

USAID/GAIN MICRONUTRIENT FORTIFICATION PROJECT IN CENTRAL ASIA, AFGHANISTAN AND PAKISTAN

ANALYSIS AND JUSTIFICATION THE POSSIBILITY OF HARMONIZING STANDARDS FOR REFINED WHEAT FLOUR FORTIFICATION IN CENTRAL ASIA, AFGHANISTAN AND PAKISTAN

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1. Comparison of standards for refined wheat flour fortification, operating in the Member Countries with the relevant recommendations of the World Health Organization (WHO).

According to an interim consensus statement, endorsed by WHO and other institutions about recommendations on wheat and maize flour fortification [1] (reference), the average levels of nutrients that can be added to fortifying wheat flour depending on the:

- estimated average per capita consumption (g/day) of wheat flour – for all the recommended micronutrients;
- extraction level of flour (low or high) – for iron and zinc;
- fortifying nutrient – for all the recommended micronutrients, and others are required by the nutrition situation of the country (Table 1).

NaFeEDTA, ferrous sulfate, ferrous fumarate and electrolytic iron may serve as the source of iron. However electrolytic iron cannot be used neither as an iron source in cases where the estimated average per capita consumption of wheat flour is less than 150 g/day nor for high-extraction flour (i.e. whole flour). (high-extraction-rate = $\geq 80\%$ wheat flour [2]; so, low-extraction-rate = $< 80\%$ wheat flour). This is because very high levels of electrolytic iron that are needed could negatively affect sensory properties of fortified flour.

The average per capita consumption of wheat flour in the member countries is [3]:

- 258,7 g/day in Kazakhstan;
- 311,3 g/day in Pakistan;
- 350,3 g/day in Tajikistan;
- 377,9 g/day in Kyrgyzstan;
- 439,0 g/day in Afghanistan;
- 467,3 g/day in Uzbekistan.

Due to differences in the average per day consumption of wheat flour per person:

- Kazakhstan assigned to countries where average consumption of wheat flour per capita is 150-300 g/day;
- Pakistan, Tajikistan, Kyrgyzstan, Afghanistan and Uzbekistan – to countries where average consumption of wheat flour per capita is > 300 g/day.

Overall, the average levels of per capita per day consumption of flour in the participating countries are high and may contribute to the harmonization of standards for flour fortification.

In 4 countries (Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan) flour is currently requested to be fortified with 6 micronutrients: vitamins B₁, B₂, B₃ (niacin) and B₉ (folate), iron and zinc; in Afghanistan, flour is expected to be fortified by 4 micronutrients (vitamins B₉ and B₁₂, iron and zinc); in Pakistan, – currently only by 2 micronutrients - vitamin B₉ and iron, are required at the national level (Table 2). Here, it is important to point out that in Afghanistan and Pakistan, the consumption of high-extraction flour is common, while in the other countries low extraction flour is more popular. For high-extraction flour, the incorporation of vitamins B₁, B₂, B₃ (niacin) is unnecessary as the intrinsic content of these micronutrients in that type of flour is high

The levels of added micronutrients to the flour:

- in Kazakhstan and Tajikistan slightly higher for supreme grade flour than for the first grade one;
- in Kyrgyzstan such differences do not exist;
- in Uzbekistan the data are given for fortification of only the first grade flour;
- in Afghanistan and Pakistan, data referred to the flour called Atta, which traditionally refers to high-extraction flour.

The levels of added micronutrients to the flour in comparison with the WHO-endorsed recommendations are:

- slightly higher in Uzbekistan and Pakistan for vitamin B₉;
- somewhat lower in Kazakhstan and Pakistan for iron;

- somewhat lower in Kazakhstan, Tajikistan and Uzbekistan for zinc;
- other parameters in those countries comply with the recommendations of WHO;
- in Afghanistan and Kyrgyzstan, all the parameters are relevant with the WHO document.

Table 1 – WHO interim consensus statement about recommendations for fortified flours, 2009^a: Average levels of nutrients to consider adding to fortified wheat flour based on extraction, fortificant compound, and estimated per capita flour availability

Nutrient	Flour extraction rate	Compound	Level of nutrient to be added in parts per million (ppm) by estimated average per capita wheat flour availability (g/day) ^b			
			<75g/day ^c	75-149 g/day	150-300 g/day	>300g/day
Iron	Low	NaFeEDTA	40	40	20	15
		Ferrous sulphate	60	60	30	20
		Ferrous fumarate	60	60	30	20
		Electrolytic iron	NR ^d	NR ^d	60	40
	High	NaFeEDTA	40	40	20	15
Folic acid	Low or high	Folic acid	5.0	2.6	1.3	1.0
Vitamin B ₁₂	Low or high	Cyanocobalamin	0.04	0.02	0.01	0.008
Vitamin A	Low or high	Vit A palmitate	5.9	3	1.5	1
Zinc ^e	Low	Zinc oxide	95	55	40	30
	High	Zinc oxide	100	100	80	70

Notes:

^a – WHO, FAO, UNICEF, GAIN, MI, & FFI. Recommendations on wheat and maize flour fortification. Meeting Report: Interim Consensus Statement. Geneva, World Health Organization, 2009. http://www.who.int/nutrition/publications/micronutrients/wheat_maize_fort_ru.pdf.

^b – These estimated levels consider only wheat flour as main fortification vehicle in a public health program. If other mass-fortification programs with other food vehicles are implemented effectively, these suggested fortification levels may need to be adjusted downwards as needed.

^c – Estimated per capita consumption of <75 g/day does not allow for addition of sufficient level of fortificant to cover micronutrients needs for women of childbearing age. Fortification of additional food vehicles and other interventions should be considered.

^d – NR = Not Recommended because very high levels of electrolytic iron needed could negatively affect sensory properties of fortified flour.

^e – These amounts of zinc fortification assume 5 mg zinc intake and no additional phytate intake from other dietary sources

Table 2 – Summary data on the levels of micronutrients to be added in parts per million (ppm) to fortified wheat flour according to standards in Central Asian Republics, Afghanistan and Pakistan

Items	Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Pakistan	Afghanistan
	premium & 1st grade [4]	premium & 1st grade [5]	premium & 1st grade [6]	1st grade [7]	Atta [8]	Atta [9]
Vitamin B ₁	2.0 & 1.6	2,0	2.0 & 1.6	1,6	n/f	n/f
Vitamin B ₂	3.0 & 2.4	3,0	3.0 & 2.4	2,4	n/f	n/f
Vitamin B ₃	10.0 & 8.0	10,0	10.0 & 8.0	8,0	n/f	n/f
Vitamin B ₉ WHO, 2009	1.5 & 1.2 1,3	1,0 1,0	1.5 & 1.2 1,0	1,2 1,0	1,5 1,0	1,0 1,0
Vitamin B ₁₂ WHO, 2009	n/f 0,01	n/f 0,008	n/f 0,008	n/f 0,008	n/f 0,008	0,008 0,008
Iron WHO, 2009	50.0 & 40.0 60,0 Electrolytic	15,0 15,0 Sodium Iron EDTA	50.0 & 40.0 40,0 Electrolytic	40,0 40,0 Electrolytic	10,0 15,0 Sodium Iron EDTA	15,0 15,0 Sodium Iron EDTA
Zinc WHO, 2009	22.0 & 17.6 40,0	30,0 30,0	22.0 & 17.6 30,0	17,6 30,0	n/a 30,0	30,0 30,0

Notes:

n/f – not fortified

Wheat flour consumption in g/capita/day:

< 300 in Kazakhstan

> 300 in Afghanistan, Kyrgyzstan, Pakistan, Tajikistan and Uzbekistan

2. Standards for mandatory and voluntary fortification of wheat flour.

It seems to be appropriate to develop the following standards for:

- Mandatory fortification of flour with micronutrients endorsed by the World Health Organization, namely, by vitamins B₉ and B₁₂, iron and zinc for all types of flour, plus B₁, B₂ and B₃ for refined (low extraction) flour;
- As the high-extraction wheat flour contains good amounts of the latter vitamins (B₁, B₂ and B₃); those would not be added to this type of flour;
- Carry out studies of vitamin A and vitamin D deficiencies in all the countries in order to establish if the addition of these other micronutrients would be appropriate for the whole region.

3. Setting the level of bioavailability of minerals in Afghanistan, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan and Uzbekistan.

The Food Agriculture Organization of the United Nations/World Health Organization set iron bioavailability at 5% for a strict vegetarian diet, at 10% when some meat and ascorbic acid was added, and at 15% for diets rich in meat and fruits [10].

In our calculations, we used the following assumptions:

- The diet of the population of Kazakhstan, where the average per capita intake of wheat flour is about 250 g/day, and generous contribution of meat/poultry and vegetables/fruits can be attributed to the group with a high bioavailability (15%) of minerals.

- Other participating countries where the average per capita intake of low-extraction wheat flour is more than 300 g/day, may be referred to the group with 10% or moderate bioavailability (Kyrgyzstan, Tajikistan and Uzbekistan), and for those consuming high-extraction wheat flour as 5% or low bioavailability (Afghanistan and Pakistan). In the case of zinc, the first country would have good bioavailability (30%), and the rest moderate bioavailability (15%).

This subdivision of diet dependent levels of minerals bioavailability we took into account for calculating the levels of micronutrients in fortified flour and comparing them with vitamin and mineral requirements in human nutrition according to WHO/FAO data [11].

Our considerations are based on the average per capita consumption levels of main promoters (meat and meat products calculated per meat, vegetables and fruits) and inhibitors (cereals, which are rich in phytic acids) in the member countries (Table 3).

Table 3 – Per capita consumption of main dietary promoters and inhibitors of iron absorption in member countries*

Promoters & inhibitors	Per capita consumption (g/day or ratio**) of main dietary promoters and inhibitors of iron absorption, by countries											
	Afghanistan		Kazakhstan		Kyrgyzstan		Pakistan		Tajikistan		Uzbekistan	
	g/day	ratio	g/day	ratio	g/day	ratio	g/day	ratio	g/day	ratio	g/day	ratio
Promoters												
Meat & meat products (heme iron)	34	0,2	191	1,0	101	0,5	45	0,2	38	0,2	45	0,2
Vegetables (vitamin C)	79	0,1	616	1,0	404	0,7	72	0,1	432	0,7	660	1,1
Fruits (vitamin C)	93	0,5	195	1,0	85	0,4	80	0,4	78	0,4	151	0,8
Total		0,8		3,0		1,6		0,8		1,3		2,1
Inhibitors												
Wheat flour	351,2	13,6	25,9	1,0	37,8	1,5	248,8	9,6	35,0	1,4	46,7	1,8
Milk and dairy products (calcium)?	171	0,2	772	1,0	570	0,7	502	0,7	145	0,2	367	0,5
Total		13,8		2,0		2,2		10,3		1,6		2,3
Difference (between promoters & inhibitors)		-13		1,0		-0,6		-9,5		-0,3		-0,2

Notes:

* - Adapted from reference [12]

** - with respect to indicators of Kazakhstan

Based on the data in Table 4 and literature sources [12, 13], it can be recommended to use a high (15%) of bioavailability of minerals in Kazakhstan, a moderate (10%) in Kyrgyzstan, Tajikistan and Uzbekistan, and low (5%) in Afghanistan and Pakistan.

There are other dietary promoters and inhibitors of iron absorption (Table 4). However, the data on per capita consumption for some of those promoters and inhibitors are not available.

Table 4 - Dietary promoters and inhibitors of iron absorption.

Food and/or food compounds	Comments
Promoters	
Acid ascorbic	Present in fruits, juices and vegetables such as green leaves, peppers
Heme iron	Present in meat, poultry, fish and seafood (~40% of the total iron)
Muscle tissue, the digestion products of meat, fish or poultry	30g of muscle has the enhancer property as 25mg of ascorbic acid, possible due to the presence of cysteine- containing peptides or a multitude of small peptides
Fermented or germinated food and condiments	Sauerkraut and soy sauce (cooking, fermentation, or germination of food reduces the amount of phytates)
Caseinophosphopeptides (CPPs)	The CPPs added to fruit beverage (grape and orange) appears to improve iron bioavailability*.
Polyoxycarbonic acids	Such as citrate and malate
Inhibitors	
Phytate or phytic acid	Present in cereal grains, high-extraction flour, legumes, and seeds
Polyphenols	Foods that contain the most potent inhibitors (e.g. tannins) resistant to the influence of enhancers include tea, coffee, cocoa, herbal infusions (tea) in general, certain spices (e.g. oregano), and some vegetables
Calcium	Particularly from milk and milk products found as calcium phosphate, inhibit absorption of non-heme and heme iron
Proteins	Proteins from products like milk and eggs, and albumin, casein, and soy protein (independent of the phytate content)

Source:

Adapted from reference [14]

The total iron content of a diet provides little information about its content of bioavailable iron, which is considerably influenced by the foods in the diet and can vary 10-fold from different meals of similar iron content [15]. Although a vegetarian diet is likely to contain iron in amounts equivalent to amounts in a nonvegetarian diet, the iron from a vegetarian diet is likely to be substantially less available for absorption [16] because of differences in the chemical form of iron and the accompanying constituents that enhance or inhibit iron absorption [17].

The chemical form of iron is an important factor affecting the iron availability of vegetarian diets. In the diet inorganic iron-salts (non-heme) are present in plants and animal tissues, and organic iron (heme), which comes from hemoglobin (blood) and myoglobin (red muscle), is present in animal food sources. Heme-iron absorption is less affected by dietary compounds with the exception of calcium compounds [14].

Less than 40% of the iron in meat, poultry, and fish [18] is in the heme form, which is more efficiently absorbed than the remaining nonheme iron present in these and all other foods [19]. Nonvegetarian diets with substantial amounts of red meat supply about 2 mg/d, or 10–15%, of the total iron in the heme form (10). Heme iron is better absorbed (around 15–40%) than nonheme iron (around 1–15%) [20].

Whole cereals contain phytic acids and polyphenols, which decrease iron bioavailability [21]. The phytic acid levels in low extraction wheat flour is low compared to high extraction flour. Also bread in most of the countries in CAR is fermented using yeast. Pakistan and Afghanistan have high consumption of unleavened bread made from high extraction flour. This means the phytic acid is not broken in the latter country by the fermentation step.

The fact is that the whole wheat flour (i.e. high extraction flour) is a good source of phytic acid, which is the main inhibitor of non-heme iron absorption from plant products. The phosphate groups of phytic acid are negatively charged under physiologically relevant conditions, resulting in phytate chelation of cations such as iron and zinc, making these minerals less available for absorption [22]. Consuming of phytic acid can substantially reduce iron absorption [23, 24]. Phytate content in refined (white) flour is about 100 mg/100 g, and in wheat and whole-wheat flour it is about 600 mg/100 g [25]. Polyphenols also forms insoluble complexes with iron thereby reducing its bioavailability to the body.

In addition, in Kazakhstan the consumption level of meat and meat products is much higher compared to other participating countries. The bioavailability of the heme iron from meat and meat products [26] is significantly higher (15-40%) than the bioavailability of non-heme iron from plant foods [27]. Heme-iron absorption is less affected by dietary compounds with the exception of calcium compounds [28].

The inhibitory effect of calcium on iron absorption was recognized many years ago, and the presence of large amounts of calcium can inhibit the absorption of iron from a fortified food [12]. Different studies have been conducted but they often give conflicting results because several factors influence the interaction between calcium and iron absorption [29].

Milk and dairy products are good sources of calcium. But, absorption of iron and zinc from milk products is higher than from vegetable products, even it is considered that calcium from milk and milk products found as calcium phosphate, inhibit absorption of non-heme and heme iron [14], and again there are conflicting results. For example, goat milk consumption leads to a better recovery of body Fe stores, minimizing Ca-Fe interactions and improving Fe status and its absorption [30]. The absorption of iron from the cereal-based diets was not inhibited by cow's milk [31]. On the other hand, milk contains calcium and caseins, which inhibit absorption of both non-heme and heme iron. It enters into the mucosal cells by different pathways and leave in the same form which implies that calcium inhibit the intracellular transport of iron [32].

To ensure an appropriate iron absorption, the intake of iron should be high enough to improve or maintain iron status. This condition might be attained adding sufficient iron to the fortification vehicle and/or incorporating simultaneously absorption enhancers. In the case of wheat flour fortification, the only practical enhancer to add is EDTA or using as an iron source NaFeEDTA; iron in the form of ferric sodium EDTA is 2 to 3 times more bioavailable than from other mineral sources and that it is efficiently incorporated into haemoglobin [33]; iron from ferric sodium EDTA has a high bioavailability despite the presence of inhibitory factors that form insoluble complexes [34]. Vitamin C, which can increase absorption of both native iron and fortification iron due to both its reducing power and chelating actions [35], is destroyed during baking. Bovine hemoglobin is not easily accepted or it is too expensive for being used as a fortificant.

More than half of the zinc in US diets is derived from animal foods, and one quarter of the zinc comes from beef [36]. The bioavailability of zinc from vegetarian diets is also to be less than that of nonvegetarian diets. Plant foods rich in zinc—such as legumes, whole grains, nuts, and seeds – are also high in phytic acid, an inhibitor of zinc bioavailability [37]. Bioavailability of zinc is enhanced by dietary protein [38], but plant sources of protein are also generally high in phytic acid. Because of lower absorption of zinc, those consuming vegetarian diets, especially with phytate-zinc molar ratios > 15 , may require as much as 50% more zinc than nonvegetarians [39].

Thus, the iron and zinc from vegetarian diets are generally less bioavailable than from nonvegetarian diets because of reduced meat intake as well as the tendency to consume more phytic acid and other plant-based inhibitors of iron and zinc absorption.

Iron bioavailability is estimated to be around 5-12% for vegetarian diets and 14-18% for mixed diets. These values are used to generate dietary reference values for all population groups [40]. Considering all factors that may influence iron bioavailability, the estimated average absorption iron rate for a typical western diet is between 15-18% [41, 42].

4. Premix formulation for fortification of refined wheat flour.

In view of the above WHO recommendations, the average per capita consumption of wheat flour g/day in the participating countries, and the characteristics of diets with low and moderate bioavailability of minerals, premix composition is formulated for mandatory fortification of refined (white) flour, which is presented in Table 5.

Table 5 – The main parameters of the premix for fortification of refined wheat flour.

Nutrient	Fortificant compound	Selected FL (mg/kg flour)	Amount of fortificant (mg/kg flour)	Premix Formulation			
				Fortificant (g/kg premix)	Nutrient (g/kg premix)	Cost (US\$/kg)	% Cost
Vit. B-1 (Thiamin)	Thiamin mononitrate	2,0	2,5	9,9	8	\$0,25	2,5
Vit. B-2 (Riboflavin)	Riboflavin	3,0	3,0	12,0	12	\$0,72	7,5
Vit. B-3 (Niacin)	Niacinamide	10,0	10,1	40,4	40	\$0,40	4,2
Vit. B-9 (Folate)	Folic Acid	1,0	1,1	4,4	4	\$0,49	5,1
Vit. B-12	Vit. B-12 0.1% WS	0,008	8,0	32,0	0,03	\$1,28	13,4
Iron	Ferrous sulfate dried	10	31,3	125,0	40	\$0,34	4,0
Iron	NaFeEDTA	15	115,4	461,5	60	\$3,00	31,4
Zinc	Zinc oxide	30	37,5	150,0	120	\$0,88	9,2
	Filling material (at least 25%)		31,3	164,7		\$0,16	1,7
		TOTAL	240,1	1000,0			
	Estimated cost of manufacturing, quality control and delivery (Approx. US\$2/kg premix)					\$2,00	20,9
				Approximate Cost per kg =		\$9,56	100,0
Estimated cost of micronutrient premix per metric ton of fortified product*:						\$2,39	
						0,48 % of the Price	

Minimum Amount (grams per MT)	240
Selected Amount (grams per MT)	250**

Maximum Dilution Factor = 1/	4164
Selected Dilution Factor = 1/	4000

Notes:

* - The costs of the fortificants are always the largest cost of the fortification process, when it carried out by formal and centralized factories.

** - This value should be larger than the estimated minimum amount per metric ton (above).

5. Establishment of production and regulatory parameters for fortification of refined wheat flour.

Based on the composition of the premix, production and regulatory parameters for fortification of refined (white) flour are established, which are presented in Table 6.

Table 6 – The main production and regulatory parameters for fortification of refined wheat flour

Nutrient	Fortificant compound	Selected FL (mg/kg flour)	Production Parameters			Regulatory Parameters	
			mFL (1) (mg/kg flour)	Average (2) (mg/kg flour)	MFL (3) (mg/kg flour)	LmL (4) (mg/kg flour)	MTL (5) (mg/kg flour)
Vit. B-1 (Thiamin)	Thiamin mononitrate	2,0	1,5	2,8	4,1	1,3	4,1
Vit. B-2 (Riboflavin)	Riboflavin	3,0	2,0	3,6	5,2	1,8	5,2
Vit. B-3 (Niacin)	Niacinamide	10,0	11,0	20,0	29,0	9,9	29,0
Vit. B-9 (Folate)	Folic Acid	1,0	0,7	1,3	1,9	0,6	1,9
Vit. B-12	Vit. B-12 0.1% WS	0,008	0,004	0,008	0,012	0,004	0,012
Iron	Ferrous sulfate dried (6)	10,0	13,0	19,0	25,0	13,0	25,0
Iron	NaFeEDTA (7)	15,0	16,0	24,0	32,0	16,0	32,0
Zinc	Zinc oxide	30,0	26,0	38,0	50,0	26,0	50,0

Notes:

(1) mFL = Minimum Fortification Level, using equation 2.

(2) Average = Selected Fortification Level + Intrinsic content of micronutrient in unfortified food.

(3) MFL = Maximum Fortification Level, using equation 3.

(4) LmL= Legal Minimum Level, using equation 4.

(5) MTL = Maximum Tolerable Level, equivalent to MFL but only for those micronutrients with safety concerns, and rounded.

(6) As the iron from ferrous sulfate is very difficult to measure independently from intrinsic iron, as well as from NaFeEDTA, because the usual analytical methods require ashing of the sample, the expected total iron amount is presented here (i.e. intrinsic iron + iron from NaFeEDTA + iron from ferrous sulfate).

(7) As the iron from NaFeEDTA can be determined separated of the intrinsic iron (and perhaps the iron from ferrous sulfate), these values are only expressing the variation of the content of iron coming from NaFeEDTA.

6. Daily intake of micronutrients by population groups in the composition of fortified wheat flour, by countries, in % EAR/day.

Terms [43]:

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50% apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population.

All basic calculations in this and other sections are conducted using the Formulator, developed by Omar Dary и Michael Hainsworth [44].

In terms of daily **vitamin B₁ (thiamin)** intake in the composition of fortified wheat flour, in % EAR/day, in all population groups (Table 7) the participating countries are located in the following ascending order:

- Kazakhstan: 27% to 35% in different age and gender groups
- Pakistan: 32 to 42%
- Tajikistan: 36% to 47%
- Kyrgyzstan: 39% to 51%
- Afghanistan: 45% to 59%
- Uzbekistan: 48% to 63%.

So, the value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which was the smallest in Kazakhstan and the largest in Uzbekistan.

In terms of daily **vitamin B₂ (riboflavin)** intake in the composition of fortified wheat flour, in % EAR/day, in all population groups the participating countries are located in the following ascending order:

- Kazakhstan: 50% to 66% in different age and gender groups
- Pakistan: 60% to 78%
- Tajikistan: 68% to 88%
- Kyrgyzstan: 73% to 94%
- Afghanistan: 85% to 110%
- Uzbekistan: 90% to 117%.

The value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which was the smallest in Kazakhstan and the largest in Uzbekistan, as well.

In terms of daily **vitamin B₃ (niacin)** intake in the composition of fortified wheat flour, in % EAR/day, in all population groups the participating countries are located in the following ascending order:

- Kazakhstan: 14% to 18% in different age and gender groups
- Pakistan: 17% to 22%
- Tajikistan: 19% to 24%
- Kyrgyzstan: 20% to 26%
- Afghanistan: 23% to 30%
- Uzbekistan: 25% to 32%.

Again, the value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which was the smallest in Kazakhstan and the largest in Uzbekistan.

That is, that the value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which was the smallest in Kazakhstan and the largest in Uzbekistan.

In terms of daily **folic acid** intake in the composition of fortified wheat flour, in % EAR/day, in all population groups the participating countries are located in the following ascending order:

- Kazakhstan: 79% to 113% in different age and gender groups
- Pakistan: 96% to 136%
- Tajikistan: 108% to 154%
- Kyrgyzstan: 116% to 166%

- Afghanistan: 135% to 192%
- Uzbekistan: 240% to 205%.

So, the value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which was the smallest in Kazakhstan and the largest in Uzbekistan.

In a similar manner the participating countries are arranged by the level of daily intake of added **vitamin B₁₂** in % RNI/day:

- Kazakhstan: 62% to 94%
- Pakistan: 74% to 113%
- Tajikistan: 83% to 127%
- Kyrgyzstan: 90% to 137%
- Afghanistan: 105% to 160%
- Uzbekistan: 111% to 170%.

Unlike vitamins, by the level of daily **iron** intake in the composition of fortified wheat flour, in % EAR/day, for all groups of population, the participating countries are located in the following ascending order:

- Pakistan: 28% to 113%
- Afghanistan: 40% to 159%
- Tajikistan: 52% to 206%
- Kyrgyzstan: 56% to 223%
- Kazakhstan: 57% to 229%
- Uzbekistan: 69% to 275%.

That is, that the value of this indicator is also correlated with an average per capita consumption of wheat flour in g/day, with the exception of Kazakhstan, where the value of the index was higher than in Pakistan, Afghanistan, Tajikistan and Kyrgyzstan, but lower than in Uzbekistan. This is because the average diet in Kazakhstan attributed, as mentioned above, to the group with a high bioavailability of minerals and the diet of other participating countries - to the group with a moderate (Kyrgyzstan, Tajikistan and Uzbekistan) low (Afghanistan and Pakistan) bioavailability of minerals.

In terms of daily **zinc** intake in the composition of fortified wheat flour, in % EAR/day, in all population groups the participating countries are located in the following ascending order:

- Pakistan: 50% to 90%
- Afghanistan: 71% to 127%
- Kazakhstan: 84% to 150%.
- Tajikistan: 114% to 203%
- Kyrgyzstan: 123% to 219%
- Uzbekistan: 152% to 271%

Table 7 – Daily intake of micronutrients by population groups in the composition of fortified wheat flour, by countries, in % EAR/day

Nutrient	Additional daily intake of nutrients by countries population groups, in %EAR/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Children, 1-3 years						
Vit. B-1 (Thiamin)	54,8	32,3	47,2	38,9	43,7	58,4
Vit. B-2 (Riboflavin)	103,5	61,0	89,1	73,4	82,6	110,2
Vit. B-3 (Niacin)	29,9	17,6	25,8	21,2	23,9	31,8
Vit. B-9 (Folate)	189,8	111,9	163,4	134,6	151,5	202,1
Vit. B-12	159,5	94,0	137,3	113,1	127,3	169,8

Nutrient	Additional daily intake of nutrients by countries population groups, in %EAR/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Iron (Ferrous sulfate dried)	32,6	57,7	56,2	23,1	52,1	69,5
Iron (NaFeEDTA)	97,9	129,8	126,4	69,4	117,2	156,3
Total iron	130,5	187,5	182,6	92,5	169,2	225,7
Zinc	70,5	84,0	122,8	50,0	113,8	151,8
Children, 4-6 years						
Vit. B-1 (Thiamin)	58,0	34,2	50,0	41,1	46,3	61,8
Vit. B-2 (Riboflavin)	109,6	64,6	94,4	77,7	87,5	116,7
Vit. B-3 (Niacin)	28,5	16,8	24,5	20,2	22,7	30,3
Vit. B-9 (Folate)	180,9	106,6	155,7	128,3	144,3	192,5
Vit. B-12	140,3	82,7	120,8	99,5	112,0	149,3
Iron (Ferrous sulfate dried)	39,8	70,3	68,5	28,2	63,5	84,7
Iron (NaFeEDTA)	119,4	158,3	154,1	84,7	142,9	190,6
Total iron	159,2	228,6	222,7	112,9	206,4	275,3
Zinc	77,4	91,2	133,2	54,9	123,5	164,7
Children, 7-9 years						
Vit. B-1 (Thiamin)	48,6	28,6	41,8	34,4	38,8	51,7
Vit. B-2 (Riboflavin)	91,7	54,1	79,0	65,0	73,2	97,6
Vit. B-3 (Niacin)	23,9	14,1	20,5	16,9	19,0	25,4
Vit. B-9 (Folate)	151,4	89,2	130,3	107,3	120,8	161,1
Vit. B-12	117,4	69,2	101,1	83,3	93,7	125,0
Iron (Ferrous sulfate dried)	35,4	62,5	60,9	25,1	56,4	75,3
Iron (NaFeEDTA)	106,1	140,6	137,0	75,2	127,0	169,4
Total iron	141,4	203,2	197,8	100,3	183,4	244,7
Zinc	83,3	98,1	143,3	59,0	132,9	177,2
Males, 10-18 years						
Vit. B-1 (Thiamin)	54,5	32,1	46,9	38,7	43,5	58,0
Vit. B-2 (Riboflavin)	95,1	56,0	81,8	67,4	75,9	101,2
Vit. B-3 (Niacin)	27,9	16,4	24,0	19,8	22,3	29,7
Vit. B-9 (Folate)	177,0	104,3	152,4	125,5	141,2	188,4
Vit. B-12	137,3	80,9	118,2	97,4	109,6	146,2
Iron (Ferrous sulfate dried)	16,2	28,6	27,0	11,5	25,1	33,4

Nutrient	Additional daily intake of nutrients by countries population groups, in %EAR/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
sulfate dried)						
Iron (NaFeEDTA)	48,5	64,3	60,8	34,4	56,4	75,2
Total iron	64,6	92,8	87,9	45,8	81,5	108,7
Zinc	85,0	99,6	145,5	60,3	134,9	180,0
Males, 19-50 years						
Vit. B-1 (Thiamin)	59,3	34,9	51,0	42,0	47,3	63,1
Vit. B-2 (Riboflavin)	103,3	60,9	89,0	73,3	82,5	110,0
Vit. B-3 (Niacin)	30,3	17,9	26,1	21,5	24,2	32,3
Vit. B-9 (Folate)	192,4	113,4	165,6	136,4	153,5	204,8
Vit. B-12	149,3	88,0	128,5	105,8	119,1	158,9
Iron (Ferrous sulfate dried)	21,3	37,7	36,7	15,1	34,0	45,4
Iron (NaFeEDTA)	63,9	84,8	82,5	45,3	76,5	102,1
Total iron	85,2	122,4	119,2	60,4	110,5	147,4
Zinc	112,9	133,0	194,3	80,0	180,2	240,3
Males, 51-65 years						
Vit. B-1 (Thiamin)	58,1	34,2	50,0	41,2	46,3	61,8
Vit. B-2 (Riboflavin)	101,3	59,7	87,2	71,8	80,8	107,8
Vit. B-3 (Niacin)	29,7	17,5	25,6	21,1	23,7	31,6
Vit. B-9 (Folate)	188,6	111,1	162,3	133,7	150,5	200,7
Vit. B-12	146,3	86,2	125,9	103,7	116,7	155,7
Iron (Ferrous sulfate dried)	20,9	36,9	36,0	14,8	33,3	44,5
Iron (NaFeEDTA)	62,6	83,1	80,9	44,4	75,0	100,0
Total iron	83,5	120,0	116,8	59,2	108,3	144,5
Zinc	110,6	130,4	190,5	78,4	176,6	235,5
Males, +65 years						
Vit. B-1 (Thiamin)	48,6	28,6	41,8	34,5	38,8	51,7
Vit. B-2 (Riboflavin)	84,7	49,9	72,9	60,1	67,6	90,2
Vit. B-3 (Niacin)	24,9	14,7	21,4	17,6	19,8	26,5
Vit. B-9 (Folate)	157,8	93,0	135,8	111,9	125,9	167,9
Vit. B-12	122,4	72,1	105,4	86,8	97,7	130,3
Iron (Ferrous sulfate dried)	17,5	30,9	30,1	12,4	27,9	37,2

Nutrient	Additional daily intake of nutrients by countries population groups, in %EAR/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Iron (NaFeEDTA)	52,4	69,5	67,7	37,2	62,7	83,7
Total iron	69,9	100,4	97,8	49,6	90,6	120,9
Zinc	92,6	109,1	159,4	65,6	147,7	197,1
Females, 10-18 years						
Vit. B-1 (Thiamin)	49,8	29,3	42,9	35,3	39,7	53,0
Vit. B-2 (Riboflavin)	94,8	55,9	81,6	67,2	75,7	100,9
Vit. B-3 (Niacin)	23,3	13,8	20,1	16,6	18,6	24,9
Vit. B-9 (Folate)	148,2	87,3	127,5	105,1	118,2	157,7
Vit. B-12	114,9	67,7	98,9	81,5	91,7	122,3
Iron (Ferrous sulfate dried)	9,9	17,5	17,3	7,0	16,0	21,4
Iron (NaFeEDTA)	29,6	39,3	38,9	21,0	36,0	48,1
Total iron	39,5	56,8	56,2	28,0	52,0	69,4
Zinc	84,5	99,6	145,5	59,9	134,9	179,9
Females, 19-50 years						
Vit. B-1 (Thiamin)	51,1	30,1	44,0	36,2	40,8	54,4
Vit. B-2 (Riboflavin)	96,5	56,9	83,0	68,4	77,0	102,7
Vit. B-3 (Niacin)	27,4	16,1	23,6	19,4	21,8	29,1
Vit. B-9 (Folate)	152,0	89,6	130,8	107,8	121,3	161,8
Vit. B-12	117,9	69,5	101,5	83,6	94,1	125,5
Iron (Ferrous sulfate dried)	13,1	23,1	22,5	9,3	20,9	27,9
Iron (NaFeEDTA)	39,3	52,1	50,7	27,9	47,0	62,7
Total iron	52,4	75,2	73,3	37,1	67,9	90,6
Zinc	127,4	150,2	219,3	90,3	203,3	271,2
Females, 51-65 years						
Vit. B-1 (Thiamin)	51,1	29,7	43,4	35,8	40,2	53,7
Vit. B-2 (Riboflavin)	96,5	56,1	82,0	67,5	76,0	101,4
Vit. B-3 (Niacin)	27,4	15,9	23,3	19,2	21,6	28,8
Vit. B-9 (Folate)	150,1	88,4	129,2	106,4	119,8	159,8
Vit. B-12	116,4	68,6	100,2	82,6	92,9	123,9
Iron (Ferrous sulfate dried)	33,6	59,5	57,9	23,9	53,7	71,6
Iron	100,9	133,8	130,3	71,6	120,8	161,1

Nutrient	Additional daily intake of nutrients by countries population groups, in %EAR/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
(NaFeEDTA)						
Total iron	134,5	193,3	188,2	95,4	174,5	232,7
Zinc	125,8	148,3	216,6	89,2	200,7	267,8
Females, +65 years						
Vit. B-1 (Thiamin)	45,3	26,7	39,0	32,1	36,1	48,2
Vit. B-2 (Riboflavin)	85,5	50,4	73,6	60,6	68,2	91,0
Vit. B-3 (Niacin)	24,3	14,3	20,9	17,2	19,4	25,8
Vit. B-9 (Folate)	134,7	79,4	115,9	95,5	107,5	143,4
Vit. B-12	104,5	61,6	89,9	74,1	83,4	111,2
Iron (Ferrous sulfate dried)	21,8	38,5	37,5	15,4	34,7	46,3
Iron (NaFeEDTA)	65,3	86,5	84,3	46,3	78,1	104,2
Total iron	87,0	125,0	121,7	61,7	112,8	150,5
Zinc	112,9	133,0	194,3	80,0	180,2	240,3

Note:

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50% apparently healthy individuals in an age- and sex-specific population.

7. Daily intake of micronutrients by population groups in the composition of fortified wheat flour, by countries, in % RNI/day.

In terms of total daily **vitamin B₁ (thiamin)** intake groups in the composition of fortified wheat flour, in % RNI/day, in all population groups (Table 8) the participating countries are located in the following ascending order:

- Kazakhstan: 22% to 29% in different age and gender groups
- Pakistan: 28% to 35%
- Tajikistan: 30% to 39%
- Kyrgyzstan: 33% to 43%
- Afghanistan: 38% to 49%
- Uzbekistan: 40% to 53%.

The value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which is the smallest in Kazakhstan and the largest in Uzbekistan.

In terms of total daily **vitamin B₂ (riboflavin)** intake groups in the composition of fortified wheat flour, in % RNI/day, in all population groups (Table 8) the participating countries are located in the following ascending order:

- Kazakhstan: 42% to 52% in different age and gender groups
- Pakistan: 50% to 62%
- Tajikistan: 56% to 70%
- Kyrgyzstan: 61% to 76%
- Afghanistan: 71% to 88%
- Uzbekistan: 75% to 93%.

The value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which is the smallest in Kazakhstan and the largest in Uzbekistan, as well.

The value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which is the smallest in Kazakhstan and the largest in Uzbekistan.

In terms of total daily **vitamin B₃ (niacin)** intake groups in the composition of fortified wheat flour, in % RNI/day, in all population groups (Table 8) the participating countries are located in the following ascending order:

- Kazakhstan: 11% to 14% in different age and gender groups
- Pakistan: 13% to 17%
- Tajikistan: 14% to 19%
- Kyrgyzstan: 16% to 20%
- Afghanistan: 18% to 23%
- Uzbekistan: 19% to 25%.

The value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which is the smallest in Kazakhstan and the largest in Uzbekistan, as well.

In a similar manner, the participating countries are arranged by the levels of total daily intake. In terms of total daily **follic acid** intake groups in the composition of fortified wheat flour, in % RNI/day, in all population groups (Table 8) the participating countries are located in the following ascending order:

- Kazakhstan: 64% to 91% in different age and gender groups
- Pakistan: 76% to 109%
- Tajikistan: 86% to 123%
- Kyrgyzstan: 93% to 133%
- Afghanistan: 108% to 156%
- Uzbekistan: 115% to 164%.

That is, that the value of this indicator is correlated with an average per capita consumption of wheat flour in g/day, which is the smallest in Kazakhstan and the largest in Uzbekistan.

In a similar manner, the participating countries are arranged by the levels of total daily intake of **vitamin B₁₂**, in % RNI/day:

- Kazakhstan: 51% to 73%
- Pakistan: 62% to 88%
- Tajikistan: 70% to 99%
- Kyrgyzstan: 75% to 107%
- Afghanistan: 87% to 124%
- Uzbekistan: 93% to 132%.

Unlike vitamins, by the level of total daily intake of **iron**, in % RNI/day, for all groups of population, the participating countries are located in the following ascending order:

- Pakistan: 15% to 46%
- Afghanistan: 21% to 66%
- Tajikistan: 27% to 85%
- Kyrgyzstan: 30% to 92%
- Kazakhstan: 30% to 94%
- Uzbekistan: 37% to 113%.

That is, that the value of this indicator is also correlated with an average per capita consumption of wheat flour in g/day, with the exception of Kazakhstan, where the value of the index was slightly higher than in Pakistan, Afghanistan, Tajikistan and Kyrgyzstan, but lower than in Uzbekistan. This is because the average diet in Kazakhstan attributed, as mentioned above, to the group with a high bioavailability of minerals and the diet of other participating countries - to the group with a moderate (Kyrgyzstan, Tajikistan and Uzbekistan) and low (Afghanistan and Pakistan) bioavailability of minerals.

In terms of total daily **zinc** intake, in % RNI/day, in all population groups the participating countries are located in the following ascending order:

- Pakistan: 41% to 75%
- Afghanistan: 59% to 106%
- Kazakhstan: 70% to 125%.
- Tajikistan: 95% to 169%
- Kyrgyzstan: 102% to 183%
- Uzbekistan: 127% to 226%

Table 8 – Daily intake of micronutrients by population groups in the composition of fortified wheat flour, by countries, in % RNI/day

Nutrient	Total daily intake of nutrients by countries population groups, in % RNI/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Children, 1-3 years						
Vit. B-1 (Thiamin)	43,9	25,8	37,8	31,1	35,0	46,7
Vit. B-2 (Riboflavin)	82,8	48,8	71,3	58,7	66,1	88,2
Vit. B-3 (Niacin)	23,0	13,6	19,8	16,3	18,4	24,5
Vit. B-9 (Folate)	151,9	89,5	130,7	107,7	121,2	161,7
Vit. B-12	122,7	72,3	105,6	87,0	97,9	130,6
Iron (Ferrous sulfate dried)	14,0	24,8	24,1	9,9	22,3	29,8
Iron (NaFeEDTA)	42,0	55,7	54,2	29,8	50,3	67,1
Total iron	56,0	80,5	78,3	39,7	72,6	96,9
Zinc	58,7	70,0	102,3	41,6	94,8	126,5
Children, 4-6 years						
Vit. B-1 (Thiamin)	46,4	27,4	40,0	32,9	37,0	49,4
Vit. B-2 (Riboflavin)	87,7	51,7	75,5	62,2	70,0	93,3
Vit. B-3 (Niacin)	21,9	12,9	18,9	15,5	17,5	23,3
Vit. B-9 (Folate)	144,7	85,3	124,6	102,6	115,5	154,0
Vit. B-12	116,9	68,9	100,6	82,9	93,3	124,5
Iron (Ferrous sulfate dried)	16,4	28,9	28,2	11,6	26,1	34,9
Iron (NaFeEDTA)	49,1	65,1	63,4	34,8	58,8	78,4
Total iron	65,5	94,1	91,6	46,4	84,9	113,3
Zinc	64,5	76,0	111,0	45,7	102,9	137,3
Children, 7-9 years						
Vit. B-1 (Thiamin)	38,9	22,9	33,4	27,6	31,0	41,4
Vit. B-2 (Riboflavin)	73,4	43,2	63,2	52,0	58,6	78,1
Vit. B-3 (Niacin)	18,3	10,8	15,8	13,0	14,6	19,5
Vit. B-9 (Folate)	121,1	71,4	104,2	85,9	96,6	128,9
Vit. B-12	97,8	57,7	84,2	69,4	78,1	104,2
Iron (Ferrous sulfate dried)	14,6	25,7	25,1	10,3	23,2	31,0
Iron (NaFeEDTA)	43,7	57,9	56,4	31,0	52,2	69,7

Nutrient	Total daily intake of nutrients by countries population groups, in % RNI/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Total iron	58,2	83,6	81,4	41,3	75,5	100,7
Zinc	69,4	81,8	119,4	49,2	110,7	147,7
Males, 10-18 years						
Vit. B-1 (Thiamin)	45,4	26,8	39,1	32,2	36,3	48,4
Vit. B-2 (Riboflavin)	79,2	46,7	68,2	56,2	63,2	84,3
Vit. B-3 (Niacin)	21,5	12,6	18,5	15,2	17,1	22,8
Vit. B-9 (Folate)	141,6	83,5	121,9	100,4	113,0	150,7
Vit. B-12	114,4	67,4	98,5	81,1	91,3	121,8
Iron (Ferrous sulfate dried)	11,5	20,4	19,3	8,2	17,9	23,9
Iron (NaFeEDTA)	34,6	45,9	43,5	24,5	40,3	53,7
Total iron	46,2	66,3	62,8	32,7	58,2	77,6
Zinc	70,9	83,0	121,3	50,2	112,4	150,0
Males, 19-50 years						
Vit. B-1 (Thiamin)	49,4	29,1	42,5	35,0	39,4	52,6
Vit. B-2 (Riboflavin)	86,1	50,7	74,1	61,1	68,7	91,7
Vit. B-3 (Niacin)	23,3	13,7	20,1	16,5	18,6	24,8
Vit. B-9 (Folate)	153,9	90,7	132,5	109,1	122,8	163,8
Vit. B-12	124,4	73,3	107,1	88,2	99,3	132,4
Iron (Ferrous sulfate dried)	16,0	28,3	27,6	11,4	25,6	34,1
Iron (NaFeEDTA)	48,1	63,7	62,1	34,1	57,5	76,7
Total iron	64,1	92,1	89,6	45,4	83,1	110,9
Zinc	94,1	110,9	162,0	66,7	150,1	200,3
Males, 51-65 years						
Vit. B-1 (Thiamin)	48,4	28,5	41,7	34,3	38,6	51,5
Vit. B-2 (Riboflavin)	84,4	49,7	72,6	59,8	67,3	89,8
Vit. B-3 (Niacin)	22,9	13,5	19,7	16,2	18,2	24,3
Vit. B-9 (Folate)	150,8	88,9	129,9	107,0	120,4	160,6
Vit. B-12	121,9	71,8	104,9	86,4	97,3	129,8
Iron (Ferrous sulfate dried)	15,7	27,8	27,0	11,1	25,1	33,4
Iron (NaFeEDTA)	47,1	62,5	60,8	33,4	56,4	75,2
Total iron	62,8	90,2	87,9	44,5	81,4	108,6

Nutrient	Total daily intake of nutrients by countries population groups, in % RNI/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Zinc	92,2	108,7	158,7	65,4	147,1	196,3
Males, +65 years						
Vit. B-1 (Thiamin)	40,5	23,9	34,9	28,7	32,3	43,1
Vit. B-2 (Riboflavin)	70,6	41,6	60,8	50,1	56,3	75,2
Vit. B-3 (Niacin)	19,1	11,3	16,5	13,6	15,3	20,4
Vit. B-9 (Folate)	126,2	74,4	108,7	89,5	100,7	134,4
Vit. B-12	102,0	60,1	87,8	72,3	81,4	108,6
Iron (Ferrous sulfate dried)	13,1	23,2	22,6	9,3	21,0	28,0
Iron (NaFeEDTA)	39,4	52,3	50,9	27,9	47,2	62,9
Total iron	52,6	75,5	73,5	37,3	68,1	90,9
Zinc	77,1	90,9	132,8	54,7	123,1	164,2
Females, 10-18 years						
Vit. B-1 (Thiamin)	41,5	24,4	35,7	29,4	33,1	44,2
Vit. B-2 (Riboflavin)	86,2	50,8	74,2	61,1	68,8	91,8
Vit. B-3 (Niacin)	18,0	10,6	15,5	12,7	14,3	19,1
Vit. B-9 (Folate)	118,5	69,8	102,0	84,0	94,6	126,2
Vit. B-12	95,8	56,4	82,4	67,9	76,4	101,9
Iron (Ferrous sulfate dried)	5,2	9,2	9,1	3,7	8,4	11,2
Iron (NaFeEDTA)	15,6	20,7	20,5	11,1	19,0	25,3
Total iron	20,8	29,9	29,6	14,8	27,4	36,5
Zinc	70,4	83,0	121,2	49,9	112,4	149,9
Females, 19-50 years						
Vit. B-1 (Thiamin)	42,6	25,1	36,6	30,2	34,0	45,3
Vit. B-2 (Riboflavin)	80,4	47,4	69,2	57,0	64,2	85,6
Vit. B-3 (Niacin)	21,1	12,4	18,1	14,9	16,8	22,4
Vit. B-9 (Folate)	121,6	71,7	104,7	86,2	97,0	129,4
Vit. B-12	98,3	57,9	84,6	69,7	78,4	104,6
Iron (Ferrous sulfate dried)	5,9	10,4	10,2	4,2	9,4	12,6
Iron (NaFeEDTA)	17,7	23,5	22,8	12,5	21,2	28,3
Total iron	23,6	33,9	33,0	16,7	30,6	40,8
Zinc	106,2	125,1	182,8	75,3	169,4	226,0

Nutrient	Total daily intake of nutrients by countries population groups, in % RNI/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Females, 51-65 years						
Vit. B-1 (Thiamin)	42,6	24,8	36,2	29,8	33,5	44,7
Vit. B-2 (Riboflavin)	80,4	46,8	68,3	56,3	63,3	84,5
Vit. B-3 (Niacin)	21,1	12,3	17,9	14,7	16,6	22,1
Vit. B-9 (Folate)	120,1	70,8	103,4	85,1	95,8	127,8
Vit. B-12	97,0	57,2	83,5	68,8	77,4	103,3
Iron (Ferrous sulfate dried)	15,2	26,8	26,1	10,7	24,2	32,3
Iron (NaFeEDTA)	45,5	60,3	58,7	32,2	54,4	72,6
Total iron	60,6	87,1	84,8	43,0	78,6	104,8
Zinc	104,8	123,5	180,5	74,3	167,3	223,2
Females, +65 years						
Vit. B-1 (Thiamin)	37,7	22,2	32,5	26,7	30,1	40,1
Vit. B-2 (Riboflavin)	71,2	42,0	61,3	50,5	56,8	75,8
Vit. B-3 (Niacin)	18,7	11,0	16,1	13,2	14,9	19,9
Vit. B-9 (Folate)	107,7	63,5	92,8	76,4	86,0	114,7
Vit. B-12	87,1	51,3	75,0	61,7	69,5	92,7
Iron (Ferrous sulfate dried)	13,6	24,0	23,4	9,6	21,7	28,9
Iron (NaFeEDTA)	40,8	54,1	52,7	28,9	48,8	65,1
Total iron	54,4	78,1	76,1	38,6	70,5	94,1
Zinc	94,1	110,9	162,0	66,7	150,1	200,3

Note:

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population.

8. Brief description of the annexes.

Annexes 1-6 provide detailed characteristics of fortified refined (white) wheat flour using a premix, the main parameters of which are shown in Table 5. In particular, the following data are given in these annexes:

- Addition levels each of seven micronutrients (vitamins B₁, B₂, B₃, B₉ and B₁₂, iron as Ferrous sulfate dried and NaFeEDTA, and zinc) to flour, in mg/kg flour
- Adjusted upper limit for each of the micronutrients (vitamins B₁, B₂, B₃, B₉ and B₁₂, iron as Ferrous sulfate dried and NaFeEDTA, and zinc), in mg/kg flour
- Daily intake of micronutrients in the composition of fortified wheat flour, in:
 - mg/day
 - % EAR/day
 - % RNI/day

The mentioned information in each member country are presented for the following age and gender groups of population in accordance with WHO recommendations:

1. Children, 1-3 years
2. Children, 4-6 years
3. Children, 7-9 years
4. Males, 10-18 years
5. Males, 19-50 years
6. Males, 51-65 years
7. Males, + 65 years
8. Females, 10-18 years
9. Females, 19-50 years
10. Females, 51-65 years
11. Females, + 65 years

Total 6 annexes are drawn up by the number of countries:

- Afghanistan – Annex 1
- Kazakhstan – Annex 1
- Kyrgyzstan – Annex 1
- Pakistan – Annex 1
- Tajikistan – Annex 1
- Uzbekistan – Annex 1

9. Conclusion.

1. For the mandatory fortification of refined (white) wheat flour the following 7 micronutrients are selected:

- Vitamin B₁ (thiamin)
- Vitamin B₂ (riboflavin)
- Vitamin B₉ (niacin)
- Vitamin B₉ (folate)
- Vitamin B₁₂ (cyanocobalamin)
- Iron (as Ferrous sulfate dried and NaFeEDTA)
- Zinc (zinc oxide)

2. The proposed addition levels of micronutrients in refined flour:

▪ prepared taking into account the average per capita consumption of flour (in g/day) in the participating countries;

- fully comply with WHO recommendations

3. The proposed levels of refined flour fortification by **zinc and vitamins B₁, B₂, B₃, B₉ and B₁₂** ensure the following levels of total daily intake (in % RNI/day) of these micronutrients in the composition of refined fortified wheat flour for all population groups in participating countries:

Nutrient	Total daily intake of nutrients by countries population groups, in % RNI/day					
	Afghanistan	Kazakhstan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan
Vit. B-3 (Niacin)	18% to 23%	11% to 14%	16% to 20%	13% to 17%	14% to 19%	19% to 25%
Vit. B-1 (Thiamin)	38% to 49%	22% to 29%	33% to 43%	28% to 35%	30% to 39%	40% to 53%
Vit. B-2 (Ribiflavin)	71% to 88%	42% to 52%	61% to 76%	50% to 62%	56% to 70%	75% to 93%
Vit. B-12	87% to 124%	51% to 73%	75% to 107%	62% to 88%	70% to 99%	93% to 132%
Vit. B-9 (Folate)	108% to 156%	64% to 91%	93% to 133%	76% to 109%	86% to 123%	115% to 164%
Zinc	59% to 106%	70% to 125%	102% to 183%	41% to 75%	95% to 169%	127% to 226%

4. The proposed levels of refined flour fortification by iron don't ensure acceptable levels of total daily intake (in% RNI/day) of **iron** in females of 10-50 years old in all participating countries:

- Pakistan: 15% to 17%
- Afghanistan: 21% to 24%
- Tajikistan: 27% to 31%
- Kyrgyzstan: 30% to 33%
- Kazakhstan: 30% to 34%
- Uzbekistan: 37% to 41%.

5. The proposed levels of refined flour fortification by iron ensure more acceptable levels of total daily intake (in % RNI/day) of **iron** in other age and gender population groups in participating countries:

- Pakistan: 33% to 46%
- Afghanistan: 46% to 66%
- Tajikistan: 58% to 85%
- Kyrgyzstan: 63% to 92%
- Kazakhstan: 66% to 94%
- Uzbekistan: 78% to 113%.

Annex 1 – Refined wheat flour fortification characteristics and daily intake of micronutrients by population groups in the composition of fortified wheat flour, in Afghanistan

Afghanistan: Low diet bioavailability for minerals

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Children, 1-3 years: P-50 Food Intake of target group = 162,4 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,219	54,8	43,9
Vit. B-2 (Riboflavin)	3,0	ND	0,414	103,5	82,8
Vit. B-3 (Niacin)	10,0	10,0	1,381	29,9	23,0
Vit. B-9 (Folate)	1,0	0,3	0,134	189,8	151,9
Vit. B-12	0,008	N.D.	0,001	159,5	122,7
Iron (Ferrous sulfate dried)	10,0	40,0	1,624	32,6	14,0
Iron (NaFeEDTA)	15,0	4,7	2,436	97,9	42,0
Total iron	25,0	40,0	4,061	130,5	56,0
Zinc	30,0	7,0	4,873	70,5	58,7
Children, 4-6 years: P-50 Food Intake of target group = 206,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,279	58,0	46,4
Vit. B-2 (Riboflavin)	3,0	ND	0,526	109,6	87,7
Vit. B-3 (Niacin)	10,0	15,0	1,754	28,5	21,9
Vit. B-9 (Folate)	1,0	0,4	0,170	180,9	144,7
Vit. B-12	0,008	N.D.	0,001	140,3	116,9
Iron (Ferrous sulfate dried)	10,0	40,0	2,063	39,8	16,4
Iron (NaFeEDTA)	15,0	7,2	3,095	119,4	49,1
Total iron	25,0	40,0	5,158	159,2	65,5
Zinc	30,0	12,0	6,190	77,4	64,5
Children, 7-9 years: P-50 Food Intake of target group = 259,0g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,350	48,6	38,9
Vit. B-2 (Riboflavin)	3,0	ND	0,660	91,7	73,4
Vit. B-3 (Niacin)	10,0	17,0	2,202	23,9	18,3
Vit. B-9 (Folate)	1,0	0,5	0,214	151,4	121,1
Vit. B-12	0,008	N.D.	0,002	117,4	97,8
Iron (Ferrous sulfate dried)	10,0	40,0	2,590	35,4	14,6
Iron (NaFeEDTA)	15,0	10,1	3,885	106,1	43,7
Total iron	25,0	40,0	6,475	141,4	58,2
Zinc	30,0	12,0	7,770	83,3	69,4
Males, 10-18 years: P-50 Food Intake of target group = 403,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,545	54,5	45,4
Vit. B-2 (Riboflavin)	3,0	ND	1,030	95,1	79,2
Vit. B-3 (Niacin)	10,0	25,0	3,433	27,9	21,5
Vit. B-9 (Folate)	1,0	0,7	0,333	177,0	141,6
Vit. B-12	0,008	N.D.	0,003	137,3	114,4
Iron (Ferrous sulfate dried)	10,0	40,0	4,039	16,2	11,5

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Iron (NaFeEDTA)	15,0	19,8	6,058	48,5	34,6
Total iron	25,0	40,0	10,097	64,6	46,2
Zinc	30,0	28,0	12,116	85,0	70,9
Males, 19-50 years: P-50 Food Intake of target group = 439,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,593	59,3	49,4
Vit. B-2 (Riboflavin)	3,0	ND	1,119	103,3	86,1
Vit. B-3 (Niacin)	10,0	35,0	3,732	30,3	23,3
Vit. B-9 (Folate)	1,0	1,0	0,362	192,4	153,9
Vit. B-12	0,008	N.D.	0,003	149,3	124,4
Iron (Ferrous sulfate dried)	10,0	45,0	4,390	21,3	16,0
Iron (NaFeEDTA)	15,0	28,8	6,585	63,9	48,1
Total iron	25,0	45,0	10,975	85,2	64,1
Zinc	30,0	45,0	13,170	112,9	94,1
Males, 51-65 years: P-50 Food Intake of target group = 430,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,581	58,1	48,4
Vit. B-2 (Riboflavin)	3,0	ND	1,097	101,3	84,4
Vit. B-3 (Niacin)	10,0	35,0	3,657	29,7	22,9
Vit. B-9 (Folate)	1,0	1,0	0,355	188,6	150,8
Vit. B-12	0,008	N.D.	0,003	146,3	121,9
Iron (Ferrous sulfate dried)	10,0	45,0	4,302	20,9	15,7
Iron (NaFeEDTA)	15,0	27	6,453	62,6	47,1
Total iron	25,0	45,0	10,756	83,5	62,8
Zinc	30,0	45,0	12,907	110,6	92,2
Males, +65 years: P-50 Food Intake of target group = 360,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,486	48,6	40,5
Vit. B-2 (Riboflavin)	3,0	ND	0,918	84,7	70,6
Vit. B-3 (Niacin)	10,0	35,0	3,060	24,9	19,1
Vit. B-9 (Folate)	1,0	1,0	0,297	157,8	126,2
Vit. B-12	0,008	N.D.	0,002	122,4	102,0
Iron (Ferrous sulfate dried)	10,0	45,0	3,600	17,5	13,1
Iron (NaFeEDTA)	15,0	25,2	5,400	52,4	39,4
Total iron	25,0	45,0	9,000	69,9	52,6
Zinc	30,0	45,0	10,799	92,6	77,1
Females, 10-18 years: P-50 Food Intake of target group = 338,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,456	49,8	41,5
Vit. B-2 (Riboflavin)	3,0	ND	0,862	94,8	86,2
Vit. B-3 (Niacin)	10,0	25,0	2,873	23,3	18,0
Vit. B-9 (Folate)	1,0	0,7	0,279	148,2	118,5
Vit. B-12	1,0	N.D.	0,002	114,9	95,8
Iron (Ferrous sulfate dried)	0,008	40,0	3,380	9,9	5,2
Iron (NaFeEDTA)	10,0	18	5,070	29,6	15,6
Total iron	15,0	45,0	8,451	39,5	20,8
Zinc	25,0	28,0	10,141	84,5	70,4
Females, 19-50 years: P-50 Food Intake of target group = 346,8 g/day					

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Vit. B-1 (Thiamin)	2,0	ND	0,468	51,1	42,6
Vit. B-2 (Riboflavin)	3,0	ND	0,884	96,5	80,4
Vit. B-3 (Niacin)	10,0	35,0	2,948	27,4	21,1
Vit. B-9 (Folate)	1,0	1,0	0,286	152,0	121,6
Vit. B-12	0,008	N.D.	0,002	117,9	98,3
Iron (Ferrous sulfate dried)	10,0	45,0	3,468	13,1	5,9
Iron (NaFeEDTA)	15,0	23,4	5,202	39,3	17,7
Total iron	25,0	45,0	8,670	52,4	23,6
Zinc	30,0	45,0	10,404	127,4	106,2
Females, 51-65 years: P-50 Food Intake of target group = 342,4 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,468	51,1	42,6
Vit. B-2 (Riboflavin)	3,0	ND	0,884	96,5	80,4
Vit. B-3 (Niacin)	10,0	35,0	2,948	27,4	21,1
Vit. B-9 (Folate)	1,0	1,0	0,282	150,1	120,1
Vit. B-12	0,008	N.D.	0,002	116,4	97,0
Iron (Ferrous sulfate dried)	10,0	45,0	3,424	33,6	15,2
Iron (NaFeEDTA)	15,0	25,2	5,136	100,9	45,5
Total iron	25,0	45,0	8,561	134,5	60,6
Zinc	30,0	45,0	10,273	125,8	104,8
Females, +65 years: P-50 Food Intake of target group = 307,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,415	45,3	37,7
Vit. B-2 (Riboflavin)	3,0	ND	0,784	85,5	71,2
Vit. B-3 (Niacin)	10,0	35,0	2,612	24,3	18,7
Vit. B-9 (Folate)	1,0	1,0	0,254	134,7	107,7
Vit. B-12	0,008	N.D.	0,002	104,5	87,1
Iron (Ferrous sulfate dried)	10,0	45,0	3,073	21,8	13,6
Iron (NaFeEDTA)	15,0	21,6	4,610	65,3	40,8
Total iron	25,0	45,0	7,683	87,0	54,4
Zinc	30,0	45,0	9,219	112,9	94,1

Notes:

^a - These values are calculated taking in consideration the micronutrient losses during storage and distribution, as well as during cooking.

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50% apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population.

* N.D. = Not determined

Annex 2 – Refined wheat flour fortification characteristics and daily intake of micronutrients by population groups in the composition of fortified wheat flour, in Kazakhstan

Kazakhstan: High diet bioavailability for minerals

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Children, 1-3 years: P-50 Food Intake of target group = 95,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,129	32,3	25,8
Vit. B-2 (Riboflavin)	3,0	ND	0,244	61,0	48,8
Vit. B-3 (Niacin)	10,0	10,0	0,814	17,6	13,6
Vit. B-9 (Folate)	1,0	0,3	0,079	111,9	89,5
Vit. B-12	0,008	ND	0,001	94,0	72,3
Iron (Ferrous sulfate dried)	10,0	40,0	0,957	57,7	24,8
Iron (NaFeEDTA)	15,0	4,7	1,436	129,8	55,7
Total iron	25,0	40,0	2,393	187,5	80,5
Zinc	30,0	7,0	2,872	84,0	70,0
Children, 4-6 years: P-50 Food Intake of target group = 121,6 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,164	34,2	27,4
Vit. B-2 (Riboflavin)	3,0	ND	0,310	64,6	51,7
Vit. B-3 (Niacin)	10,0	15,0	1,034	16,8	12,9
Vit. B-9 (Folate)	1,0	0,4	0,100	106,6	85,3
Vit. B-12	0,008	ND	0,001	82,7	68,9
Iron (Ferrous sulfate dried)	10,0	40,0	1,216	70,3	28,9
Iron (NaFeEDTA)	15,0	7,2	1,824	158,3	65,1
Total iron	25,0	40,0	3,040	228,6	94,1
Zinc	30,0	12,0	3,648	91,2	76,0
Children, 7-9 years: P-50 Food Intake of target group = 152,6 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,206	28,6	22,9
Vit. B-2 (Riboflavin)	3,0	ND	0,389	54,1	43,2
Vit. B-3 (Niacin)	10,0	17,0	1,297	14,1	10,8
Vit. B-9 (Folate)	1,0	0,5	0,126	89,2	71,4
Vit. B-12	0,008	ND	0,001	69,2	57,7
Iron (Ferrous sulfate dried)	10,0	40,0	1,526	62,5	25,7
Iron (NaFeEDTA)	15,0	10,1	2,289	140,6	57,9
Total iron	25,0	40,0	3,816	203,2	83,6
Zinc	30,0	12,0	4,579	98,1	81,8
Males, 10-18 years: P-50 Food Intake of target group = 238,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,321	32,1	26,8
Vit. B-2 (Riboflavin)	3,0	ND	0,607	56,0	46,7
Vit. B-3 (Niacin)	10,0	25,0	2,023	16,4	12,6
Vit. B-9 (Folate)	1,0	0,7	0,196	104,3	83,5
Vit. B-12	0,008	ND	0,002	80,9	67,4
Iron (Ferrous sulfate dried)	10,0	40,0	2,380	28,6	20,4
Iron (NaFeEDTA)	15,0	19,8	3,570	64,3	45,9
Total iron	25,0	40,0	5,950	92,8	66,3

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Zinc	30,0	28,0	7,140	99,6	83,0
Males, 19-50 years: P-50 Food Intake of target group = 258,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,349	34,9	29,1
Vit. B-2 (Riboflavin)	3,0	ND	0,660	60,9	50,7
Vit. B-3 (Niacin)	10,0	35,0	2,199	17,9	13,7
Vit. B-9 (Folate)	1,0	1,0	0,213	113,4	90,7
Vit. B-12	0,008	ND	0,002	88,0	73,3
Iron (Ferrous sulfate dried)	10,0	45,0	2,587	37,7	28,3
Iron (NaFeEDTA)	15,0	28,8	3,881	84,8	63,7
Total iron	25,0	45,0	6,468	122,4	92,1
Zinc	30,0	45,0	7,761	133,0	110,9
Males, 51-65 years: P-50 Food Intake of target group = 253,5 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,342	34,2	28,5
Vit. B-2 (Riboflavin)	3,0	ND	0,646	59,7	49,7
Vit. B-3 (Niacin)	10,0	35,0	2,155	17,5	13,5
Vit. B-9 (Folate)	1,0	1,0	0,209	111,1	88,9
Vit. B-12	0,008	ND	0,002	86,2	71,8
Iron (Ferrous sulfate dried)	10,0	45,0	2,535	36,9	27,8
Iron (NaFeEDTA)	15,0	27,0	3,803	83,1	62,5
Total iron	25,0	45,0	6,338	120,0	90,2
Zinc	30,0	45,0	7,606	130,4	108,7
Males, +65 years: P-50 Food Intake of target group = 212,1 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,286	28,6	23,9
Vit. B-2 (Riboflavin)	3,0	ND	0,541	49,9	41,6
Vit. B-3 (Niacin)	10,0	35,0	1,803	14,7	11,3
Vit. B-9 (Folate)	1,0	1,0	0,175	93,0	74,4
Vit. B-12	0,008	ND	0,001	72,1	60,1
Iron (Ferrous sulfate dried)	10,0	45,0	2,121	30,9	23,2
Iron (NaFeEDTA)	15,0	25,2	3,182	69,5	52,3
Total iron	25,0	45,0	5,303	100,4	75,5
Zinc	30,0	45,0	6,364	109,1	90,9
Females, 10-18 years: P-50 Food Intake of target group = 199,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,269	29,3	24,4
Vit. B-2 (Riboflavin)	3,0	ND	0,508	55,9	50,8
Vit. B-3 (Niacin)	10,0	25,0	1,693	13,8	10,6
Vit. B-9 (Folate)	1,0	0,7	0,164	87,3	69,8
Vit. B-12	0,008	ND	0,001	67,7	56,4
Iron (Ferrous sulfate dried)	10,0	40,0	1,992	17,5	9,2
Iron (NaFeEDTA)	15,0	18,0	2,988	39,3	20,7
Total iron	25,0	40,0	4,980	56,8	29,9
Zinc	30,0	28,0	5,976	99,6	83,0
Females, 19-50 years: P-50 Food Intake of target group = 204,4 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,276	30,1	25,1
Vit. B-2 (Riboflavin)	3,0	ND	0,521	56,9	47,4

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Vit. B-3 (Niacin)	10,0	35,0	1,737	16,1	12,4
Vit. B-9 (Folate)	1,0	1,0	0,169	89,6	71,7
Vit. B-12	0,008	ND	0,001	69,5	57,9
Iron (Ferrous sulfate dried)	10,0	45,0	2,044	23,1	10,4
Iron (NaFeEDTA)	15,0	23,4	3,066	52,1	23,5
Total iron	25,0	45,0	5,109	75,2	33,9
Zinc	30,0	45,0	6,131	150,2	125,1
Females, 51-65 years: P-50 Food Intake of target group = 201,8 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,272	29,7	24,8
Vit. B-2 (Riboflavin)	3,0	ND	0,515	56,1	46,8
Vit. B-3 (Niacin)	10,0	35,0	1,715	15,9	12,3
Vit. B-9 (Folate)	1,0	1,0	0,166	88,4	70,8
Vit. B-12	0,008	ND	0,001	68,6	57,2
Iron (Ferrous sulfate dried)	10,0	45,0	2,018	59,5	26,8
Iron (NaFeEDTA)	15,0	25,2	3,027	133,8	60,3
Total iron	25,0	45,0	5,045	193,3	87,1
Zinc	30,0	45,0	6,054	148,3	123,5
Females, +65 years: P-50 Food Intake of target group = 181,1 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,244	26,7	22,2
Vit. B-2 (Riboflavin)	3,0	ND	0,462	50,4	42,0
Vit. B-3 (Niacin)	10,0	35,0	1,539	14,3	11,0
Vit. B-9 (Folate)	1,0	1,0	0,149	79,4	63,5
Vit. B-12	0,008	ND	0,001	61,6	51,3
Iron (Ferrous sulfate dried)	10,0	45,0	1,811	38,5	24,0
Iron (NaFeEDTA)	15,0	21,6	2,716	86,5	54,1
Total iron	25,0	45,0	4,527	125,0	78,1
Zinc	30,0	45,0	5,433	133,0	110,9

Notes:

^a - These values are calculated taking in consideration the micronutrient losses during storage and distribution, as well as during cooking.

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50% apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population.

* N.D. = Not determined

Annex 3 – Refined wheat flour fortification characteristics and daily intake of micronutrients by population groups in the composition of fortified wheat flour, in Kyrgyzstan

Kyrgyzstan: Moderate diet bioavailability for minerals

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Children, 1-3 years: P-50 Food Intake of target group = 139,8 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,189	47,2	37,8
Vit. B-2 (Riboflavin)	3,0	ND	0,357	89,1	71,3
Vit. B-3 (Niacin)	10,0	10,0	1,188	25,8	19,8
Vit. B-9 (Folate)	1,0	0,3	0,115	163,4	130,7
Vit. B-12	0,008	N.D.	0,001	137,3	105,6
Iron (Ferrous sulfate dried)	10,0	40,0	1,398	56,2	24,1
Iron (NaFeEDTA)	15,0	4,7	2,097	126,4	54,2
Total iron	25,0	40,0	3,496	182,6	78,3
Zinc	30,0	7,0	4,195	122,8	102,3
Children, 4-6 years: P-50 Food Intake of target group = 177,6 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,240	50,0	40,0
Vit. B-2 (Riboflavin)	3,0	ND	0,453	94,4	75,5
Vit. B-3 (Niacin)	10,0	15,0	1,510	24,5	18,9
Vit. B-9 (Folate)	1,0	0,4	0,147	155,7	124,6
Vit. B-12	0,008	N.D.	0,001	120,8	100,6
Iron (Ferrous sulfate dried)	10,0	40,0	1,776	68,5	28,2
Iron (NaFeEDTA)	15,0	7,2	2,664	154,1	63,4
Total iron	25,0	40,0	4,440	222,7	91,6
Zinc	30,0	12,0	5,328	133,2	111,0
Children, 7-9 years: P-50 Food Intake of target group = 223,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,301	41,8	33,4
Vit. B-2 (Riboflavin)	3,0	ND	0,569	79,0	63,2
Vit. B-3 (Niacin)	10,0	17,0	1,895	20,5	15,8
Vit. B-9 (Folate)	1,0	0,5	0,184	130,3	104,2
Vit. B-12	0,008	N.D.	0,002	101,1	84,2
Iron (Ferrous sulfate dried)	10,0	40,0	2,230	60,9	25,1
Iron (NaFeEDTA)	15,0	10,1	3,344	137,0	56,4
Total iron	25,0	40,0	5,574	197,8	81,4
Zinc	30,0	12,0	6,689	143,3	119,4
Males, 10-18 years: P-50 Food Intake of target group = 347,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,469	46,9	39,1
Vit. B-2 (Riboflavin)	3,0	ND	0,887	81,8	68,2
Vit. B-3 (Niacin)	10,0	25,0	2,955	24,0	18,5
Vit. B-9 (Folate)	1,0	0,7	0,287	152,4	121,9
Vit. B-12	0,008	N.D.	0,002	118,2	98,5
Iron (Ferrous sulfate dried)	10,0	40,0	3,477	27,0	19,3
Iron (NaFeEDTA)	15,0	19,8	5,215	60,8	43,5
Total iron	25,0	40,0	8,692	87,9	62,8

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Zinc	30,0	28,0	10,430	145,5	121,3
Males, 19-50 years: P-50 Food Intake of target group = 377,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,510	51,0	42,5
Vit. B-2 (Riboflavin)	3,0	ND	0,964	89,0	74,1
Vit. B-3 (Niacin)	10,0	35,0	3,212	26,1	20,1
Vit. B-9 (Folate)	1,0	1,0	0,312	165,6	132,5
Vit. B-12	0,008	N.D.	0,003	128,5	107,1
Iron (Ferrous sulfate dried)	10,0	45,0	3,779	36,7	27,6
Iron (NaFeEDTA)	15,0	28,8	5,669	82,5	62,1
Total iron	25,0	45,0	9,448	119,2	89,6
Zinc	30,0	45,0	11,337	194,3	162,0
Males, 51-65 years: P-50 Food Intake of target group = 370,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,500	50,0	41,7
Vit. B-2 (Riboflavin)	3,0	ND	0,944	87,2	72,6
Vit. B-3 (Niacin)	10,0	35,0	3,148	25,6	19,7
Vit. B-9 (Folate)	1,0	1,0	0,306	162,3	129,9
Vit. B-12	0,008	N.D.	0,003	125,9	104,9
Iron (Ferrous sulfate dried)	10,0	45,0	3,703	36,0	27,0
Iron (NaFeEDTA)	15,0	27	5,555	80,9	60,8
Total iron	25,0	45,0	9,259	116,8	87,9
Zinc	30,0	45,0	11,110	190,5	158,7
Males, +65 years: P-50 Food Intake of target group = 309,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,418	41,8	34,9
Vit. B-2 (Riboflavin)	3,0	ND	0,790	72,9	60,8
Vit. B-3 (Niacin)	10,0	35,0	2,634	21,4	16,5
Vit. B-9 (Folate)	1,0	1,0	0,256	135,8	108,7
Vit. B-12	0,008	N.D.	0,002	105,4	87,8
Iron (Ferrous sulfate dried)	10,0	45,0	3,099	30,1	22,6
Iron (NaFeEDTA)	15,0	25,2	4,648	67,7	50,9
Total iron	25,0	45,0	7,747	97,8	73,5
Zinc	30,0	45,0	9,296	159,4	132,8
Females, 10-18 years: P-50 Food Intake of target group = 291,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,393	42,9	35,7
Vit. B-2 (Riboflavin)	3,0	ND	0,742	81,6	74,2
Vit. B-3 (Niacin)	10,0	25,0	2,473	20,1	15,5
Vit. B-9 (Folate)	1,0	0,7	0,240	127,5	102,0
Vit. B-12	0,008	N.D.	0,002	98,9	82,4
Iron (Ferrous sulfate dried)	10,0	40,0	2,910	17,3	9,1
Iron (NaFeEDTA)	15,0	18	4,365	38,9	20,5
Total iron	25,0	40,0	7,275	56,2	29,6
Zinc	30,0	28,0	8,729	145,5	121,2
Females, 19-50 years: P-50 Food Intake of target group = 298,5 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,403	44,0	36,6
Vit. B-2 (Riboflavin)	3,0	ND	0,761	83,0	69,2

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Vit. B-3 (Niacin)	10,0	35,0	2,538	23,6	18,1
Vit. B-9 (Folate)	1,0	1,0	0,246	130,8	104,7
Vit. B-12	0,008	N.D.	0,002	101,5	84,6
Iron (Ferrous sulfate dried)	10,0	45,0	2,985	22,5	10,2
Iron (NaFeEDTA)	15,0	23,4	4,478	50,7	22,8
Total iron	25,0	45,0	7,464	73,3	33,0
Zinc	30,0	45,0	8,956	219,3	182,8
Females, 51-65 years: P-50 Food Intake of target group = 294,8 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,398	43,4	36,2
Vit. B-2 (Riboflavin)	3,0	ND	0,752	82,0	68,3
Vit. B-3 (Niacin)	10,0	35,0	2,505	23,3	17,9
Vit. B-9 (Folate)	1,0	1,0	0,243	129,2	103,4
Vit. B-12	0,008	N.D.	0,002	100,2	83,5
Iron (Ferrous sulfate dried)	10,0	45,0	2,948	57,9	26,1
Iron (NaFeEDTA)	15,0	25,2	4,421	130,3	58,7
Total iron	25,0	45,0	7,369	188,2	84,8
Zinc	30,0	45,0	8,843	216,6	180,5
Females, +65 years: P-50 Food Intake of target group = 264,5 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,357	39,0	32,5
Vit. B-2 (Riboflavin)	3,0	ND	0,675	73,6	61,3
Vit. B-3 (Niacin)	10,0	35,0	2,249	20,9	16,1
Vit. B-9 (Folate)	1,0	1,0	0,218	115,9	92,8
Vit. B-12	0,008	N.D.	0,002	89,9	75,0
Iron (Ferrous sulfate dried)	10,0	45,0	2,645	37,5	23,4
Iron (NaFeEDTA)	15,0	21,6	3,968	84,3	52,7
Total iron	25,0	45,0	6,613	121,7	76,1
Zinc	30,0	45,0	7,936	194,3	162,0

Notes:

^a - These values are calculated taking in consideration the micronutrient losses during storage and distribution, as well as during cooking.

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50% apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population.

* N.D. = Not determined

Pakistan: Low diet bioavailability for minerals

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Children, 1-3 years: P-50 Food Intake of target group = 115,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,155	38,9	31,1
Vit. B-2 (Riboflavin)	3,0	ND	0,294	73,4	58,7
Vit. B-3 (Niacin)	10,0	10,0	0,979	21,2	16,3
Vit. B-9 (Folate)	1,0	0,3	0,095	134,6	107,7
Vit. B-12	0,008	N.D.	0,001	113,1	87,0
Iron (Ferrous sulfate dried)	10,0	40,0	1,152	23,1	9,9
Iron (NaFeEDTA)	15,0	4,7	1,728	69,4	29,8
Total iron	25,0	40,0	2,880	92,5	39,7
Zinc	30,0	7,0	3,455	50,0	41,6
Children, 4-6 years: P-50 Food Intake of target group = 146,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,198	41,1	32,9
Vit. B-2 (Riboflavin)	3,0	ND	0,373	77,7	62,2
Vit. B-3 (Niacin)	10,0	15,0	1,244	20,2	15,5
Vit. B-9 (Folate)	1,0	0,4	0,121	128,3	102,6
Vit. B-12	0,008	N.D.	0,001	99,5	82,9
Iron (Ferrous sulfate dried)	10,0	40,0	1,463	28,2	11,6
Iron (NaFeEDTA)	15,0	7,2	2,195	84,7	34,8
Total iron	25,0	40,0	3,658	112,9	46,4
Zinc	30,0	12,0	4,389	54,9	45,7
Children, 7-9 years: P-50 Food Intake of target group = 183,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,248	34,4	27,6
Vit. B-2 (Riboflavin)	3,0	ND	0,468	65,0	52,0
Vit. B-3 (Niacin)	10,0	17,0	1,561	16,9	13,0
Vit. B-9 (Folate)	1,0	0,5	0,152	107,3	85,9
Vit. B-12	0,008	N.D.	0,001	83,3	69,4
Iron (Ferrous sulfate dried)	10,0	40,0	1,837	25,1	10,3
Iron (NaFeEDTA)	15,0	10,1	2,755	75,2	31,0
Total iron	25,0	40,0	4,592	100,3	41,3
Zinc	30,0	12,0	5,510	59,0	49,2
Males, 10-18 years: P-50 Food Intake of target group = 286,4 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,387	38,7	32,2
Vit. B-2 (Riboflavin)	3,0	ND	0,730	67,4	56,2
Vit. B-3 (Niacin)	10,0	25,0	2,434	19,8	15,2
Vit. B-9 (Folate)	1,0	0,7	0,236	125,5	100,4
Vit. B-12	0,008	N.D.	0,002	97,4	81,1
Iron (Ferrous sulfate dried)	10,0	40,0	2,864	11,5	8,2
Iron (NaFeEDTA)	15,0	19,8	4,296	34,4	24,5
Total iron	25,0	40,0	7,160	45,8	32,7
Zinc	30,0	28,0	8,592	60,3	50,2
Males, 19-50 years: P-50 Food Intake of target group = 311,3 g/day					

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Vit. B-1 (Thiamin)	2,0	ND	0,420	42,0	35,0
Vit. B-2 (Riboflavin)	3,0	ND	0,794	73,3	61,1
Vit. B-3 (Niacin)	10,0	35,0	2,646	21,5	16,5
Vit. B-9 (Folate)	1,0	1,0	0,257	136,4	109,1
Vit. B-12	0,008	N.D.	0,002	105,8	88,2
Iron (Ferrous sulfate dried)	10,0	45,0	3,113	15,1	11,4
Iron (NaFeEDTA)	15,0	28,8	4,670	45,3	34,1
Total iron	25,0	45,0	7,783	60,4	45,4
Zinc	30,0	45,0	9,339	80,0	66,7
Males, 51-65 years: P-50 Food Intake of target group = 305,1 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,412	41,2	34,3
Vit. B-2 (Riboflavin)	3,0	ND	0,778	71,8	59,8
Vit. B-3 (Niacin)	10,0	35,0	2,593	21,1	16,2
Vit. B-9 (Folate)	1,0	1,0	0,252	133,7	107,0
Vit. B-12	0,008	N.D.	0,002	103,7	86,4
Iron (Ferrous sulfate dried)	10,0	45,0	3,051	14,8	11,1
Iron (NaFeEDTA)	15,0	27	4,576	44,4	33,4
Total iron	25,0	45,0	7,627	59,2	44,5
Zinc	30,0	45,0	9,152	78,4	65,4
Males, +65 years: P-50 Food Intake of target group = 255,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,345	34,5	28,7
Vit. B-2 (Riboflavin)	3,0	ND	0,651	60,1	50,1
Vit. B-3 (Niacin)	10,0	35,0	2,170	17,6	13,6
Vit. B-9 (Folate)	1,0	1,0	0,211	111,9	89,5
Vit. B-12	0,008	N.D.	0,002	86,8	72,3
Iron (Ferrous sulfate dried)	10,0	45,0	2,553	12,4	9,3
Iron (NaFeEDTA)	15,0	25,2	3,829	37,2	27,9
Total iron	25,0	45,0	6,382	49,6	37,3
Zinc	30,0	45,0	7,658	65,6	54,7
Females, 10-18 years: P-50 Food Intake of target group = 239,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,324	35,3	29,4
Vit. B-2 (Riboflavin)	3,0	ND	0,611	67,2	61,1
Vit. B-3 (Niacin)	10,0	25,0	2,037	16,6	12,7
Vit. B-9 (Folate)	1,0	0,7	0,198	105,1	84,0
Vit. B-12	0,008	N.D.	0,002	81,5	67,9
Iron (Ferrous sulfate dried)	10,0	40,0	2,397	7,0	3,7
Iron (NaFeEDTA)	15,0	18	3,596	21,0	11,1
Total iron	25,0	40,0	5,993	28,0	14,8
Zinc	30,0	28,0	7,191	59,9	49,9
Females, 19-50 years: P-50 Food Intake of target group = 245,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,332	36,2	30,2
Vit. B-2 (Riboflavin)	3,0	ND	0,627	68,4	57,0
Vit. B-3 (Niacin)	10,0	35,0	2,090	19,4	14,9
Vit. B-9 (Folate)	1,0	1,0	0,203	107,8	86,2

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	% EAR/day	% RNI/day
Vit. B-12	0,008	N.D.	0,002	83,6	69,7
Iron (Ferrous sulfate dried)	10,0	45,0	2,459	9,3	4,2
Iron (NaFeEDTA)	15,0	23,4	3,689	27,9	12,5
Total iron	25,0	45,0	6,148	37,1	16,7
Zinc	30,0	45,0	7,378	90,3	75,3
Females, 51-65 years: P-50 Food Intake of target group = 242,8 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,328	35,8	29,8
Vit. B-2 (Riboflavin)	3,0	ND	0,619	67,5	56,3
Vit. B-3 (Niacin)	10,0	35,0	2,064	19,2	14,7
Vit. B-9 (Folate)	1,0	1,0	0,200	106,4	85,1
Vit. B-12	0,008	N.D.	0,002	82,6	68,8
Iron (Ferrous sulfate dried)	10,0	45,0	2,428	23,9	10,7
Iron (NaFeEDTA)	15,0	25,2	3,642	71,6	32,2
Total iron	25,0	45,0	6,070	95,4	43,0
Zinc	30,0	45,0	7,284	89,2	74,3
Females, +65 years: P-50 Food Intake of target group = 217,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,294	32,1	26,7
Vit. B-2 (Riboflavin)	3,0	ND	0,556	60,6	50,5
Vit. B-3 (Niacin)	10,0	35,0	1,852	17,2	13,2
Vit. B-9 (Folate)	1,0	1,0	0,180	95,5	76,4
Vit. B-12	0,008	N.D.	0,001	74,1	61,7
Iron (Ferrous sulfate dried)	10,0	45,0	2,179	15,4	9,6
Iron (NaFeEDTA)	15,0	21,6	3,269	46,3	28,9
Total iron	25,0	45,0	5,448	61,7	38,6
Zinc	30,0	45,0	6,537	80,0	66,7

Notes:

^a - These values are calculated taking in consideration the micronutrient losses during storage and distribution, as well as during cooking.

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50 apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5) apparently healthy individuals in an age- and sex-specific population.

* N.D. = Not determined

Annex 5 – Refined wheat flour fortification characteristics and daily intake of micronutrients by population groups in the composition of fortified wheat flour, in Tajikistan

Tajikistan: Moderate diet bioavailability for minerals

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	EAR/day	RNI/day
Children, 1-3 years: P-50 Food Intake of target group = 129,6 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,175	43,7	35,0
Vit. B-2 (Riboflavin)	3,0	ND	0,331	82,6	66,1
Vit. B-3 (Niacin)	10,0	10,0	1,102	23,9	18,4
Vit. B-9 (Folate)	1,0	0,3	0,107	151,5	121,2
Vit. B-12	0,008	N.D.	0,001	127,3	97,9
Iron (Ferrous sulfate dried)	10,0	40,0	1,296	52,1	22,3
Iron (NaFeEDTA)	15,0	4,7	1,944	117,2	50,3
Total iron	25,0	40,0	3,240	169,2	72,6
Zinc	30,0	7,0	3,888	113,8	94,8
Children, 4-6 years: P-50 Food Intake of target group = 164,6 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,222	46,3	37,0
Vit. B-2 (Riboflavin)	3,0	ND	0,420	87,5	70,0
Vit. B-3 (Niacin)	10,0	15,0	1,399	22,7	17,5
Vit. B-9 (Folate)	1,0	0,4	0,136	144,3	115,5
Vit. B-12	0,008	N.D.	0,001	112,0	93,3
Iron (Ferrous sulfate dried)	10,0	40,0	1,646	63,5	26,1
Iron (NaFeEDTA)	15,0	7,2	2,470	142,9	58,8
Total iron	25,0	40,0	4,116	206,4	84,9
Zinc	30,0	12,0	4,939	123,5	102,9
Children, 7-9 years: P-50 Food Intake of target group = 206,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,279	38,8	31,0
Vit. B-2 (Riboflavin)	3,0	ND	0,527	73,2	58,6
Vit. B-3 (Niacin)	10,0	17,0	1,757	19,0	14,6
Vit. B-9 (Folate)	1,0	0,5	0,171	120,8	96,6
Vit. B-12	0,008	N.D.	0,001	93,7	78,1
Iron (Ferrous sulfate dried)	10,0	40,0	2,067	56,4	23,2
Iron (NaFeEDTA)	15,0	10,1	3,100	127,0	52,2
Total iron	25,0	40,0	5,167	183,4	75,5
Zinc	30,0	12,0	6,200	132,9	110,7
Males, 10-18 years: P-50 Food Intake of target group = 322,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,435	43,5	36,3
Vit. B-2 (Riboflavin)	3,0	ND	0,822	75,9	63,2
Vit. B-3 (Niacin)	10,0	25,0	2,739	22,3	17,1
Vit. B-9 (Folate)	1,0	0,7	0,266	141,2	113,0
Vit. B-12	0,008	N.D.	0,002	109,6	91,3
Iron (Ferrous sulfate dried)	10,0	40,0	3,223	25,1	17,9
Iron (NaFeEDTA)	15,0	19,8	4,834	56,4	40,3
Total iron	25,0	40,0	8,057	81,5	58,2

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	EAR/day	RNI/day
Zinc	30,0	28,0	9,668	134,9	112,4
Males, 19-50 years: P-50 Food Intake of target group = 350,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,473	47,3	39,4
Vit. B-2 (Riboflavin)	3,0	ND	0,893	82,5	68,7
Vit. B-3 (Niacin)	10,0	35,0	2,978	24,2	18,6
Vit. B-9 (Folate)	1,0	1,0	0,289	153,5	122,8
Vit. B-12	0,008	N.D.	0,002	119,1	99,3
Iron (Ferrous sulfate dried)	10,0	45,0	3,503	34,0	25,6
Iron (NaFeEDTA)	15,0	28,8	5,255	76,5	57,5
Total iron	25,0	45,0	8,758	110,5	83,1
Zinc	30,0	45,0	10,509	180,2	150,1
Males, 51-65 years: P-50 Food Intake of target group = 343,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,463	46,3	38,6
Vit. B-2 (Riboflavin)	3,0	ND	0,875	80,8	67,3
Vit. B-3 (Niacin)	10,0	35,0	2,918	23,7	18,2
Vit. B-9 (Folate)	1,0	1,0	0,283	150,5	120,4
Vit. B-12	0,008	N.D.	0,002	116,7	97,3
Iron (Ferrous sulfate dried)	10,0	45,0	3,433	33,3	25,1
Iron (NaFeEDTA)	15,0	27	5,149	75,0	56,4
Total iron	25,0	45,0	8,582	108,3	81,4
Zinc	30,0	45,0	10,299	176,6	147,1
Males, +65 years: P-50 Food Intake of target group = 287,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,388	38,8	32,3
Vit. B-2 (Riboflavin)	3,0	ND	0,732	67,6	56,3
Vit. B-3 (Niacin)	10,0	35,0	2,442	19,8	15,3
Vit. B-9 (Folate)	1,0	1,0	0,237	125,9	100,7
Vit. B-12	0,008	N.D.	0,002	97,7	81,4
Iron (Ferrous sulfate dried)	10,0	45,0	2,872	27,9	21,0
Iron (NaFeEDTA)	15,0	25,2	4,309	62,7	47,2
Total iron	25,0	45,0	7,181	90,6	68,1
Zinc	30,0	45,0	8,617	147,7	123,1
Females, 10-18 years: P-50 Food Intake of target group = 269,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,364	39,7	33,1
Vit. B-2 (Riboflavin)	3,0	ND	0,688	75,7	68,8
Vit. B-3 (Niacin)	10,0	25,0	2,293	18,6	14,3
Vit. B-9 (Folate)	1,0	0,7	0,223	118,2	94,6
Vit. B-12	0,008	N.D.	0,002	91,7	76,4
Iron (Ferrous sulfate dried)	10,0	40,0	2,697	16,0	8,4
Iron (NaFeEDTA)	15,0	18	4,046	36,0	19,0
Total iron	25,0	40,0	6,743	52,0	27,4
Zinc	30,0	28,0	8,092	134,9	112,4
Females, 19-50 years: P-50 Food Intake of target group = 276,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,374	40,8	34,0
Vit. B-2 (Riboflavin)	3,0	ND	0,706	77,0	64,2

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	EAR/day	RNI/day
Vit. B-3 (Niacin)	10,0	35,0	2,352	21,8	16,8
Vit. B-9 (Folate)	1,0	1,0	0,228	121,3	97,0
Vit. B-12	0,008	N.D.	0,002	94,1	78,4
Iron (Ferrous sulfate dried)	10,0	45,0	2,767	20,9	9,4
Iron (NaFeEDTA)	15,0	23,4	4,151	47,0	21,2
Total iron	25,0	45,0	6,918	67,9	30,6
Zinc	30,0	45,0	8,302	203,3	169,4
Females, 51-65 years: P-50 Food Intake of target group = 273,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,369	40,2	33,5
Vit. B-2 (Riboflavin)	3,0	ND	0,697	76,0	63,3
Vit. B-3 (Niacin)	10,0	35,0	2,322	21,6	16,6
Vit. B-9 (Folate)	1,0	1,0	0,225	119,8	95,8
Vit. B-12	0,008	N.D.	0,002	92,9	77,4
Iron (Ferrous sulfate dried)	10,0	45,0	2,732	53,7	24,2
Iron (NaFeEDTA)	15,0	25,2	4,099	120,8	54,4
Total iron	25,0	45,0	6,831	174,5	78,6
Zinc	30,0	45,0	8,197	200,7	167,3
Females, +65 years: P-50 Food Intake of target group = 245,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,331	36,1	30,1
Vit. B-2 (Riboflavin)	3,0	ND	0,625	68,2	56,8
Vit. B-3 (Niacin)	10,0	35,0	2,084	19,4	14,9
Vit. B-9 (Folate)	1,0	1,0	0,202	107,5	86,0
Vit. B-12	0,008	N.D.	0,002	83,4	69,5
Iron (Ferrous sulfate dried)	10,0	45,0	2,452	34,7	21,7
Iron (NaFeEDTA)	15,0	21,6	3,678	78,1	48,8
Total iron	25,0	45,0	6,130	112,8	70,5
Zinc	30,0	45,0	7,356	180,2	150,1

Notes:

^a - These values are calculated taking in consideration the micronutrient losses during storage and distribution, as well as during cooking.

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50 apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5) apparently healthy individuals in an age- and sex-specific population.

* N.D. = Not determined

Annex 6 – Refined wheat flour fortification characteristics and daily intake of micronutrients by population groups in the composition of fortified wheat flour, in Uzbekistan

Uzbekistan: Moderate diet bioavailability for minerals

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	EAR/day	RNI/day
Children, 1-3 years: P-50 Food Intake of target group = 172,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,233	58,4	46,7
Vit. B-2 (Riboflavin)	3,0	ND	0,441	110,2	88,2
Vit. B-3 (Niacin)	10,0	10,0	1,470	31,8	24,5
Vit. B-9 (Folate)	1,0	0,3	0,143	202,1	161,7
Vit. B-12	0,008	N.D.	0,001	169,8	130,6
Iron (Ferrous sulfate dried)	10,0	40,0	1,729	69,5	29,8
Iron (NaFeEDTA)	15,0	4,7	2,594	156,3	67,1
Total iron	25,0	40,0	4,323	225,7	96,9
Zinc	30,0	7,0	5,187	151,8	126,5
Children, 4-6 years: P-50 Food Intake of target group = 219,6 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,297	61,8	49,4
Vit. B-2 (Riboflavin)	3,0	ND	0,560	116,7	93,3
Vit. B-3 (Niacin)	10,0	15,0	1,867	30,3	23,3
Vit. B-9 (Folate)	1,0	0,4	0,181	192,5	154,0
Vit. B-12	0,008	N.D.	0,001	149,3	124,5
Iron (Ferrous sulfate dried)	10,0	40,0	2,196	84,7	34,9
Iron (NaFeEDTA)	15,0	7,2	3,294	190,6	78,4
Total iron	25,0	40,0	5,491	275,3	113,3
Zinc	30,0	12,0	6,589	164,7	137,3
Children, 7-9 years: P-50 Food Intake of target group = 275,7 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,372	51,7	41,4
Vit. B-2 (Riboflavin)	3,0	ND	0,703	97,6	78,1
Vit. B-3 (Niacin)	10,0	17,0	2,344	25,4	19,5
Vit. B-9 (Folate)	1,0	0,5	0,227	161,1	128,9
Vit. B-12	0,008	N.D.	0,002	125,0	104,2
Iron (Ferrous sulfate dried)	10,0	40,0	2,757	75,3	31,0
Iron (NaFeEDTA)	15,0	10,1	4,136	169,4	69,7
Total iron	25,0	40,0	6,893	244,7	100,7
Zinc	30,0	12,0	8,271	177,2	147,7
Males, 10-18 years: P-50 Food Intake of target group = 429,9 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,580	58,0	48,4
Vit. B-2 (Riboflavin)	3,0	ND	1,096	101,2	84,3
Vit. B-3 (Niacin)	10,0	25,0	3,654	29,7	22,8
Vit. B-9 (Folate)	1,0	0,7	0,355	188,4	150,7
Vit. B-12	0,008	N.D.	0,003	146,2	121,8
Iron (Ferrous sulfate dried)	10,0	40,0	4,299	33,4	23,9
Iron (NaFeEDTA)	15,0	19,8	6,449	75,2	53,7
Total iron	25,0	40,0	10,748	108,7	77,6

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	EAR/day	RNI/day
Zinc	30,0	28,0	12,897	180,0	150,0
Males, 19-50 years: P-50 Food Intake of target group = 467,3 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,631	63,1	52,6
Vit. B-2 (Riboflavin)	3,0	ND	1,192	110,0	91,7
Vit. B-3 (Niacin)	10,0	35,0	3,972	32,3	24,8
Vit. B-9 (Folate)	1,0	1,0	0,386	204,8	163,8
Vit. B-12	0,008	N.D.	0,003	158,9	132,4
Iron (Ferrous sulfate dried)	10,0	45,0	4,673	45,4	34,1
Iron (NaFeEDTA)	15,0	28,8	7,010	102,1	76,7
Total iron	25,0	45,0	11,683	147,4	110,9
Zinc	30,0	45,0	14,019	240,3	200,3
Males, 51-65 years: P-50 Food Intake of target group = 458,0 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,618	61,8	51,5
Vit. B-2 (Riboflavin)	3,0	ND	1,168	107,8	89,8
Vit. B-3 (Niacin)	10,0	35,0	3,893	31,6	24,3
Vit. B-9 (Folate)	1,0	1,0	0,378	200,7	160,6
Vit. B-12	0,008	N.D.	0,003	155,7	129,8
Iron (Ferrous sulfate dried)	10,0	45,0	4,580	44,5	33,4
Iron (NaFeEDTA)	15,0	27	6,869	100,0	75,2
Total iron	25,0	45,0	11,449	144,5	108,6
Zinc	30,0	45,0	13,739	235,5	196,3
Males, +65 years: P-50 Food Intake of target group = 383,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,517	51,7	43,1
Vit. B-2 (Riboflavin)	3,0	ND	0,977	90,2	75,2
Vit. B-3 (Niacin)	10,0	35,0	3,257	26,5	20,4
Vit. B-9 (Folate)	1,0	1,0	0,316	167,9	134,4
Vit. B-12	0,008	N.D.	0,003	130,3	108,6
Iron (Ferrous sulfate dried)	10,0	45,0	3,832	37,2	28,0
Iron (NaFeEDTA)	15,0	25,2	5,748	83,7	62,9
Total iron	25,0	45,0	9,580	120,9	90,9
Zinc	30,0	45,0	11,496	197,1	164,2
Females, 10-18 years: P-50 Food Intake of target group = 359,8 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,486	53,0	44,2
Vit. B-2 (Riboflavin)	3,0	ND	0,918	100,9	91,8
Vit. B-3 (Niacin)	10,0	25,0	3,058	24,9	19,1
Vit. B-9 (Folate)	1,0	0,7	0,297	157,7	126,2
Vit. B-12	0,008	N.D.	0,002	122,3	101,9
Iron (Ferrous sulfate dried)	10,0	40,0	3,598	21,4	11,2
Iron (NaFeEDTA)	15,0	18	5,397	48,1	25,3
Total iron	25,0	40,0	8,996	69,4	36,5
Zinc	30,0	28,0	10,795	179,9	149,9
Females, 19-50 years: P-50 Food Intake of target group = 369,2 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,498	54,4	45,3
Vit. B-2 (Riboflavin)	3,0	ND	0,941	102,7	85,6

Nutrient	Addition level to flour, mg/kg	Adjusted upper limit, mg/day	Daily intake of micronutrients in the composition of fortified wheat flour		
			mg/day ^a	EAR/day	RNI/day
Vit. B-3 (Niacin)	10,0	35,0	3,138	29,1	22,4
Vit. B-9 (Folate)	1,0	1,0	0,305	161,8	129,4
Vit. B-12	0,008	N.D.	0,003	125,5	104,6
Iron (Ferrous sulfate dried)	10,0	45,0	3,692	27,9	12,6
Iron (NaFeEDTA)	15,0	23,4	5,538	62,7	28,3
Total iron	25,0	45,0	9,229	90,6	40,8
Zinc	30,0	45,0	11,075	271,2	226,0
Females, 51-65 years: P-50 Food Intake of target group = 364,5 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,492	53,7	44,7
Vit. B-2 (Riboflavin)	3,0	ND	0,929	101,4	84,5
Vit. B-3 (Niacin)	10,0	35,0	3,098	28,8	22,1
Vit. B-9 (Folate)	1,0	1,0	0,301	159,8	127,8
Vit. B-12	0,008	N.D.	0,002	123,9	103,3
Iron (Ferrous sulfate dried)	10,0	45,0	3,645	71,6	32,3
Iron (NaFeEDTA)	15,0	25,2	5,467	161,1	72,6
Total iron	25,0	45,0	9,112	232,7	104,8
Zinc	30,0	45,0	10,935	267,8	223,2
Females, +65 years: P-50 Food Intake of target group = 327,1 g/day					
Vit. B-1 (Thiamin)	2,0	ND	0,442	48,2	40,1
Vit. B-2 (Riboflavin)	3,0	ND	0,834	91,0	75,8
Vit. B-3 (Niacin)	10,0	35,0	2,780	25,8	19,9
Vit. B-9 (Folate)	1,0	1,0	0,270	143,4	114,7
Vit. B-12	0,008	N.D.	0,002	111,2	92,7
Iron (Ferrous sulfate dried)	10,0	45,0	3,271	46,3	28,9
Iron (NaFeEDTA)	15,0	21,6	4,907	104,2	65,1
Total iron	25,0	45,0	8,178	150,5	94,1
Zinc	30,0	45,0	9,813	240,3	200,3

Notes:

^a - These values are calculated taking in consideration the micronutrient losses during storage and distribution, as well as during cooking.

EAR = Estimated Average Requirement is the daily intake which meets the nutrient requirements of 50 apparently healthy individuals in an age- and sex-specific population.

RNI = Recommended nutrient intake is the daily intake which meets the nutrient requirements of almost all (97.5) apparently healthy individuals in an age- and sex-specific population.

* N.D. = Not determined

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