Flour fortification: reporting accomplishments

Report of a joint WHO/UNICEF/MI intercountry technical review meeting on flour fortification
Cairo, Egypt, 17–19 July 2001
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1. Introduction

An Intercountry Technical Review Meeting on Flour Fortification: Reporting Accomplishments took place in Cairo, Egypt from 17 to 19 July 2001. The meeting was sponsored by the WHO Regional Office for the Eastern Mediterranean (EMRO) jointly with the Micronutrient Initiative (MI) and United Nations Children's Fund Middle East and North Africa Regional Office (UNICEF/MENARO) as part of the activities taking place under the implementation of the MI fund. Present at the meeting were country programme officers in flour fortification programmes, or micronutrient programmes, from Bahrain, Egypt, Islamic Republic of Iran, Jordan, Lebanon, Libyan Arab Jamahiriya, Morocco, Oman, Palestine, Qatar, Syrian Arab Republic, United Arab Emirates and Republic of Yemen. The meeting was also attended by representatives from the Health Ministers' Council for Gulf Cooperation Council States, United States Agency for International Development (USAID), Food and Agricultural Organization for the United Nations (FAO), MI and UNICEF/MENARO.

The objectives of the meeting were to review the progress of the national flour fortification programmes, including the successes and constraints encountered in the introduction of flour fortification, as well as to provide a platform for all involved parties to share experiences and knowledge generated from the flour fortification projects in different countries with diverse social, political, economic and cultural environments, and offer an opportunity to develop strategies for improvement.

The intercountry meeting was preceded by a WHO/UNICEF/MI Consultation on Communication Needs in Flour Fortification, held in Cairo on 15 and 16 July 2001. Attending that consultation were experts from Bahrain, Canada, Egypt, Islamic Republic of Iran, Jordan, Morocco, Netherlands and United States of America. The objective was to analyse the ongoing national flour fortification programmes in the Eastern Mediterranean Region that have a communication component, either social marketing or advocacy, to subsequently review the encountered constraints and needs in the area of effectively targeting communication in the introduction of flour fortification, and to develop strategies for improvement.

In his opening message Dr Hussein A. Gezairy, WHO Regional Director for the Eastern Mediterranean described the effects of anaemia in the Region. Laying the blame for anaemia on iron deficiency, he stressed that iron nutrition played an important role in maternal survival and the cognitive and psychomotor development, growth and resistance to infection of children of all ages. He emphasized that iron deficiency reduced
productivity and had profound negative effects on national and socio-economic development.

Micronutrient deficiencies were a grave problem. Approximately 23 million children in the Region suffered from vitamin A deficiency. At least 150 million people were at risk of iodine deficiency disorders, and an estimated 200 million people might be anaemic. Women of childbearing age, young children, school-age children and adolescents were affected. Anaemia in the Region affected only small proportions of healthy adult men, and this fact suggested that the high prevalence of anaemia seen in women and children was due to iron deficiency. In most countries, malaria was not a problem, and the prevalence of anaemia seemed to be relatively independent of income, as high-income countries in the Region were equally affected. It was not that haemoglobin levels were extremely low; rather, one could speak of an epidemic of unsatisfactory haemoglobin levels. If, as had been postulated, for each anaemic individual there was another one already iron deficient, the size of the problem became overwhelming.

The main causes of iron deficiency in the Region were a combination of factors. Total iron intakes were low, with the main sources being non-haem iron. The iron consumed had a low bioavailability due to very high intakes of inhibitors such as tea and low intakes of enhancers such as fresh fruit and meat. Furthermore, the Region’s high birth rates, short birth intervals and high prevalence of parasitic infestations led to significant losses of iron and high iron requirements. Traditionally, the strategy to combat anaemia had focused on iron supplementation of pregnant women and, in a few countries, also of pre-school children. Evaluation of these programmes showed a number of serious flaws leading to low coverage and low compliance. Thus, there was a need for the development of an action plan which would be based on a combination of strategies appropriate to the Region.

For centuries, bread had been a staple food of life for people of the Eastern Mediterranean. Bread consumption in countries of the Region was among the highest in the world, thus offering an opportunity to inexpensively deliver adequate levels of iron to reduce the prevalence of iron deficiency and anaemia. Therefore, it had been recommended in a technical consultation held in Teheran in October 1995 that countries of the Region explore the feasibility of flour fortification as a long-term strategy, given that it had already proved to be the most effective means of improving iron intake in industrialized countries. A workshop was subsequently held in Oman, in 1996, to examine the practical implications of flour fortification, and form a consensus on regional standards. Several countries had started preliminary work, and a few had actually embarked
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on flour fortification with iron and folate. In 1998, a joint WHO/UNICEF/MI/ILSI workshop on the fortification of flour for the control of micronutrient deficiencies in the Eastern Mediterranean, Middle East and North Africa was held in Beirut, Lebanon, to review the experiences in flour fortification in countries of the Region since 1996 and to build on the consensus developed at the 1996 meeting.

At that meeting, the Executive Director of the Micronutrient Initiative had announced the establishment of a fund, the Micronutrient Initiative fund (MI fund), which would assist countries in addressing obstacles to the implementation of flour fortification with iron and folate, and initiating a national flour fortification programme. The Regional Office, UNICEF/MENARO and MI jointly developed terms of reference. The management of the fund was a collaborative effort by the three organizations, with WHO Regional Office responsible for its execution. A technical review committee was established comprising representatives from the three organizations involved.

In the last two years, said Dr Gezairy, many efforts had been made to implement the national flour fortification programmes that were funded under the MI fund. However, a number of important cross-cutting issues encountered during implementation of the flour fortification projects that could not be anticipated during the planning stage of the project, or were not considered to have a potentially important effect on the outcome of the project, had become obvious. One important issue was that of mistrust. In a number of countries, the existence of a groundswell of mistrust of anything being added to flour or bread had been noticed. The fact that the iron originally present in wheat had been removed by milling and needed replacing had not been well communicated, and might not be a convincing enough factor to educate the population regarding fortification of their staple food. There was also not one single, definitive, agreed upon, word in Arabic that conveyed the meaning of fortification. Furthermore, although ministers of health and other partners of WHO were to a large extent convinced of the importance of flour fortification as a population-wide strategy to improve iron status, there was still insufficient collaboration with the other stakeholders such as ministries of supplies, commerce and finance, and the milling industry itself. The concept of improved products with improved status and quality was difficult to sell in the face of severely controlled markets for bread. However, by addressing these target groups with the right messages it was hoped that these barriers would eventually be eliminated.

Dr Gezairy concluded by saying that lack of knowledge and the existence of misconceptions, either in the populations or in national policy-
makers, had seriously hampered the implementation of national flour fortification programmes in some countries. It was expected that one of the outcomes of the consultation would be a plan for a regional campaign which could also act as a prototype for national campaigns. Through this consultation it was also hoped to offer a set of tools which would aid national programme officers in the development of materials and national campaigns. The regional campaign would focus both on consumers, through the development of a confidence-inspiring regional logo and targeted regional marketing activities, and on programme officers and policy makers, through technical advice on social marketing.

A number of strategies for improvement in the implementation of the flour fortification efforts were to be developed during the meeting, through analysis of the ongoing national flour fortification programmes that have a communication component, as well as through a review of the needs and constraints encountered in effectively targeting communication for the introduction of flour fortification. During the meeting, all countries present would give an overview of activities undertaken in the field of flour fortification and would receive information on some recent technical developments. Plans of action for the countries would also be developed.

Dr Khairya Moussa, (Bahrain) was elected Chairperson and Ms Dina Alasfour (Oman) acted as Rapporteur. The meeting programme and list of participants are included as Annexes 1 and 2, respectively. Annex 3 contains a summary report of a 2000 workshop held in Monterrey, Mexico, on evaluating the usefulness of elemental iron powders. A review of legislation pertaining to wheat flour fortification is included as Annex 4. A summary report of the consultation on communication needs in flour fortification held in Cairo on 15 16 July 2001, and its programme and list of participants, are included as Annexes 5, 6 and 7, respectively.

2. Flour fortification in the Eastern Mediterranean Region

Worldwide, 2 billion people do not get sufficient iron in their diet, which leads to visible effects such as increased death risk to women during childbirth, low birth weight in infants, greater risk of severe infections and higher death rates for children. The invisible effects are that children score an average of 10 points lower on the Intelligence Quotient (IQ) test, that their school performance is below normal, and that their future productivity is diminished. Adult men and women suffer physical weakness and fatigue, and the entire population has a lower work output and is less productive.

Flour fortification is an appropriate strategy for combating anaemia in a region where on average 250 grams of bread are eaten per person per day.
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That is among the highest levels of bread and flour consumption in the world. Flour is consumed on a daily basis by all, including the so-called ‘at risk’ groups, such as disadvantaged women and children, and milling is for most countries centralized and at a very sophisticated level. Also, fortification will not lead to a change in product characteristics of either the flour or the bread. In most mills, other micro ingredients are already being added, and thus the technology is already available.

Flour fortification has been proven to be safe and effective in countries such as the United States of America and Canada, where for more than 60 years wheat flour has been fortified with iron and other nutrients. Currently, flour fortification is a fact in both industrialized and developing countries, where physiological amounts of iron are added daily to foodstuffs that are consumed widely, thus providing most of the population with the required amounts of micronutrients.

In June 1999, after several years of collaboration with WHO/EMRO and UNICEF/MENARO in flour fortification in the Region, MI established a fund to assist countries of the Eastern Mediterranean Region “to accelerate action towards national flour fortification programmes”. The MI fund is in effect a partnership between the MI, WHO Eastern Mediterranean Regional Office and UNICEF/MENARO. The Centers for Disease Control and Prevention, Atlanta (CDC) has recently joined in with additional funding and expertise for monitoring and evaluating the extent of micronutrient deficiencies, and the impact of intervention on the prevalence patterns.

Proposals for funding from the MI fund have been received from 12 countries, and the areas covered by the proposals include:

- fortification technology
- hardware (feeders) and software (premix)
- advocacy, qualitative research
- baking and fortification trials
- baseline and impact assessments.

As of July 2001, the status of fortification of flour with iron and folic acid is as follows:

- 3 countries decided to, or are carrying out a pilot project or trial on flour fortification
- 1 country has successfully finalized a pilot project
- 8 countries have committed to national scale flour fortification and are dealing with logistics and/or constraints identified
- 1 major importing country decreed all imported flour must be fortified
- 3 countries already fortify their flour
- 7 countries are poised “on the brink”.

In the course of implementation of the flour fortification programmes in these countries, the programme managers identified several potential problem areas:

- technical feeders for premix
- regulatory standards that may not allow adding iron and other micronutrients
- financial concern as to who will bear the costs
- consumer acceptance since consumer awareness and demand are low
- lack of involvement of other sectors
- mistrust of the private sector
- frequent changes in government and policy.

Many of these obstacles can only be dealt with through effective communication.

The supporting activities of the WHO Regional Office for the Eastern Mediterranean include:

- provision of technical expertise to several countries in the Region
- development and distribution of specifications for premix
- development and distribution of advocacy tools, such as a website, and PowerPoint shows
- organization and attendance of advocacy sessions for various interest groups, such as politicians and millers
- provision of quality control training.

There are still a number of misconceptions that will have to be addressed by the regional and national programmes. It is, for instance, not well understood that anaemia is the end of a process, that a large proportion of the population is already iron-deficient without showing signs and that their health needs to be improved. Flour fortification is often seen by many as the only strategy to control anaemia rather than as one important, preventive part of a comprehensive set of strategies with a health promotion objective.

Two years ago, the Region embarked on a unique project to gain experience through "learning by-doing." Now it is time to take stock and plan for the future.

3. Major issues and constraints: how close are we to achieving flour fortification in countries of the Region?

In the Eastern Mediterranean Region, iron deficiency anaemia (IDA) prevalence varies, and is moderate to high in most countries. The solutions decided upon to reduce the prevalence of anaemia are: strategic action in
changing dietary behaviour, promotion of family planning and breastfeeding, various public health measures such as the reduction of parasitic contamination, targeted supplementation programmes for vulnerable segments of the population like growing children and pregnant women, and the fortification of suitable foods. Since the consumption of wheat flour, as bread or pasta, in the countries of the Eastern Mediterranean Region ranges from 225 to 500 grams per day, and averages 340 grams per day, the last strategy is suitable for most countries of the Region.

The preparatory activities of a flour fortification programme consist of assuring political support, thus policy level advocacy and education are the key components in the initial process. Since flour fortification is not an activity that ministries of health can undertake on their own, but do with the assistance of various other key ministries, the establishment of a multisectoral, national flour fortification committee, which will subsequently have the responsibility for the preparation of a national plan, is strongly recommended. In order to guarantee successful and timely implementation of flour fortification programmes, experience has shown that thorough preparation is of key importance. Thus, the mobilization of all interested parties at an early stage, assuring involvement of, and consideration for, all relevant opportunities and problems anticipated, will allow for successful implementation.

Once established, the actual activities of the flour fortification programme undertaken by the national committee should start with a thorough situation analysis. Essential components of this situation analysis are a review of all ongoing and past IDA related activities, plus rapid IDA surveys to establish the baseline, if no other prevalence studies have been undertaken, a milling sector review, flour consumption research, and policy, regulatory and standards review.

Another essential component, apart from the formation of a multisectoral national flour fortification committee for the prevention of possible barriers at a later stage of project implementation, is assuring the support of all other relevant sectors at the beginning of activities. This could be achieved through the organization of a national advocacy meeting in which all possible supporters and opponents are invited. Experience has shown that unless all sectors are involved from the beginning of a project, small problems that could be considered slight might become major barriers.

The actual launch of flour fortification is only to be considered when all components of the process are in place and have been tested, in order to guarantee sustainability of the process. Continuous programme impact monitoring and evaluation, and possible reprogramming if indicated, is
imperative, considering the large number of factors and interested parties that might influence the successful outcome of the programme.

The following technical and logistical components should be addressed in a flour fortification programme:
- feeder selection, procurement, installation and training
- premix procurement
- policy, legislation, and regulatory development
- food control system capacity building
- regulation, inspection
- small/laboratory scale production and trials
- baking trials
- consumer taste panels
- focus group discussions
- communications, education and social marketing.

Following the situation analysis, a review of the milling sector is important, with reference to feeder selection, procurement, installation and training especially. Then a decision must be taken as to the extent of fortification, whether all wheat flour or only bread wheat flour gets fortified, and the method that is appropriate. Care should be given to proper selection of feeder equipment, as well as installation. The operators of the feeder equipment must be thoroughly trained, not only in the operation of the machinery but also in all aspects of quality assurance since they will be responsible for calibration and of the equipment.

A decision must also be taken pertaining to the most suitable premix for a given situation with consideration given to the climatic conditions, logistical aspects and consumer habits. Factors such as centralized milling and baking, whereby conditions can be monitored, versus small-scale and private sector baking, and the sale of flour rather than wheat, as well as the local production of premix, will make a decision for one kind of premix more or less appropriate than another.

Throughout the preparatory phase, it is important to address policy, legislation and regulatory development, since this tends to be a lengthy process and has halted programmes in certain countries considerably. For this, the involvement of the relevant authorities, such as food control, standards and metrology, possible trade and commerce, is imperative.

In the preparation for the implementation of fortification, not only the operators of machinery and technicians responsible for quality assurance should be involved, but the food inspectors and analysts of the public food control system should be considered in capacity building. Some of the testing methods for fortified flour are not usually undertaken, and require equipment, chemicals and skilled analysts that might not be available in a
usual food control system. In this exercise of capacity building, attention can also be given to the organizational aspects of regulation and inspection.

In order to ensure that fortified wheat as well as bread will be of acceptable quality, small, laboratory scale production and trials, as well as baking trials and consumer taste panels, will enable the development of appropriate protocols for milling, analysis, and baking, in addition to assuring that the product will be of acceptable quality for the consumer. By holding focus group discussions with targeted, representative groups, representing all relevant stakeholders, it will be possible to identify strengths, weaknesses, opportunities and threats to a flour fortification programme. This will enable the programme managers to address needs for information and advocacy that might otherwise be overlooked. The focus group discussions should therefore ideally be implemented at a very early stage of the programme. The development of a thorough strategy for communications, education and social marketing that addresses all possible target audiences, and pre-empts possible negative publicity due to lack of information is of primary importance.

4. Premix, procurement, specifications, funding and local production issues

4.1 Iron fortification of cereal food staples: the Monterrey Workshop recommendations and guidelines for iron fortification of cereal food staples

Iron deficiency anaemia is one of the most prevalent public health problems in the developing world. Due to the high content of inhibitors in cereal products, iron absorption from food is low, which, combined with additional poor nutritional practices, results in staggering levels of IDA.

Elemental iron powders are the most common iron fortificants used worldwide. SUSTAIN (Sharing U.S. Technology to Aid in the Improvement of Nutrition) convened a meeting of expert scientists in Monterrey, Mexico in September 2000 in order to review bioavailability data of iron fortification of cereal food staples. (For more details see Annex 3). A guideline for iron fortification of cereal food staples was consequently published by SUSTAIN, which was endorsed by the Micronutrient Initiative.

In the selection of iron fortification, the following list of fortificants should be considered:

- **Haem iron compounds**: bovine haemoglobin
- **Non-haem iron compounds**:
  - Elemental iron
  - Ferrous sulfate
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- Ferrous fumarate
- Ferric phosphates
- Ferrous fumarate/gluconate
- Sodium iron EDTA.

However, in practice only a few of these compounds are used, because of high costs and impracticalities connected with using the other compounds. Therefore, a number of compounds have been used rather widely, such as ferrous sulfate, ferrous fumarate and elemental iron powder.

*Ferrous sulfate* has the distinct advantage that it is highly bioavailable, and can be used in low extraction flour (72%-78%). In bakery flour it has to be used within 1 to 2 months after milling. The powder should be a fine particle size, dried material. The disadvantages are that ferrous sulfate as a premix can cause colour and spotting problems, as well as storage and sensory problems in high extraction “brown” flours or extraction rates above 82%. The premix is therefore not recommended in products stored for extended periods, flour used in mixes with added fat and all-purpose flour.

*Ferrous fumarate* has the advantages that it is highly bioavailable, similar to ferrous sulfate, and in addition is insoluble in water, thus causing fewer organoleptic problems. Distinct disadvantages are that it is much more costly than ferrous sulfate, and has a dark-brown colour, which visibly darkens the colour of the bread.

*Elemental iron powders* are manufactured through several different methods of production, with each yielding a product that has distinct physical properties. There are three iron powders that are commonly used, carbonyl iron, electrolytic iron and reduced iron (Table 1).

Determining the addition level of premix for iron fortification will depend on a number of factors, including:
- prevalence of iron deficiency
- nature of the diet
- distribution of cereal foods
- bioavailability of the added iron.

The minimum addition level recommended to restore the iron present in whole grain products is 25 ppm iron for white flour. Higher addition levels may be necessary in countries with low flour consumption where iron deficiency is prevalent. For the Eastern Mediterranean Region calculations were made to determine the optimal levels of fortification, during the joint WHO/UNICEF/MI/ILSI Workshop, in Beirut, in Lebanon in June 1998. The WHO/UNICEF/MI Regional guidelines for flour fortification are: 60 ppm for reduced iron for white flour made with an extraction rate below
82% and a shelf life requirement greater than one month; and 30 ppm for ferrous sulfate for white flour made with an extraction rate below 82% and a shelf life requirement of less than one month.

Table 1. Physical properties and manufacturers of iron powders

<table>
<thead>
<tr>
<th>Powder type</th>
<th>Manufacturers</th>
<th>Particle size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-reduced (sponge)</td>
<td>Pyron Corporation, USA</td>
<td>325 mesh</td>
</tr>
<tr>
<td>H-reduced</td>
<td>QMP, Canada</td>
<td>325 mesh</td>
</tr>
<tr>
<td>CO-reduced (sponge)</td>
<td>Höganas AB, Sweden</td>
<td>325 mesh</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 mesh</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 mesh</td>
</tr>
<tr>
<td>Electrolytic iron</td>
<td>OMG Americas, USA</td>
<td>325 mesh</td>
</tr>
<tr>
<td></td>
<td>(Glidden A131)</td>
<td>(39%&lt;1.0 mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35% 1.0–2.0 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16% 2.0–3.0 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8% 3.0–4.4 mm</td>
</tr>
<tr>
<td>Carbonyl iron</td>
<td>BASF, Germany</td>
<td>325 mesh (&gt;99.5% Fe or&gt;90% Fe)(10%&lt;3.5 mm, 50%&lt;8.5 mm, 40%&lt;21 mm)</td>
</tr>
<tr>
<td>ISP, USA</td>
<td>325 mesh (mean particle size 5 mm)</td>
<td></td>
</tr>
</tbody>
</table>

*325 mesh means that ca. 95% of particles are <45 mm; 300 mesh means that ca. 95% of particles are <50 mm; 100 mesh means that ca. 95% of the particles are <150 mm

These guidelines are based on the best information currently available and may be subject to modification as more complete data on iron compounds becomes available. Based on presently available information, elemental iron (of the prescribed grade and size) and ferrous sulfate are still recommended for use in cereal flours in the Eastern Mediterranean Region.

4.2 Procurement of premix with the assistance of WHO

Procurement means the acquisition, through purchase, rental or lease, of goods and services. In WHO, two forms of purchase are described, overseas purchase, which is implemented by EMRO through headquarters, and local purchase, which is done through EMRO, the WHO Representatives' Office or directly from the supplier.
When ordering for purchase through WHO, the following requirements apply:

- identification of specific needs
- completion of WHO Requisition Form
- full description of requested items (i.e., catalogue and model number)
- supplier's name and address
- source of funding (i.e., extrabudgetary funds, reimbursable purchase).

The request process for supplies and equipment follows the procurement cycle:

- recognition of needs and verification of budget availability
- identification of detailed requirements
- development of specifications
- preparation and review of requisition
- placing purchase authorization or purchase order
- transport and insurance
- receiving and inspection at final destination
- evaluation and reporting.

Requests arriving at the procurement office will follow the cycle of requests, as outlined in Figure 1, in which the procurement officer will prepare the purchase authorization (PA), send it to WHO headquarters, request offers from suppliers, issue a purchase order (PO), and place the order with the selected supplier. The supplier subsequently delivers goods to a forwarder agent, who will ship the goods to their destination. There a clearing agent will arrange for custom clearance, and a receiving report will be issued, after which the file will be closed. Shipping duration may vary; for air freight approximately 10 to 15 days, for sea freight it ranges from 30 days to a few months and longer if trans-shipsments are necessary en route.

**Figure 1. The request process for supplies and equipment**
Local procurement may be effected provided that goods are of an internationally recognized standard quality, or are required urgently and are available for immediate delivery at a competitive cost, the difference in cost being considered reasonable.

With regard to the use of premix, the guidelines for the Region are 60 ppm elemental iron/folic acid or 30 ppm ferrous sulfate/1.5 ppm folic acid.

The prices of premix to date, July 2001, according to the type, range from US$ 3 per kilogram to US$ 13 per kilogram. Folic acid ranges from US$ 29 per kilogram to US$ 35 per kilogram. Packaging of premix as per specification is in 25 kilogram net weight polyethylene lined, heavy-duty, corrugated cardboard boxes.

4.3 Financing premix

The WHO regional guidelines for flour fortification specify fortification of wheat flour with 30 ppm iron from either ferrous sulfate, or 60 ppm elemental iron, and 1.5 ppm folic acid. The cost of fortification per metric tonnes of flour is half a US dollar, and with an annual consumption of 150 kilograms of bread per person per year, the annual cost increase per consumer is US$ 0.075. Per kilo of flour this is 0.06 cents extra, or per loaf of bread from 0.01 to 0.02 cents extra. The cost increase per person seems negligible, however, if the costs are extrapolated to the whole population, they suddenly become a considerable burden for the annual budget (Table 2).

There are several scenarios for financing the fortification of bread.
- The Ministry of Health pays the cost of fortification. This will need inclusion in annual budget of an amount for purchase of premix, as well as a process of tendering, ordering and distributing.
- Reduced taxation or tax rebates, whereby the government pays in a roundabout way. The government (Ministry of Finance, customs etc) does not have to make an actual payment but will lose some of their expected income.
- The milling industry pays. Costs may be spread out over many mills, but without price increases, or other financial mechanisms to ensure the market, the industry may not be very keen to absorb the cost, albeit small.
- The consumer pays. Ultimately this is the optimal solution, but there is the difficulty of implementation when a country heavily subsidizes or controls the prices for bread, which is the case in many countries of the Region.
Table 2. Cost increases of fortified bread in several countries of the Eastern Mediterranean Region

<table>
<thead>
<tr>
<th>Country</th>
<th>Per person per year</th>
<th>Per country per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average bread</td>
<td>Cost of</td>
</tr>
<tr>
<td></td>
<td>consumption (kg)</td>
<td>fortification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>per person (US$)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lebanon</td>
<td>123.0</td>
<td>0.07</td>
</tr>
<tr>
<td>Jordan</td>
<td>157.8</td>
<td>0.09</td>
</tr>
<tr>
<td>Republic of Yemen</td>
<td>119.4</td>
<td>0.07</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>180.3</td>
<td>0.10</td>
</tr>
<tr>
<td>Morocco</td>
<td>167.9</td>
<td>0.09</td>
</tr>
<tr>
<td>Egypt</td>
<td>146.5</td>
<td>0.08</td>
</tr>
<tr>
<td>Islamic Republic of Iran</td>
<td>159.9</td>
<td>0.09</td>
</tr>
<tr>
<td>Pakistan</td>
<td>135.9</td>
<td>0.07</td>
</tr>
</tbody>
</table>

4.4 Quality assurance of iron premix

The objective in flour fortification is not simply to add iron to the diet, but to increase the level of absorbable iron for the target population. Wheat flour, along with bread or other products made from flour, is a good vehicle for delivering additional iron because it is widely consumed, and because iron can be added with no effect on product quality or appearance, and at a very low cost. The stability of iron in wheat flour is good, and iron will hardly diminish during production, storage or baking. However, over time interactions between ferrous sulfate and the fat naturally contained in flour will cause rancidity. This interaction between ferrous sulfate and fat tends to increase with humidity and length of storage, as well as the amount of iron added. Reduced or elemental iron, and iron EDTA does not react with fat in flour and will not promote rancidity. The amount of iron to be added depends on two factors: the amount of flour consumed and the severity of
Flour fortification: reporting accomplishments

the iron deficiency. The interplay of stability and bioavailability governs the choice of iron fortificant. As a general rule, the more bioavailable the iron, the more likely it will cause organoleptic changes in the flour and flour products. On the other hand, iron compounds, which are more stable in flour, are less readily bioavailable.

Ferrous sulfate as premix has excellent bioavailability. However, over time it becomes unstable and reacts with the fats in flour. Therefore, ferrous sulfate is a good choice in flour destined for food processing and baking industries with a relatively quick turnover of the flour.

Elemental iron is about half as bioavailable as ferrous sulfate. However, elemental iron has the advantage of not interacting with the flour fat and thus can be stored for lengthy periods of time under a variety of conditions.

Iron-EDTA is a comparatively new chemical form and relatively expensive. However, it may be useful to consider in the case of high-extraction flours because it resists the absorption inhibiting effects of phytates in the flour.

The guidelines for premix addition are as follows:

- For white flour made with an extraction rate below 82% and a shelf life requirement of less than one month, add 30 ppm iron in the form of ferrous sulfate.
- For white flour made with an extraction rate below 82% and a shelf life requirement of greater than one month, add up to 60 ppm iron in the form of reduced iron.
- For brown flour with an extraction rate above 82% up to 20 ppm iron in the form of iron-EDTA or ferrous sulfate/ferrous fumarate plus EDTA in a 1:1 molar ratio of Fe to EDTA can be added.
- For semolina or flour used in pasta production, add up to 30 ppm iron in the form of ferrous sulfate.

Preparation of ferrous sulfate premix is as follows:

- Ferrous sulfate must be of anhydrous or desiccated form, and food grade.
- The material used as the carrier must meet food grade standards. Suitable diluents are food grade cornstarch, wheat starch, calcium sulfate or calcium carbonate with a similar particle size profile to the ferrous sulfate.
- Premix should be prepared shortly before use and kept in a cool, dry place. The ratio of ferrous sulfate to the carrier is 1:1.
- The quantitative analysis of the iron content in ferrous sulfate and premix should be done before use.
Quality control tests for fortified flour are:

- Documented sampling procedure at the mill must be revised to include the iron spot test to be carried out regularly for the fortified flour.
- The spot test must be run as an hourly test during the milling of the flour.
- The spot test must be run on the flour as the bags are packed using the existing documented square root sampling plan, i.e. for 600 bags, 24 samples are taken.
- The quality inspector at the mill should be responsible for the preparation of the samples for quantitative analysis. This sample should be made up of the packing samples, thoroughly blended into 1 sample for each 8 hour shift of production and tested daily (3 samples per day).

The test is carried out as follows:

- 5 grams of flour are made flat on a glass surface.
- Just before use, mix together equal volumes of the 10% KCNS and 20% HCl.
- Add a few drops of this mix to the flour.
- Then add a few drops of 3% hydrogen peroxide.
- If ferrous sulfate is present dark red spots will appear.

The quantitative analysis is carried out as follows:

- Put 2 grams of flour in a crucible.
- Place in a muffle furnace at 550°C for 6 H. until complete ashing.
- Dissolve ash in dilute HCl (0.1 N) and made up to fixed volume.
- Determine the iron concentration using the atomic absorption spectrometer.

### 4.5 Working groups work on premix issues

The working groups came to the conclusion that, in order to overcome the problems currently faced in premix procurement, funding and supply, more emphasis should be given to local production of fortificants, encouraging the private sectors to fortify flour, ensure that the price increase for consumers is non-existent for fortified versus non-fortified flour, and instigating social marketing campaigns. Furthermore, technical assistance must continue to be provided from international organizations.

In order to assure sustainable provision and availability of premix for flour fortification, several financing options must be considered. The Ministry of Health should assure financing of premix through sustainable funding, either from government or donor sources, a reduction of taxes as a government policy to ensure private sector interest, and the inclusion of all
stakeholders, such as the milling industry at local or regional production level, and consumers.

The outcome of the working groups will be reflected in the recommendations.

5. Communication issues

Consumer and leadership level research supported by WHO, MI and USAID showed some common features and parallels for the countries that were studied. The perceptions of anaemia, and the recognition of clinical symptoms but lack of awareness of "hidden" impact, seem to be connected to poverty and low status in society. Anaemia is considered a fact of life, a natural rather than dramatic event. Often the lack of iron is not connected to anaemia, but is the result of other factors such as pollution, calcium, and fast foods, so anaemia prevention is very low on the public health priority list. These factors, combined with misconceptions in the health sector and the common perceptions about bread, in all its dimensions, make an intervention such as flour fortification an interesting communication challenge. Ideas about bread are complex, with cultural, religious, natural, social, quality and nutritional dimensions.

Some general conclusions about iron fortification of bread can be drawn from research into perceptions and beliefs, including an initial receptivity to the idea of iron fortified bread, which ranged from acceptance, to neutrality, to suspicion. As people were informed of the benefits they became supportive and even enthusiastic. However, the requirements were that there was no substantial price increase, nor any noticeable change in the taste, smell or colour.

The public's negative perceptions of fortified bread are based on the assumption that there will be a change in the physical properties of the bread, that chemicals are being added into a natural product, that the fortification effort is purely based on the objective to raise the price of the bread, or to lower its quality, and that fortification is an exercise of manipulation by foreign interests. In addition, concerns about safety from the medical sector, as well as concerns about the quality assurance capacity of the industry, and confusion with supplementation and genetic modification of foods lead to misinterpretations.

Differences in ways and means of communication define the needs and approaches for a given setting. For the market environment, bread or flour is the 'vehicle' for a message, for the consumer environment demand or acceptance of that message will be critical issues. The language, nuance, and timing of the message, whether at the beginning of a programme or towards the launch of the fortification, all define the actual content. It is a
requirement to identify the perceptions of the population, in order to be able to identify the strategy for communication, whether this should remain at the level of public relations or should extend to a mass media campaign.

The optimum role for the WHO/UNICEF/MI fund is to provide technical expertise if and when required, to provide communication channels, to lend fortification efforts credibility and trust, and to provide the required financial resources for national programmes to initiate fortification efforts. The traditional role has been to lend direct assistance to national initiatives, to provide tools, training and capacity building, to set benchmarks, guidelines, best practices and to create an opportunity, a platform to share knowledge and experience. A potential new role might be to produce a regional campaign, aimed at public relations, with media advocacy through optimal channels such as spokespeople and celebrities. The use of existing regional networks is strongly encouraged. The objective of the programme in future should be to raise awareness and enlist support of leadership among medical and health personnel, government, industry and community leaders.

With respect to the actual content of the campaign, the development of generic material for a consumer campaign, as well as the possible development of a regional logo, will assist national programmes in the development of specific materials for use within their countries. The consumer campaign should aim to raise general public awareness of anaemia and promote consumer demand for fortified flour. Issues to be considered when developing this regional material are the objectives and the target audience. The design and language should be culturally appropriate, and a certain degree of quality assurance and control with respect to campaign material should be built in.

The recommendations of the Consultation on Communication needs in flour fortification, on which further information can be found in Annex 5, are that EMRO, in the implementation of the MI fund, should develop a communications training component, to be considered from programme inception; and develop generic and adaptable advocacy tools, documentary film and film elements. It was also felt that WHO should provide guidelines for a logo, a slogan and terminology for fortification. They should engage public relations experience to assist in capitalizing on regional communication channels to target influential and leadership groups, and consider individual assistance as requested under the MI fund guidelines.
6. Legislation and standards issues

6.1 Formalization of legislation

Preparatory activities for the implementation of a flour fortification programme include policy, legislation and regulatory development, as well as food control system capacity building and the development of regulation and inspection protocols. In order to be able to assure sustainable fortification of food, it is strongly recommended that these activities be initiated at an early stage of the programme.

The situation as to fortification within the Eastern Mediterranean Region at present differs: 3 countries are actually fortifying, and a fourth is receiving fortified flour, 10 countries are almost ready to launch, 8 countries have already developed legislation, while others are reviewing or developing it; a total of 15 countries have an active flour fortification programme, most with a multi disciplinary committee; 6 countries have multiple donors funding; and 4 countries have active collaboration with the private sector. An overview of legislation on flour fortification, globally and regionally, is provided in Annex 4.

At the FAO Consultation on Food Fortification: Technology and Quality Control, which was held in Rome, from 20 to 23 November 1995, it was stated that in the context of implementation of fortification programmes, efforts should continue to harmonize national legislation concerning fortified foods, with the international standards of the Codex Alimentarius. Food control systems based on Hazard Analysis and Critical Control Point (HACCP) principles, risk-based inspection procedures, and internationally accepted analytical methods should be developed in support of fortification programmes. The impact of food fortification on the nutritional status of target populations should be monitored so that appropriate corrective action can take place as required.

The practice of the addition of nutrients to foods may require additional legal provisions. Such provisions should cover the subject of the addition of nutrients horizontally across a range of foods. Product specific legislation should be discouraged unless strictly necessary.

Within the FAO/WHO Food Standards Programme, the Codex Alimentarius Commission has adopted General Principles for the Addition of Essential Nutrients to Foods. Such rules would be the responsibility of national authorities and respond to specific regional, national or even local situations.

Specific provisions may address:

- specific food vehicles to be chosen on the basis of the recommendations given above
specific nutrients that may be added to these foods

specific levels that would be appropriate for the situation.

The establishment of an advisory list of nutrients and nutrient compounds to be used in food fortification should be encouraged, similar to the advisory lists of mineral salts and vitamin compounds for use in foods for infants and young children detailed in the Codex Alimentarius. Such a list should be regularly updated taking into account new scientific and technological developments and data on safety, bioavailability, stability and other relevant data.

The selection of foods to which nutrients may be added should be guided by the principles set out in the appropriate Codex guidelines. Minimum levels for the addition of nutrients should be set in internationally recommended standards, according to the purpose of the addition. Furthermore, the setting of maximum levels should be considered for those nutrients for which there is evidence that excessive intake would result in undesirable effects.

It has already been stated that general labelling rules and specific rules on nutrition labelling should apply. A particular issue of interest is that of nutrition claims and health claims to be made for foods to which nutrients are added. Experience has shown that permitting the manufacturers to make relevant claims can enhance the success of food fortification programmes. Commercial realities would also advocate that such permission also be granted when nutrients are added voluntarily to foods. However, care should be taken that the use of claims does not result in practices that could either mislead or deceive the consumer, or distort the true value of the fortification.

The extent of legislative measures to be developed should not make fortification practices cumbersome nor restrict communication on the availability of the fortified food. The legislative development process should involve extensive consultation with the scientific community, industry, consumers and other relevant, interested parties.

Countries receiving food aid should be made aware of existing mechanisms for requesting fortified food products according to local requirements.

6.2 Standards

A food control system covers activities such as issuance of laws and regulations, government inspections and analyses, and quality assurance by industry. An efficient food control system is needed for food fortification processes to meet nutritional objectives. Inspection procedures should be
risk based, and quality assurance procedures at the production level should be based on HACCP.

Inadequacies in the food control system at any or all stages in the production–consumption chain have a cumulative contribution to the deterioration of product quality. This results in economic losses, loss of product reputation and social development setback when the expected impact, in terms of benefit to target population groups, is not realized.

Major obstacles to the implementation of adequate food control system programmes occur when material sourcing, production, packaging, storage, transport conditions and delivery systems are sub-optimal. Poor or variable quality of raw materials, unreliable and poorly fabricated equipment, and inadequate manufacturing and marketing facilities lead to poor product quality.

The lack of efficient and skilled human resources to carry out an effective food control system both at the production and the government levels, coupled with limited training opportunities is another major obstacle.

Legislation and regulation may not be well developed nor enforcement mechanisms established to ensure that government standards are met. The lack of adequate political, financial and technical support of an efficient monitoring and surveillance system is often the cause of failure.

Government, industry, and the consumer need to collaborate to make the food control system work effectively. There should be multisectoral participation in the development of necessary laws, regulations and standards, and the commitment of government to their enforcement through adequate monitoring, inspection and surveillance. Adequate training of people at all levels of the food control system should be a priority.

An aspect of food control requiring attention that is specific to control of fortified foods is the selection of methodologies for the determination of vitamin and mineral content of foods. Methodologies used must be internationally recognized, but must at the same time take into account local circumstances. While developing food standards, the guidelines of the Codex Alimentarius (Standard 152-1985 for Wheat Flour) should be taken into consideration.

It is recommended that food control and regulation officials are included in the fortification efforts from day zero, all existing legislation and standards are reviewed, new horizontal legislation allowing for fortification of food products are developed and fortification of vertical product groups is specified.
7. Quality assurance and control issues

The definition of quality assurance is: "All matters and activities that influence the quality of a product." Quality assurance applies to equipment, product design, processing, supplies, logistics, management and human resources. In the case of flour fortification, the matters and activities are feeders, premix, packaging, labelling, sampling, etc. The objective of quality assurance is to ensure that the products meet quality standards for their intended use at the consumer level.

Quality control are those activities that are concerned with sampling, testing, specifications with the organization, documentation and release procedures, in order to ensure that tests are carried out and products not released until quality standards are met.

The country requirements for quality control are the presence of standards, operating manuals and protocols. For a fortification programme therefore, standards for fortified food, as well as premix specifications, should ideally be based on the WHO regional guidelines or the GCC Standard. In addition, background documentation on the safety and toxicity assessment of vitamins and minerals, based on existing Codex Alimentarius Standards or Food Chemicals Codex (FCC) standards, is required, as is determination of the shelf life, both of the premix as well as the fortified food. The recommendation for premix is a maximum of 2 years, for fortified flour 6 to 12 months, depending on the extraction rate.

Country requirements for proper quality assurance include the implementation of hazard analysis in order to establish critical control points according to the HACCP system. These are variable, and must be based on the individual milling system, the specific location of feeder equipment, and the weighing system. The establishment of an adequate recall system, as well as a protocol for audit and corrective action, combined with quality assurance system documentation, will further help to ensure adequate quality assurance. Optimal analytical laboratory facilities, both at central and regional level, as well as adequate legal provisions, flour standards and regulations, and legislation for standards and enforcement, will further optimise the quality assurance activities. The legal provisions should ideally cover the following subjects: internal monitoring, or routine examination of processes and procedures by industry, and external monitoring by government. This should provide information for enforcement of laws and regulations.

In order to implement a quality assurance system, a monitoring programme should be initiated. Requirements for such a programme are a monitoring and sampling plan, as well as a list of producers. Producers and
importers must be monitored according to a given sampling frequency. All data must be noted and accessible. Fortification must be guaranteed if obligatory by law.

The requirements for premix are described in the specifications. Regarding the purity of the ingredients, these must be as described in Food Chemicals Codex (FCC), the United States Pharmacopoeia (USP) or the British Pharmacopoeia (BP). Clarity as to the selection of elemental iron versus ferrous sulfate, required dosage levels, and storage conditions, for example, cool, dry, and dark, must be assured to all handlers of the premix. Stock rotation using the first-in-first-out system, in order not to waste stocks, should be applied. A Certificate of Analysis, issued by the supplier, should accompany each batch of ingredients.

The quality assurance requirements for the milling industry include partnership from the industry vis-à-vis the fortification activities. Thus it is strongly recommended that the industry be involved and consulted in the purchase of equipment and premix supplies. Routine inspections of processing equipment, calibration and validation of the blending process for consistency, as well as routine monitoring of flour ready for distribution, in combination with up to date records, will further ensure that the products' quality can be assured.

Requirements for quality control in the mill include feeder calibration, calculations of feed rate, with the establishment of process controls, and the development of a schedule for weighing, standards and sampling. There should be a description of a protocol for the iron spot test, in combination with record keeping, and regular quantitative laboratory analysis.

In Table 3 the feed rate calculations are presented for mills of various capacities.

<table>
<thead>
<tr>
<th>Mill capacity (MT)</th>
<th>25 MT</th>
<th>100 MT</th>
<th>500 MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kg/min</td>
<td>17</td>
<td>69</td>
<td>347</td>
</tr>
<tr>
<td>Premix (g/MT)</td>
<td>600</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Add rate (g/min)</td>
<td>10.2</td>
<td>13.8</td>
<td>69.4</td>
</tr>
<tr>
<td>Premix use (kg/hr)</td>
<td>4.9</td>
<td>6.6</td>
<td>33</td>
</tr>
</tbody>
</table>

In order to verify that premix is added at correct levels, the establishment of an inventory control system is strongly encouraged. Such a system could be relatively simple, and must be maintained regularly, with
in-built controls and prescribed measures for those situations where addition levels are not correct. A possible system is shown in Figure 2.

Other considerations in an effective quality assurance programme are the selection of the method of analysis, for iron this should be Atomic Absorption, Spectrophotometric, for vitamins it should be HPLC, GC. The use of official analysis methods as described by ICC, AOAC, or AACC is strongly encouraged. An analytical variation for iron of ±25% and for folic acid of ±50% is considered acceptable.

<table>
<thead>
<tr>
<th>Premix</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Starting inventory</td>
<td>kg</td>
</tr>
<tr>
<td>B Amount purchased</td>
<td>kg</td>
</tr>
<tr>
<td>C Ending inventory</td>
<td>kg</td>
</tr>
<tr>
<td>D Amount used (A + B - C)</td>
<td>kg</td>
</tr>
<tr>
<td>E Production of fortified flour</td>
<td>MT</td>
</tr>
<tr>
<td>F Addition rate (D * 1000 / E)</td>
<td>G/MT</td>
</tr>
<tr>
<td>G Target addition rate</td>
<td>G/MT</td>
</tr>
<tr>
<td>H Percentage of target (100*F/ C)</td>
<td>%</td>
</tr>
</tbody>
</table>

Figure 2. Fortification premix control records

Finally, the criteria for assessing the adequacy of a fortification programme are summarized in Table 4.

Table 4. Criteria for assessing adequacy of a fortification programme

<table>
<thead>
<tr>
<th>Level of measurement</th>
<th>Process indicator</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill or importer</td>
<td>% Flour fortified claimed by producer</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>% Flour effectively fortified</td>
<td>Minimum 90%</td>
</tr>
<tr>
<td></td>
<td>Internal monitoring</td>
<td>Minimum 90%</td>
</tr>
<tr>
<td></td>
<td>External monitoring</td>
<td>10-12 times per month per mill</td>
</tr>
<tr>
<td>Consumer</td>
<td>% Monitoring sites with adequately fortified flour</td>
<td>90% of samples adequate</td>
</tr>
<tr>
<td></td>
<td>Adequacy of monitoring</td>
<td>Monitoring in 90% of sites</td>
</tr>
</tbody>
</table>
8. Status of flour fortification programmes in countries of the Region

8.1 Bahrain

Bahrain has had a national strategy for prevention and control of iron deficiency and anaemia since 1998. Components of this strategy are:

- iron/folate supplementation programme
- dietary diversification programme
- flour fortification programme using elemental iron 60 ppm and folic acid 1.5 ppm.

So far, according to the work plan, a number of essential components have been implemented. The prevalence of iron deficiency anaemia has been established (Table 5). Consumption data for wheat flour, the potential vehicle, have been collected. This has established that consumption of wheat is approximately 200 to 250 gm per day. All flour consumed in Bahrain is imported, either as wheat or as flour. The decision makers have been familiarized with the subject of flour fortification. In 1998 a “National Fortification Task Force” was established, consisting of representatives from the Ministries of Health and Commerce, and the Bahrain Flour Mills Company. Standards and legislation that allow for the fortification of flour were established in 1999. Equipment was purchased, in coordination with Flour Mills Co. in 2001. A plan for social marketing, based on the outcome of focus group discussions, has been developed. A national education campaign was undertaken in July 2001 in coordination with governmental and nongovernmental organizations. Training programmes for public health laboratory staff and flour mills staff on technical issues related to programme implementation as well as laboratory testing for quality assurance have been undertaken since 1999.

The official launch of fortification on a national level is planned for September 2001. Premix funding will initially, for the first year, be by the Ministry of Health, but afterwards be the responsibility of the Ministry of Commerce.
Table 5. Anaemia among different age groups in Bahrain

<table>
<thead>
<tr>
<th>Age group</th>
<th>Data available on Reference Year</th>
<th>anaemia prevalence</th>
<th>Reference</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant women</td>
<td></td>
<td>33.5% anaemic (Hb &lt; 11 gm/dl).</td>
<td>Moussa K, Ahmed Z. 'Assessment of the iron status and dietary intake of pregnant women in Bahrain'. Ministry of Health, Bahrain</td>
<td>1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40% (IDA or at risk)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.1% (IDA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>low Hb and low serum ferritin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>41.9% anaemic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-school (≤ 5 yrs.)</td>
<td>48.3% anaemic → Hb &lt; 11 gm/dl</td>
<td>Report in Progress 1997</td>
<td></td>
<td>1997</td>
</tr>
<tr>
<td>School (6-18 Yrs.)</td>
<td>Boys = 31.3% anaemic → Hb &lt; 12 gm/dl</td>
<td>Data not yet published</td>
<td></td>
<td>1999</td>
</tr>
<tr>
<td></td>
<td>Girls = 41.5% anaemic → Hb &lt; 12 gm/dl</td>
<td>(unpublished data)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults and elderly</td>
<td>Male = 20.9% anaemic → Hb &lt; 13 gm/dl</td>
<td>National Nutrition Survey</td>
<td></td>
<td>1999</td>
</tr>
<tr>
<td></td>
<td>Female = 37.3% anaemic → Hb &lt; 11 gm/dl</td>
<td>(unpublished data)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elderly population &gt;60 yrs. → low Hb = 58%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.2 Egypt

IDA is the most severe of the micronutrient deficiency problems in Egypt (Table 6). A study by the Nutrition Institute, undertaken in 1998, showed that the dietary iron intake is below 75% of the recommended daily allowance. The major dietary sources are cereals, which all have low iron bioavailability, and there is a high consumption of tannins, phytates and dietary fibres in the Egyptian diet. Fruits and vegetables comprise a small part of the diet, as do haem iron sources, which are generally rather costly. Furthermore, parasitic infestations in schoolchildren range from 17% to 20%. (Curtail et al. 1998)
In the national plan of action that was developed in 1994, the micronutrient deficiencies were addressed. Specific subjects addressed were supplementation, prevention and control of infectious diseases, fortification of flour with iron, and nutrition education.

The iron fortification of foods in Egypt started with a school biscuit programme, implemented by the Ministry of Health and the Ministry of Education, in which schoolchildren get 80 gram packets of biscuits that are fortified with 4mg to 5mg of iron. Furthermore, complementary foods have been developed that provide 7mg to 7.5mg of iron per 100g, as well as infant formulas, which provide 6mg to 9mg of iron per 100g. Pasta marketed by the private sector provides 5mg of iron per 100g.

About 70% of wheat flour is subsidized by the government (82% extraction rate) for brown flatbread (balady) production. This flour is milled either in roller or stone mills. About 30% of wheat flour (72% extraction) is used by the private sector for white bread, biscuits, confectioneries, and macaroni.

A trial for the fortification of balady bread has been approved by the Minister of Health for implementation through the Ministry of Supplies, and is planned to start in 2001. The population covered will be 500 000. The fortificant is 30 ppm food grade FeSO₄; the premix will be manufactured locally. Part of the project activities, such as the development of social marketing material based on the outcome of focus group discussions, technical training of staff of the Nutrition Institute and several mills, have already been implemented. Obstacles faced in the implementation are mainly due to the large number of involved parties, which make a coordinated execution of the programme problematic.

8.3 Islamic Republic of Iran

There has been a formal nutrition strategy since 1994, and the reduction of iron deficiency anaemia is part of it. (Prevalence figures of anaemia for
the Islamic Republic of Iran can be seen in Table 7. Its component strategies are: nutrition education and food diversification, iron supplementation, public health education and food fortification. In 1996, flour fortification on a small scale was conducted in one of the districts in Isfahan.

A national committee was established in 1999, and is comprised of representatives from the following institutions: Nutrition Department, Food Safety Department, Food and Drug Laboratory in the Ministry of Health and Medical Education, Nutrition Research Institute, State Grain Organization (SGO), Bread Research Institute, Self Sufficiency and Research for Milling, and baking and other related industries.

Table 7. Prevalence of anaemia in the Islamic Republic of Iran

<table>
<thead>
<tr>
<th>Population group</th>
<th>Prevalence of anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children 6 months to 5 years</td>
<td>10%-40% ID</td>
</tr>
<tr>
<td></td>
<td>15%-30% anaemia</td>
</tr>
<tr>
<td></td>
<td>15%-25% IDA</td>
</tr>
<tr>
<td>Children 5-14 years</td>
<td>38.8% ID (SF&lt;12 microgram/L)</td>
</tr>
<tr>
<td>Pregnant and lactating women</td>
<td>25%-55% ID 20%-43% anaemia,</td>
</tr>
<tr>
<td></td>
<td>15%-25% IDA</td>
</tr>
<tr>
<td>Non-pregnant women</td>
<td>ID 34.5%, anaemia 33.4%, IDA</td>
</tr>
<tr>
<td></td>
<td>16.6%</td>
</tr>
<tr>
<td>Adult men</td>
<td>ID 9.9%-11.9% anaemia 7.9%-9.9%</td>
</tr>
<tr>
<td></td>
<td>IDA 0.3%-1.4%</td>
</tr>
<tr>
<td>Elderly population (above 60</td>
<td>anaemia 20%-25%</td>
</tr>
<tr>
<td>years)</td>
<td></td>
</tr>
</tbody>
</table>

The results showed an increase in haemoglobin in the target population. Based on the success of these activities, a larger scale flour fortification programme was started in Bushehr province, where the population was 800,000, in early 2001. Bushehr province was selected for several reasons. It has a high prevalence of iron deficiency and anaemia among women of childbearing age, 50% iron deficiency according to a survey in 1996. There is efficient health management in the province, and a high level of commitment, as well as a strong primary health care network. It has quality control laboratories for monitoring the amount of iron in the fortified flour. All the flour consumed is produced in two large-scale mills. Furthermore, in this province, sodium bicarbonate is used in bread, and this trial will provide a good opportunity to check whether the remaining phytate inhibits absorption of the added iron. The daily average
consumption of flour per capita is 400 grams, and flour is either produced locally or imported.

Legislation has not yet been amended to allow for the fortification of flour. Equipment for the mills has been procured, as well as premix, and an "advocacy meeting" with the Governor, and all the policy-makers of Health in Bushehr was convened. Following this, a multisectoral announcement meeting for all the related official authorities (education, television, radio, literacy movement, agriculture, industry, commerce, etc.) was convened, to launch the fortification. The standard qualifications of the premix used are 60 ppm elemental iron, 1.5 ppm folic acid. The first batch of premix was procured internationally, but in the future premix will be produced locally, and the constitution will be 30 ppm ferrous sulfate and 1.5 ppm folic acid.

The successes of the flour fortification programme are that very strong political commitment has been obtained, and financial support by the Governor in the project area has been offered. Health personnel of the relevant sectors are involved very actively. Furthermore, the private sector is interested in assisting by producing local premix, and generally there is good acceptance by people for iron-fortified bread.

The weaknesses identified are the low quality of wheat and flour, the practice of adding sodium bicarbonate instead of yeast for making bread, which leaves high levels of phytate in bread, and a lack of general consensus among nutritionists, especially scientific members of the committees.

8.4 Jordan

Iron deficiency anaemia is considered a major public health problem in Jordan. The prevalence of anaemia is about 35% among pregnant and lactating women, 28% among mothers of reproductive age, 15.3% among school children (20% in high risk areas) and 8.8% among infants.

A number of strategies are followed to combat iron deficiency anaemia, including iron supplementation, dietary counselling, exclusive breastfeeding for six months and control of infections and parasitic diseases. Flour fortification was recommended through the Jordanian national plan of action for nutrition in 1996.

Estimates for total wheat consumption in Jordan are about 500,000 metric tonnes per year by Jordanian millers. The daily average consumption of bread per capita is 500 grams.

There are 10 mills in Jordan, distributed all over the country. Most of them are technically sophisticated and can easily adapt feeders and fortification technology. Balady bread has been introduced and promoted by the government as a lower cost bread.
A Ministry of Health position paper was prepared and submitted to the Minister of Health, who committed to the project. A multisectoral national fortification committee was established, that planned and conducted technical trials on the acceptability of bread prepared from fortified flour and the action of iron during processing. A two-day multi-sectoral technical workshop was held to review results of technical trials and produce a consensus on the technical strategy to implement national fortification. The conclusion of the trial showed that the addition of 30 ppm of iron as ferrous sulfate resulted in bread with lower colour and flavour scores but the fortified bread is still acceptable, even among the public. Neither the bread type, nor the bakery, or bread storage had significant effects on the total iron in the bread.

Legislation has not been amended yet to allow for the fortification of flour.

Due to limited resources and shortage of money, although there is a higher commitment, the programme may face some implementation problems. However, the cost of the fortification premix will be included in the cost of the wheat provided by the government of Jordan.

By the year 2002 flour fortification should be implemented all over the country and in all the mills in Jordan.

8.5 Lebanon

Prevalence of iron deficiency anaemia for children from 6 months to 5 years seems high, considering there is a prevalence of 23% of low serum ferritin (1997). For women, pregnant, lactating, and non pregnant, the prevalence of low serum ferritin is 27%.

Lebanon has formulated a project for flour fortification as part of the strategy for the control and prevention of iron deficiency and anaemia. Components of this strategy are the control of parasitic infestations through health education, nutrition education on absorption inhibitors and enhancers, fortification of flour, and supplementation for pregnant women and children from 6 to 18 months.

The ministries of health and industry are responsible for the implementation of the flour fortification programme. Fortification will be on a national level. The average daily consumption of flour is 250 grams per capita. Wheat is both imported and produced locally. Lebanese standards for flour have been amended to allow for the addition of iron, ferrous sulfate and other micronutrients.
8.6 Libyan Arab Jamahiriya

A committee is presently studying the implementation of a decision from the People's General Committee of Health and Social Insurance, issued in 1999, that states that all flour imported into Libyan Arab Jamahiriya must be fortified with 30 ppm ferrous sulfate or 60 ppm elemental iron, and 1.5 ppm folic acid. The Ministry of Health, National Centre for Food Control and Inspection, General National Company for Mills and Fodder, National Centre for Standardization, NASCO, and the national procurement office, are all members of this committee, which was established in February 2000. The average daily consumption of flour per capita is 330 grams.

8.7 Morocco

Morocco has an overall strategy for micronutrient deficiency control and a multisectoral partnership that targets comprises all micronutrient deficiencies. The iron deficiency anaemia strategies are supplementation, fortification, nutritional education and public health measures, for all micronutrients, and include the fortification of flour as one of the strategies.

A technical file has been compiled, including all available publications on flour fortification, as well as a rationale for the calculation of the fortification level.

The strategy is implemented by a committee, which has representatives from the Ministry of Health, Ministry of Agriculture, Ministry of Commerce and Industry, the Hassan II Institute for Agronomy and Veterinary Science, the Ibn Tofail University, Faculty of Science, Rabat and Casablanca University Hospital Centres, the National Federation of Flour Millers, USAID, MOST, CMS and WHO. The Ministry of Health is responsible for the implementation of the programme.

Flour fortification will be on a national level. The average daily consumption of flour per capita is 365 grams. Morocco has national production of wheat, which is supplemented by import. Legislation is presently being revised. The procurement of the feeders will be by the millers. The fortification rate is 1.53 ppm folic acid and 45 ppm iron. Flour millers conducted a study on bread fortified with iron, and this bread was tasted at the Flour Millers Institute and in the National Micronutrients Committee at the Ministry of Health. There is an advocacy strategy for the senior and middle decision makers. Among the developed tools is a brochure on fortified flour.

National communication strategy and media campaigns are being developed through television and radio adverts. The National Federation of Flour Millers will fortify, as well as purchase, the premix and feeders. The
flour millers are very much involved and very enthusiastic. The launch, on a national scale, is scheduled for just before Ramadan, 2001.

### 8.8 Oman

The downward trend in anaemia prevalence in Oman, as shown in Table 8, can partly be explained by increased family planning efforts and supplementation for pregnant women. The fortification of flour, which started in 1997 and covers all of the 2.5 million population, is hoped to further reduce the prevalence.

**Table 8. Anaemia prevalence in Oman**

<table>
<thead>
<tr>
<th>Year</th>
<th>Population group</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>Women</td>
<td>55.9%</td>
</tr>
<tr>
<td>1992</td>
<td>Pre-school children</td>
<td>60.2%</td>
</tr>
<tr>
<td>1992</td>
<td>Pregnant women</td>
<td>48.5%</td>
</tr>
<tr>
<td>1995</td>
<td>Pre-school children</td>
<td>46.4%</td>
</tr>
<tr>
<td>1996</td>
<td>School-age children</td>
<td>51.46%</td>
</tr>
<tr>
<td>2001</td>
<td>Pregnant women</td>
<td>38%</td>
</tr>
<tr>
<td>2001</td>
<td>Non-pregnant women</td>
<td>40%</td>
</tr>
<tr>
<td>2001</td>
<td>School-age children</td>
<td>41.4%</td>
</tr>
</tbody>
</table>

In 1997 a Ministerial Decree was issued on the fortification of white flour with 30 ppm iron and 1.5-2.0 ppm folate. In Oman, rice and bread are the basic staples. Two major mills supply 80% of the country's flour, which is presently fortified. All imported white flour is fortified. A number of small mills produce whole-wheat flour. Fortification is totally funded by the private sector.

Efforts are presently under way to increase the fortification level to 60 ppm as per WHO recommendations, and to include all flours, white as well as brown.

### 8.9 Pakistan

Pakistan has a national plan for 2001 to 2011, in which the strategy to control iron deficiency anaemia is outlined. This is part of a strategy for the control and prevention of micronutrient deficiencies.

The overall plan to control iron deficiency has three components:
- supplementation of target groups
- food fortification
- food diversification.
There is a committee to oversee the flour fortification programme, which was established in 1998. The main institutions represented in this committee are the Federal Ministry of Health, Ministry of Food Agriculture, wheat flour producers and international organizations. The Ministry of Planning and Development and the Nutrition Institute are responsible for the implementation. The Government of Pakistan provides the premix. The project is on a pilot scale in two provinces, and will cover a population of about 10 million. The daily average consumption of flour per capita is 342 grams. Most of the flour is produced nationally, but a very small proportion is imported. Fortification is covered in the Pure Food Act, dating back to 1965.

There has been a national consultation on wheat flour fortification, to familiarize decision makers with the subject, and workshops were organized to involve all other stakeholders. The population will be educated through a mass communication campaign organized by the Federal Ministry of Health, based on a knowledge, attitudes and practices study. Mass awareness activities to promote the consumption of fortified flour are being planned.

Overall the wheat flour production processes can be divided into two categories: firstly the small scale grinders, covering 55% of the total product, and secondly the modern large scale flour-milling sector, which covers the remaining 45%. Both processes differ, and therefore, addressing the fortification issue has to be through two disjointed sectors. However there are common constraints, such as the lack or low level of awareness among the public, existence of negative rumours, and problems with technological aspects, cost sharing and quality control.

8.10 Qatar

Fortification of flour with iron and folic acid is part of the plan for the control and prevention of iron deficiency and its anaemia in Qatar. The Ministry of Public Health has, in discussion with the flour mill authorities, developed a work plan for fortification. The Ministry of Economy and Finance, through the Standards and Methodology Department, is also involved in the project. Funding of the project will be completely covered by the private sector. Fortification of wheat flour will be on a national level, and cover the whole population of 600,000. The wheat is imported from Australia according to the specifications of the Government of Qatar. Legislation has been amended to allow for the fortification of wheat flour, as per regional guidelines. The wheat flour is used for the production of flat bread, spongy bread, cakes, biscuits etc. Monitoring will be done on a national level, using Atomic Absorption Spectrophotometrical (AAS) methods, by the laboratories.
in the mills, the public health laboratories, and the food monitoring laboratories.

8.11 Saudi Arabia

In 1998, Saudi Arabia developed a national eradication programme, which was presented in a symposium on nutritional anaemia. However, fortification on a national level began as part of the normal milling procedures with the start of milling operations in newly built mills, which became operational in 1978, and which were built complete with micro feeder equipment. Initially fortification was seen purely as a process to compensate for micronutrient loss during milling and extraction. Later it was supported by scientific surveys to use flour fortification to combat the micronutrient deficiencies. When fortification became a public health issue, a committee was formed to initiate a comprehensive flour fortification programme. This committee is composed of the Grain Silos and Flour Mills Organization, which is a government institution, the Saudi Arabian Standards Organization (SASO), the Nutrition Department of the Ministry of Health, the Ministry of Commerce, as well as the Ministry of Agriculture and Water and the Ministry of Municipality and Rural Affairs.

The average per capita consumption of flour is 258 grams. All the wheat consumed in Saudi Arabia is locally produced. Saudi Arabia is self-sufficient in wheat production, and actually exports wheat.

Legislation has been amended to allow for the fortification of flour, and SASO has formulated and issued the guidelines and specifications. The fortification levels are reduced iron 26.47 ppm and folic acid 1.44 ppm. In addition, other micronutrients are added as well, such as niacin, thiamine, riboflavin and calcium phosphate. Premix is imported. The wheat flour is used for bread, semolina, biscuits, cakes, pizzas and other baked products.

A meeting for all decision-makers and other concerned parties was organized to inform them on studies related to nutritional anaemia, iron deficiency and fortification.

As of date no studies have been carried out to assess the benefits or successes of the flour fortification programme. However, no complaints have been received from the public so far regarding the taste or any effects of fortification, and it is assumed that the flour fortification programme is well accepted.

8.12 Syrian Arab Republic

The Syrian Arab Republic has had a national plan for the prevention and control of micronutrient deficiencies, including iron deficiency and its
anaemia, since 1997. Fortification is part of this plan, and a project in which the MI fund and UNICEF are both contributing has been ongoing for a number of years.

The responsibility for the implementation of the flour fortification programme is shared between the Ministry of Health and the Ministry of Supply, with implementation being undertaken by the Ministry of Health. The initial phase will be a pilot project, covering 140,000 of the population.

The average daily consumption of flour per capita is 400 grams for men and 300 grams for women. All wheat is produced nationally. Legislation has not been amended. Fortification will be according to regional guidelines, which specify 30 ppm ferrous sulfate and 1.5 ppm folic acid. The flour will be used for the production of bread.

8.13 United Arab Emirates

Since 1994, when the Ministry of Health established a nutrition division in the Maternal and Child Health department, there has been a strategy for the control and prevention of micronutrient deficiencies that includes iron deficiency anaemia. The plan incorporates nutrition education, aiming at diet modification and supplementation. Presently, the health authorities in the United Arab Emirates are in the process of evaluating the situation through suitable research to plan for flour fortification in the near future. For the implementation of a flour fortification programme, the Ministries of Health, Agriculture, Finance, Industry and Municipality will be responsible. The daily average consumption of bread per capita is 100 grams, and fortification will be at 36.3 mg of iron per kilogram of flour. Legislation has not yet been amended to allow for the fortification of bread with micronutrients.

8.14 Republic of Yemen

The Republic of Yemen has a national strategy for the control and prevention of micronutrient deficiencies. This includes a plan for the control and prevention of iron deficiency and its anaemia by the distribution of supplements to vulnerable groups, and flour fortification. Legislation was developed and approved: decree 165 of 5 June 2001, was issued and signed by the Prime Minister. An advocacy workshop is being organized to inform key flour producers and the public. Technical guidelines to the field health workers of different levels are under development. There is no national committee to oversee the flour fortification programme. The ministries responsible for the implementation of the flour fortification programme are the Ministry of Public Health, Trade, Housing and Environmental Health.
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and Industry. Funding of the programme will be partly private, by the flour mills. The daily average consumption of flour is 2 kilograms per family and the average size of families is six. Wheat is grown and produced locally, imported and donated. Fortification will be according to the Regional guidelines, 60 ppm elemental iron and 1.5 ppm folic acid.

9. Conclusions

Currently, Afghanistan, Bahrain, Egypt, Islamic Republic of Iran, Iraq, Jordan, Pakistan and Syrian Arab Republic are implementing a project with funding from the MI fund. In Lebanon and the Republic of Yemen contracts have been cancelled because of the expiry of the contract and the non-commencement of activities within the contract period. In both countries efforts for the re-establishment of a feasible programme are under way.

In the Eastern Mediterranean Region the visibility of the flour fortification programme is high, through continued attention being given to the subject at various forums, and through the collaboration between the various agencies involved, specifically UNICEF and WHO. Where it is feasible, keeping in mind the presence of favourable factors such as political willingness, a strong motivator in a central role, and a favourable consumer population, flour fortification has been introduced or will be soon. In those countries where the project has failed to proceed there is either a need for more time for all required preliminary activities to be finalized, or a lack of one of those factors. The leadership role played by the Regional Office in flour fortification is clearly established. Collaboration with MI is through the provision by MI of either funds or consultants with technical expertise. Both UNICEF and EMRO have been providing a regular budget for the provision of equipment and training. In the most recent Joint Programme Review Mission 2002-2003 rounds, various countries, namely Islamic Republic of Iran, Iraq, Jordan, Kuwait, Syrian Arab Republic and United Arab Emirates have allocated regular budget funds for flour fortification activities.

Flour fortification is progressing in Islamic Republic of Iran, Oman and Saudi Arabia, in collaboration with the World Food Programme’s bakery project, in Afghanistan. Currently 22.5 million people in the Region have access to fortified bread. During the intercountry technical review meeting, Bahrain, Jordan, Morocco, Qatar and the Syrian Arab Republic announced that they are planning to launch fortification on a national scale in the coming months, which will mean that 50 million people in the Region have access to iron fortified bread.

During the meeting, two main challenges to the implementation of flour fortification were identified: firstly, technical challenges, such as
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Premix, equipment and analysis specification, and assessment methods, then sustainability of flour fortification in view of the recurrent costs in the form of micronutrient premix procurement. While costs of premix per capita, if compared to the health budget, are very low, the cost on a national level is considerable.

The Regional Office is currently seeking further funds to be able to continue providing technical expertise to countries in the implementation of national flour fortification programmes. At the same time, in order to assure sustainability, it is strongly recommended that Member States ensure continued political support for, and multisectoral involvement to, their national flour fortification programmes.

Further issues requiring focus in the Member States are the local production of fortificants as a way to assure sustainable provision and availability, as is currently being studied and implemented in Egypt and the Islamic Republic of Iran; and the updating of relevant legislation to ensure that fortification is in fact permitted, in line with the Codex Alimentarius guidelines. Fortification regulations and legislation are considered an essential requirement for the attainment of public health, to prevent them from being a possible barrier to trade under World Trade agreements.

The intercountry meeting reviewed and accepted the recommendations of the consultation on communication needs in flour fortification (Annex 5) and incorporated these in the recommendations below.

10. Recommendations

1. The provision of expertise, in all relevant fields, should be continued by Regional Office, in the implementation of the MI fund, as well as the facilitation of a continuous exchange of technical expertise within the Region.

2. WHO and its partners should promote flour fortification in all countries of the Region.

3. In future, WHO should more closely involve potential partners such as the Arab League of Ministries of Health, Arab Women's Association, GCC, Health Ministers Council, and General Secretariat and similar bodies in the implementation of the flour fortification project.

4. WHO should explore regional communication channels, in order to target influential and leadership groups.

5. Basic training material on communication, programme development, as well as advocacy tools, documentary film elements and guidelines for promotional campaigns and logo development should be developed by WHO for use in Member States.
6. The involvement of the private sector in flour fortification should be assured by national governments through advocacy, tax deduction and other encouraging arrangements.

7. The local production of fortificants should be considered by national governments as a feasible option for the assurance of sustainable provision and availability.

8. In Member States with flour fortification, legislation should be updated, bearing in mind the Codex Alimentarius. The meeting considers fortification regulations and legislation an essential requirement for the attainment of public health, and thus not a possible barrier to trade under world trade agreements.
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Annex 1

Programme

Tuesday, 17 July 2001
08:00–09:00 Registration
09:00–09:30 Opening ceremony
09:30–10:00 Address of the Regional Director, WHO/EMRO
10:00–10:30 Flour fortification in the Eastern Mediterranean Region / Dr Anna Verster
11:00–13:00 Country presentations:
Bahrain, Egypt, Islamic Republic of Iran, Iraq, Jordan,
Kuwait, Lebanon, Libyan Arab Jamahiriya, Morocco,
Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Syrian
Arab Republic, United Arab Emirates, Republic of Yemen
(20 minutes per country)
14:00–17:00 Country presentations (continued)

Wednesday, 18 July 2001
08:30–09:00 Major issues and constraints: how close are we to
achieving flour fortification in the Region / Mrs Susan
Gelders
09:00–10:30 Issues identified I: premix procurement, specifications,
funding and local production
Presentation 1: iron fortification of cereal food staples,
Monterrey workshop recommendations and guidelines
for iron fortification of cereal food staples (SUSTAIN) / Dr Louis Laleye, Micronutrient Initiative, Ottawa, Canada
Presentation 2: procurement / Ms Mona Abbassy,
WHO/EMRO
Presentation 3: financing premix / Dr Anna Verster,
WHO/EMRO
Presentation 4: quality control of local production / Dr Ehab Hegazy, Nutrition Institute, Cairo, Egypt
11:00–13:00 Working groups work on solving premix issues
14:00–15:00 Reporting on premix working groups
15:00–17:00 Issues identified II: communication / Mr Jack Bagriansky,
Micronutrient Initiative
Thursday, 19 July 2001
08:30-09:30  Issues identified III: legislation and standards/
Mrs Susan Gelders, WHO/EMRO
09:30-10:00  Issues identified IV: quality assurance and
control/Mr Quentin Johnson, Micronutrient
Initiative
10:30-11:00  Looking towards the future: country action
plans. Introduction/Dr Anna Verster,
WHO/EMRO
11:30-13:30  Country action plans: working session
14:30-16:30  Country action plans: presentation by
participants
16:30-17:30  Recommendations, conclusions and closing
remarks
Annex 2

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Annex 3

Monterrey workshop summary: evaluating the usefulness of elemental iron powders

Convened by SUSTAIN in September 2000

Presented by Liz Turner (Executive Director, SUSTAIN) at a technical consultation convened by PAHO on iron compounds (10–12 January 2001)

Iron deficiency anaemia (IDA) is one of the most prevalent public health problems in the developing world, with women and children especially affected. The World Health Organization estimates that approximately 1.48 billion individuals are afflicted worldwide. Iron deficiency anaemia is a significant challenge in developing countries because their diets consist mainly of cereal products that have relatively low levels of absorbable iron. This results, in part, from plant components such as phytates and polyphenols that inhibit iron absorption.

Despite the magnitude of IDA, little is known about the extent to which iron powders commonly used as food fortificants are absorbed by the body. Elemental iron powders are the most common iron fortificant used worldwide because they cause the fewest problems with colour, flavour, and rancidity in food products and are relatively inexpensive. However, research studies conducted over the last 45 years have produced highly variable results with respect to the bioavailability of these powders (from 5% to 145% relative to ferrous sulfate). Consequently, questions about the varying bioavailability of elemental iron have hindered implementation of cereal enrichment programmes worldwide. This came to SUSTAIN's attention as they began assisting Mexico with the fortification of corn masa flour.

To help resolve questions about the bioavailability of elemental iron powders, SUSTAIN convened a panel of internationally renowned research scientists, physicians and industrial specialists to review past research. The meeting was held in Monterrey Mexico in September 2000 at the Monterrey Institute of Technology (ITESM). During the course of the meeting, it became apparent that there was significant confusion about the precise type of iron powder used in past studies and in current enrichment programmes. In some cases, fortification companies failed to correctly identify iron powders supplied. In other cases, researchers failed to supply complete and accurate information on iron powders used in research, thus making it difficult to draw conclusions from some studies. Nevertheless, based on a review of available data, workshop participants concluded that certain powders should not be recommended for use in fortification programmes, while
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others had merit, but should be studied more thoroughly. Further, scientists and industry agreed on the need to work together to identify the most appropriate of these powders for use in fortification programmes.

Key findings and recommendations resulting from the Monterrey meeting follow:

- Electrolytic iron (325 mesh) appears to be the best choice of the elemental iron powders at the current state of our knowledge, since studies carried out between 1970 and 1990 provide the most consistent and reliable information about bioavailability of this iron powder. Electrolytic iron is approximately half as bioavailable as ferrous sulfate. The electrolytic iron used should have physical properties and dendrite structure identical to the product formerly supplied under the trade name Clid登 A131.

- If electrolytic iron is not available at a reasonable cost, another type of elemental iron powder may need to be considered. However, at the present time, there is insufficient information about the bioavailability of the other elemental iron powders to offer specific recommendations. Whatever type of elemental iron powder is selected, it is recommended that the 325 mesh (<45 microns) be used rather than 100 mesh as specified for reduced iron in the current FCC guidelines.

- Experimental evidence suggests that the bioavailability of iron powders could be enhanced with improved production technology, but the commercial feasibility of such technologies is not known.

- There is a need to evaluate the current commercial iron powders using established methodology to determine what their bioavailability.

- The results of these bioavailability studies should be used to develop a simple analytic screening test to standardize commercial iron powders in terms of bioavailability characteristics.

- Because the impact of fortifying foods that contain high levels of inhibitory factors (phytic acid or polyphenols) may be limited, fortification should be considered as only one of several strategies. In planning a fortification strategy, the optimal level of iron fortification will depend on a number of factors, including the prevalence of iron deficiency, the nature of the diet, the distribution of cereal foods, and the bioavailability of the added iron.

- Given the high prevalence of iron deficiency anaemia in developing countries, and the wide use of elemental iron powders in food fortification programmes, a thorough evaluation of iron powders in current use is highly recommended.
These findings and recommendations, together with a detailed review of studies conducted to date on elemental iron powders, will be published by SUSTAIN in a peer-reviewed journal. This review, principally authored by Richard Hurrell, will provide a detailed review of studies conducted over the last 45 years on elemental iron powders as well as a summary of the key findings and recommendations from the Monterrey Workshop. It was commissioned by SUSTAIN and will be submitted for publication in *Nutrition Reviews*.

SUSTAIN will also be publishing “Guidelines for Iron Fortification of Cereal Food Staples,” to provide recommendations on the type and levels of iron to add to cereal food staples. Prepared and reviewed by leading experts in iron metabolism and fortification in collaboration with SUSTAIN, they are based on the best information currently available and will be subject to modification as more complete information on the bioavailability of iron compounds becomes available. For information on these guidelines, please contact SUSTAIN (www.sustaintech.org).
Annex 4

Review of legislation pertaining to wheat flour fortification

<table>
<thead>
<tr>
<th>Country</th>
<th>Status</th>
<th>Legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Voluntary</td>
<td>(mg/kg) thiamine-&gt; 6.4, (mg/kg) Bi-&gt; 15;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bi-11; niacin-70; Bi-11; E-72;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>folate-2.9; Fe-86; Mg-2300; Zn-52</td>
</tr>
<tr>
<td>Canada</td>
<td>Mandatory</td>
<td>(mg/kg) Bi-4.4-7.7; Bi-2.7-4.8; niacin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35-64; Fe 29-43. The following are</td>
</tr>
<tr>
<td></td>
<td></td>
<td>voluntary; pantothenic acid 10-13; Bi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5-3.1; folate 0.4-0.5; Ca 1100-1400;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mg 1500-1900</td>
</tr>
<tr>
<td>Ecuador</td>
<td>Voluntary</td>
<td>(mg/kg) Bi-2.0; Bi-2.6; niacin-35.3; Fe-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;24; Ca-&gt;1,100</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Draft standard</td>
<td>proposal exists</td>
</tr>
<tr>
<td></td>
<td>proposal exists</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>Prohibited</td>
<td>(Restoration allowed)</td>
</tr>
<tr>
<td>Honduras</td>
<td>Voluntary</td>
<td>(mg/kg) Bi-4.4; Bi-2.6; niacin-35.2; Fe-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.7; Ca-1100</td>
</tr>
<tr>
<td>Hungary</td>
<td>Voluntary</td>
<td>1 serving must contain 1/3 of RDA</td>
</tr>
<tr>
<td>Malawi</td>
<td>Voluntary</td>
<td>Must meet nutrition labelling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>requirement</td>
</tr>
<tr>
<td>Malta</td>
<td>Voluntary</td>
<td>Mandatory for brown or whole meal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>flour. (mg/kg) Bi-2.4; niacin-16.0; Fe-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.5</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Prohibited</td>
<td>Review of legislation on nutrient addition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to foods is being undertaken</td>
</tr>
<tr>
<td>Norway</td>
<td>Prohibited</td>
<td>Rec. addition of Fe and B vitamins to 1/3</td>
</tr>
<tr>
<td>Philippines</td>
<td>Voluntary</td>
<td>of RDA</td>
</tr>
<tr>
<td>Singapore</td>
<td>Voluntary</td>
<td>If fortified one serving must contain 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of RDA of added nutrients</td>
</tr>
<tr>
<td>Sweden</td>
<td>Voluntary</td>
<td>(mg/kg) 4-8 thiamine HCI; 1.5-3 B; 40-80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nicotinic acid; 3.5-7 pyridoxine HCI;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>65-90 Fe</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Voluntary</td>
<td>(mg/kg) 4.4-B; 2.0-B; 50-niacin; 29-Fe</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Voluntary</td>
<td>(mg/kg) &gt;2.4-B; 16-niacin; 16.5-Fe;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>940 to 1560-Ca</td>
</tr>
</tbody>
</table>

1 Mandatory for thiamine
2 Maximum claim allowed

(Partial Excerpt from: Food Fortification: Technology and Quality Control FAO Technical Consultation
Instituto Nazionale della Nutrizione, Rome, Italy, 20 to 23 November 1995)
**Legislation pertaining to wheat flour fortification in the Eastern Mediterranean Region**

<table>
<thead>
<tr>
<th>Country</th>
<th>Legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>Fortification with Fe-30 ppm; Folic acid-1.5 ppm</td>
</tr>
<tr>
<td>Lebanon</td>
<td>Standards allow addition of Fe, Zn, folic acid, riboflavin, niacin, thiamine, quantities will be specified when required, by MOH</td>
</tr>
<tr>
<td>Libyan Arab Jamahiriya</td>
<td>Ministerial decree, specified quantities</td>
</tr>
<tr>
<td>Oman</td>
<td>Standards</td>
</tr>
<tr>
<td>Qatar</td>
<td>Fortification allowed</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Guidelines and specifications</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>Standard no. 194/1995, thiamine 6.38 mg, riboflavin 3.96 mg, niacin 52.92 mg, Iron 36.30 mg, vitamin D 551.15 mg, Ca 2115.0 mg, for Iron and calcium the form should be non toxic and of high bioavailability</td>
</tr>
<tr>
<td>Yemen, Republic of</td>
<td>Decree no. 165, 3 June 2001</td>
</tr>
</tbody>
</table>
Flour fortification: reporting accomplishments

Annex 5

Summary report on the WHO/UNICEF/MI Consultation on Communication Needs in Flour Fortification

WHO/EMRO, Cairo, Egypt, 15–16 July 2001

The World Health Organization (WHO) Eastern Mediterranean Regional Office (EMRO) has, in recent years, supported Member States in the initiation or implementation of national flour fortification programmes, funded through the Micronutrient Initiative fund (MI fund). The MI fund is a WHO/EMRO, UNICEF Middle East and Near Asia Regional Office (MENARO) and Micronutrient Initiative collaborative effort.

During the implementation of the MI fund, a number of important crosscutting issues were encountered. These were either issues that could not be anticipated during the planning stage of the project, or were not initially expected to have an important effect on the outcome of the project.

In order to analyse the existing communication needs, a WHO/UNICEF/MI Consultation on Communication needs in flour fortification was organized in Cairo, Egypt, on 15 and 16 July 2001. Representatives or observers of various countries of the Eastern Mediterranean Region attended this consultation (including Bahrain, Egypt, Islamic Republic of Iran, Jordan, Morocco, and Saudi Arabia). The countries participating were those in which national flour fortification programmes are actually ongoing; they can therefore discuss their experiences during implementation. In addition, representatives from a number of international organizations and national or international non-governmental organizations (NGOs) active in the area of fortification, as well as media and communication experts from both the private and public sector.

The consultation started with a session on general as well as communication issues, as observed in the context of flour fortification programmes, in order to clarify the rationale for the consultation. The second session addressed formative and qualitative research into anaemia and flour fortification in a number of countries. The session continued with a discussion on those national flour fortification programmes that have a communication component, as well as a review of the encountered constraints and needs in the area of effectively targeting communication in the introduction of flour fortification. Finally a regional campaign was discussed as an advocacy tool for validating fortification efforts.
The consultation concluded that the perception of anaemia in general is that of a fact of life, a natural and not dramatic event. Often the lack of iron is not associated with anaemia, but seen as caused by other factors, and as a result anaemia prevention tends to be very low on the public health priority list. These factors, combined with misconceptions in the health sector and the common perceptions about bread, in all its dimensions, make an intervention such as flour fortification an interesting communication challenge. Some general conclusions about iron fortification of bread can be drawn from research into perceptions and beliefs, including an initial receptivity to the idea of iron fortified bread, which ranged from acceptance to neutrality to suspicion. As people become more informed and aware of the benefits of fortification, they tend to become supportive and even enthusiastic, however, the requirements are that there is no substantial price increase in the bread or flour products, and that there are no noticeable changes in the taste, smell or colour.

The traditional role of the MI fund has been to lend direct assistance to national initiatives, to provide tools, training and capacity building, to set benchmarks, guidelines, best practices and to create an opportunity, a platform to share knowledge and experiences. A potential new role might be to produce a regional campaign, aimed at public relations, with media advocacy through optimal channels such as spokespeople and celebrities. The consultation decided that the optimum role for the MI fund continues to be the provision of technical expertise if and when required, as well as the facilitation of communication and exchange of experiences and the provision of the required financial resources to initiate fortification efforts for national programmes. The use of existing regional networks is strongly encouraged. The objective of the MI fund flour fortification programme in future should be to raise awareness and enlist support of leadership (medical, health personnel, government, industry, community leaders). With respect to the actual content of the campaign, the development of generic material for a consumer campaign, as well as the possible development of a regional logo, will assist national programmes in the development of specific materials for use within their countries. The consumer campaign should aim to raise general public awareness of anaemia and promote consumer demand for fortified flour. Issues to be considered when developing this regional material are the objectives, the target audience, the design and language should be culturally appropriate, and a certain degree of quality assurance and control with respect to campaign material should be built in.

The consultation recommended that the Regional Office, in the implementation of the MI fund, should undertake the following activities.
1. Prepare and provide basic materials such as a communications training component, which should be made available to all institutions that are considering implementing a flour fortification programme from the inception of such a programme.

2. Develop generic and adaptable advocacy tools, documentary film and film elements for the preparation of country and/or culture specific campaign materials.

3. Provide guidelines for the development of a logo, slogan and terminology for fortification.

4. Consult or engage public relations experience to assist in capitalizing on regional communication channels to target influential and leadership groups.

5. Continue to consider specific assistance to 'individual' Member States as requested under the MI fund guidelines.
Flour fortification: reporting accomplishments

Annex 6

Programme of the WHO/UNICEF/MI Consultation on Communication Needs in Flour Fortification

Sunday 15 July 2001
08:00–09:00  Registration
09:00–09:15  Opening ceremony
   Address by Dr Hussein A. Gezairy, WHO Regional Director for the Eastern Mediterranean
   Message from the Regional Director, UNICEF/MENARO
   Message from the Executive Director, Micronutrient Initiative
09:15–09:30  Communication issues in the implementation of a flour fortification programme/Dr Anna Verster, EMRO
09:30–10:30  Opportunities for regional advocacy for flour fortification with iron/Mr Jack Bagriansky, Micronutrient Initiative
10:30–11:10  Perceptions of anaemia, iron and fortified bread among consumers and professionals in Egypt/Dr Azza Gohar, Dr Ibrahim Ismail, Nutrition Institute, Cairo, Egypt
11:10–11:35  Perceptions of anaemia in Jordan/Dr Muna Hamza, Health Education Department, Ministry of Health, Amman, Jordan
11:35–12:00  Perceptions of anaemia in Bahrain/Dr Khairya Moosa, Nutrition Department, Ministry of Health, Bahrain
12:00–12:25  Qualitative research on perceptions of anaemia among adolescents in Egypt/Dr Jill Randell, Manoff Group
12:25–14:00  Discussions
14:00–14:20  Lessons from the public sector: a campaign for iodized salt/Dr N. Kalantari, Islamic Republic of Iran
14:20–15:40  Lessons from the private sector: development of a quality logo for the Middle East/Dr Galal Zaki, Intermarkets, Cairo, Egypt
15:40–16:20  Consumer research and campaign recommendation for Morocco/Dr Houda Bel Hadj, CMS/Morocco
16:20–17:00  Discussion
Monday 16 July 2001
08:30–09:30 Structure of a regional advocacy campaign/Dr Kim Bumgarner, Manoff Group
09:30–10:00 Defining and recruiting of campaign partners/sponsors
10:00–11:00 Designing potential messages
11:00–11:30 Using regional media and identifying spokespeople and champions
11:30–13:00 Designing a logo
13:00–14:30 Providing tools for national advocacy
14:30–15:30 Recommendations and next steps
15:30–16:30 Message for the technical review
16:30–17:00 Closing
Annex 7

List of participants in the WHO/UNICEF/MI Consultation on Communication Needs in Flour Fortification

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Dr Mohamed A. Jama, Assistant Regional Director, WHO/EMRO

Dr Anna Verster, Director, Health Protection and Promotion, WHO/EMRO

Dr Kunal Bagchi, Regional Adviser, Nutrition, WHO/EMRO

Mrs Susan Gelders, Short-term Professional, Food Safety and Flour Fortification, WHO/EMRO

Mr Omid Mohit, Short-term Professional, Press and Public Information Office, WHO/EMRO

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