fortificant used, the need for an alternative fortificant and the availability of fortified flour to the population.

Adequate bioavailability of iron from fortified flour remains a challenge as it depends on the form and amount of iron used as fortificant. Fortification of flour with elemental iron compounds in Oman and Kuwait had a disappointing impact on iron status. The relative bioavailability of elemental iron is lower than other iron fortification compounds and such a fortificant, even if added at higher levels or as the electrolytic iron powder, may be less suitable for the Eastern Mediterranean Region where the cereal-based diet is high in phytates and high tea consumption and relatively low in foods which enhance iron absorption. Ferrous sulphate, ferrous fumarate or NaFeEDTA are preferred as fortificants for wheat flour and NaFeEDTA has consistently shown good efficacy in a range of fortified foods. Encapsulated ferrous sulfate or encapsulated ferrous fumarate are also possible alternative compounds if they could be produced at a small enough size so as not to be retained on the sieves used during the milling process.

Although there is no evidence that folate deficiency is a public health problem in the Eastern Mediterranean Region, addition of folate to flour is considered an important preventive measure against neural tube defects where the rate of neural tube defect is above 6 per 1000 live births. The lack of information on the magnitude of folate deficiency and neural tube defects in Member States of the Region was probably due to absence of accurate approaches for the collection of appropriate data.

Inclusion of zinc should be considered where there is evidence of zinc deficiency.

Research remains an essential element of the flour fortification strategy. However, as sufficient information is available to proceed with fortification activities, appropriate utilization of this information in combination with well-designed case-control studies can be useful tools to measure the impact of flour fortification. Participants confirmed the general opinion that fortification of flour with iron and folate was not a treatment for the prevalent micronutrient deficiencies leading to anaemia. It remained a preventive measure and part of a three-component strategy: iron/folate supplementation, food diversification and fortification.

Establishment of a national 'flour fortification alliance' is necessary in every Member State that is fortifying flour with micronutrients. As part of this alliance, sharing of all relevant technical and programmatic information with the milling industry, the private sector and related ministries such as commerce, trade, agriculture and finance, is an important element of a flour fortification programme. At the same time, adequate communication and advocacy for flour fortification have to be maintained with the decision-makers, consumer groups and professional health associations.

Safety indicators, quality assurance and quality control of the fortification process are important and should be identified at the outset of the fortification

programme. In this regard, the proved safety of food fortification globally during the past 60 years could be taken into consideration.

Based on national, regional and international experiences, general purpose micro-feeders that fit the overall configuration of the mills are recommended for national fortification programmes.

To reduce the overall cost and ensure quality of the premix/fortificant, member countries of the GCC could consider common-tendering and bulk purchasing of the necessary premixes/fortificant.

Several sources are available that provide technical, logistical and programmatic information related to flour fortification. Examples of some such sources are the Flour Fortification Initiative (FFI); the Micronutrient Initiative (MI) and the International Atomic Energy Agency (IAEA) and the support provided by WHO, UNICEF, WFP, the CDC and the MI is well recognized. Member States concluded that such technical and financial support should be maintained to promote flour fortification in the Region.

6. RECOMMENDATIONS

To Member States

1. Continue the expansion of fortifying wheat flour with iron, folic acid and other needed micronutrients.
2. Examine carefully the etiology and characteristics of anaemia as part of flour fortification activities with iron. Information on the prevalence of anaemia should clearly differentiate between anaemia, anaemia resulting from iron deficiency, folate deficiency and other micronutrient deficiencies.
3. Establish expectations from the flour fortification programme with iron, bearing in mind that fortification of flour with iron and folic acid is a preventive measure and part of a comprehensive strategy.
4. Review the technical elements of the fortification process, particularly the types and levels of fortificant used. The regional standards for fortificant, as presented during this consultation, are generic in nature and serve as a reference.
5. Use iron and folate as a base fortificant and introduce an additional fortificant. The introduction of an additional fortificant will depend on the characteristics of the prevalent micronutrient deficiencies in each Member State.
6. Strengthen the national flour fortification alliance through improved information sharing and exchanges of technical knowledge between the relevant ministries,

the milling industry and consumer groups. Networking with interested partners at the international level is an important component of an effective flour fortification programme.

7. Establish a set of flour fortification standards and legislation, a quality control and quality assurance mechanism, safety guidelines and indicators for monitoring and evaluating the fortification programme.

Annex 1

AGENDA

1. Inauguration session
2. Overview of flour fortification activities in the Regional Middle East/North Africa Region
3. Food fortification: basic principles and practices
4. Key issues governing stability, absorptions and impact of multiple micronutrient fortification of wheat flour
5. Cuernavaca report: wheat flour fortification—current knowledge and practical implications
6. Fortification issues in emergency/humanitarian crisis situations
7. Milling considerations and cost implications in multiple micronutrient fortification
8. Stable isotope techniques in the development of food fortification strategies
9. Monitoring and evaluation of flour fortification programmes
10. Group work
11. Suggested regional fortificant standards
12. Discussion on the regional fortificant standards
13. Group work: Country plans of action
14. Conclusions and recommendations
15. Closing ceremony

Annex 2

PROGRAMME

Monday, 28 May 2007

08:30–09:00	Registration
09:00–09:45	Inauguration
	Message from Her Excellency, the Minister of Health, Kuwait
	Message from the WHO Regional Director for the Eastern Mediterranean
	Message from His Excellency, The Executive Secretary, Gulf Cooperation Council Ministers of Health
	Message from Dr Nawal Al-Hammad, Director, Nutrition Department, Ministry of Health, Kuwait
09:45–10:15	Group photo
10:15–10:30	Introduction of participants
	Election of officers
	Background to the consultation, objectives and mechanics <i>By Dr Kunal Bagchi, WHO/EMRO</i>
10:30–10:45	Overview of the flour fortification activities in the Region/Middle East/North Africa Region <i>By Dr Annie Wesley, the Micronutrient Initiative (MI)</i>
10:45–11:00	Food fortification: basic principles and practices <i>By Dr Bruno de Benoist, WHO/NHD</i>
11:00–11:15	Key issues governing stability, absorption and impact of multiple micronutrient fortification of wheat flour <i>By Dr Richard Hurrell, Swiss Federal Institute</i>
11:15–11:30	Cuernavaca Report: wheat flour fortification—current knowledge and practical implications <i>By Mr Ibrahim Parvanta, Centres for Diseases Control and Prevention (CDC), Atlanta</i>

11:30–17:00	Country presentations: Kuwait Afghanistan Bahrain Egypt Islamic Republic of Iran Iraq Jordan Morocco Oman Syrian Arab Republic Sudan Tunisia Yemen
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Tuesday, 29 May 2007

08:30–08:45	Review of country presentations
08:45–09:00	Fortification issues in emergency/humanitarian crisis situations <i>By Dr Anne Callanan, World Food Programme</i>
09:00–09:15	Milling considerations and cost implications in multiple micronutrient fortification <i>By Mr Quentin Johnson, MI</i>
09:15–09:30	Milling considerations and cost implications in multiple micronutrient fortification: the regional perspective <i>Kuwait Flour Mills, Kuwait.</i>
09:30–09:45	Stable isotope techniques in the development of food fortification strategies <i>Dr Lena Davidsson, International Atomic Energy Agency (IAEA)</i>
09:45–10:00	Monitoring and evaluation of flour fortification programmes <i>Mr Ibrahim Parvanta, CDC</i>
10:15–11:00	Discussion
11:00–12:30	Group work: Group 1. Technical and milling issues: standards, quality assurance and enforcement Group 2. Communication and advocacy for micronutrients fortification
15:00–16:00	Presentation of group work
16:00–16:15	Suggested regional fortificant standards <i>Dr Annie Wesley and Mr Quentin Johnson</i>

16:15–17:00 Discussion on the regional fortificants standards

Wednesday, 30 May 2007

08:30–11:30 Group work: country plans of action

11:30–14:15 Presentation of group work

14:15–15:15 Conclusions and recommendations

15:15–15:30 Closing ceremony

Annex 3

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