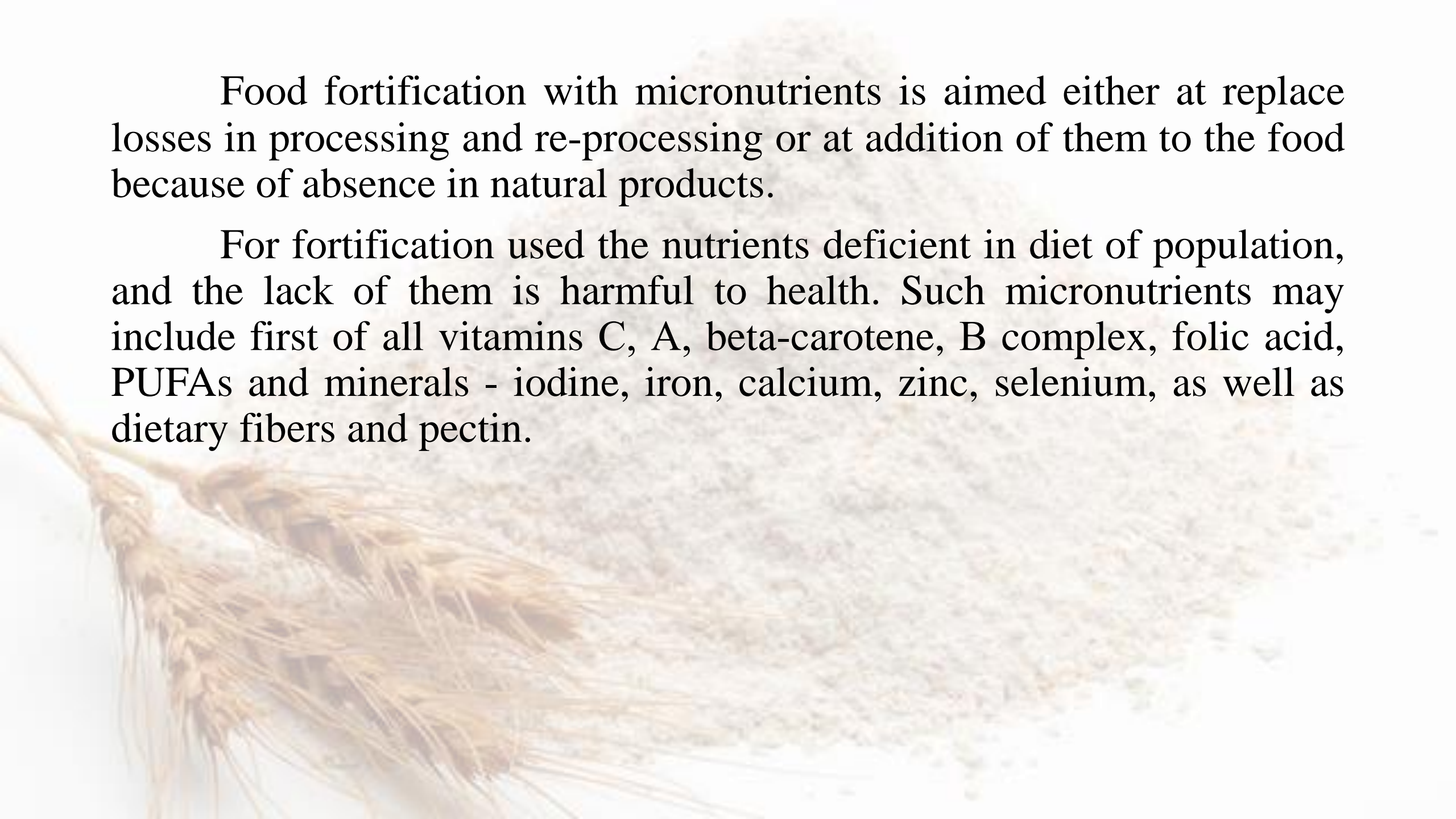


**REGIONAL STANDARDS FOR LOW- AND HIGH-  
EXTRACTION WHEAT FLOUR FORTIFICATION -  
EXAMPLES FOR DISCUSSION**

**YURIY SINYAVSKIY, VICE PRESIDENT, KAN**





Food fortification with micronutrients is aimed either at replace losses in processing and re-processing or at addition of them to the food because of absence in natural products.

For fortification used the nutrients deficient in diet of population, and the lack of them is harmful to health. Such micronutrients may include first of all vitamins C, A, beta-carotene, B complex, folic acid, PUFAs and minerals - iodine, iron, calcium, zinc, selenium, as well as dietary fibers and pectin.

For effective solution of the problem of micronutrient deficiency in all levels of population primarily shall be fortified the consumer products available for adults and children, regularly used in their daily diet. The fortified food shall be usual for use and consumption of population, or at least its target groups. **These products include flour and bakery products, milk and dairy products, sugar, salt, drinks, baby food products, fat products, meat and fat-based products.**

Food fortification with vitamins and minerals must not impair the consumer properties of these products: reduce the content and availability of other nutrients, significantly change their taste, aroma, freshness of products, reduce their expiry date.

When fortification it is necessary to take into account the possibility of chemical interaction of fortificants with each other and product components, and to select those combinations, forms, methods and stages of addition that provide their maximum safety during production and storage.



# REGIONAL STANDARDS



- Developed Regional Standards:
- «High extraction fortified wheat flour»
- «Low extraction fortified wheat flour»

# DEFINITIONS

High extraction flour (coarse flour  $\geq 80\%$  of wheat flour)



Low extraction flour (refined, low ground flour  $\leq 80\%$  of wheat flour)

## Primary product for fortified flour: the wheat fed to a mill shall meet the following requirements

Grain index	Standard, %, max.
The content of barley, rye grains and sprouted grains of these crops and wheat (in aggregate) including:	5.0
Sprouted grain	.0
Corn cockle	0.1
Extraneous matters:	
Ergot	0.05
Creeping bitterling, <i>Sophora alopecuroides</i> , thermopsis lancet (in aggregate) including creeping bitterling and multicolored coronilla (in aggregate)	0.1
Coronilla	0.1
<i>Heliotropium dasycarpum</i>	0.1
<i>Trichodesma incanum</i>	Shall be absent
Smut grain (dirty, blue-eyed mold corn)	10.0
Fusarium grain	1.0
Note: Content of sprouted grain shall be determined on analysis results before treatment.	

**ORGANOLEPTIC AND PHYSICAL AND CHEMICAL PARAMETERS OF THE LOW EXTRACTION FORTIFIED FLOUR**

Parameter	Description and standard
Color	White or white with cream shade, or white with yellow shade
Taste	Common to the wheat flour, without other tastes, not sour, not bitter
Odor	Common to the wheat flour, without other odors, not stale*
Moisture content, %, maximum	15.5
Presence of mineral impurities	No crunch by mastication
Metal magnetic admixture, mg per 1 kg of flour; size of individual particles in maximum linear dimension 0.3 mm and/or weight of no more than 0.4 mg, maximum	3.0**
Grain products pests contamination (insects, mites)	Shall be absent
Grain products pests contamination (insects, mites), total contamination density	Shall be absent
Contamination of bread with potato disease agents (36 hours after test laboratory baking)	Shall be absent
Weight ratio of vitamins and minerals, mg/kg:	

## ORGANOLEPTIC AND PHYSICAL AND CHEMICAL PARAMETERS OF THE HIGH EXTRACTION FORTIFIED FLOUR

Parameter	Description and standard
Color	White with yellow or grey shade
Taste	Common to the wheat flour, without other tastes, not sour, not bitter
Odor	Common to the wheat flour, without other odors, not stale*
Moisture content, %, maximum	15.0
Presence of mineral impurities	No crunch by mastication
Metal magnetic admixture, mg per 1 kg of flour; size of individual particles in maximum linear dimension 0.3 mm and/or weight of no more than 0.4 mg, maximum	3.0**
Grain products pests contamination (insects, mites)	Not allowed
Grain products pests contamination (insects, mites), total contamination density	Not allowed
Contamination of bread with potato disease agents (36 hours after test laboratory baking)	Not allowed
Weight ratio of vitamins and minerals, mg/kg:	



## QUALITY REQUIREMENTS OR PARAMETERS OF FORTIFIED LOW-EXTRACTION FLOUR

Parameter	Description and standard	
Ash w/w on dry basis, %, maximum	0.55-0.75	
Whiteness, s.u. of whiteness meter RZ-BPL, minimum	54.0-36.0	
Wet gluten w/w, %, minimum	28.0-30.0	
Wet gluten quality, s.u. of IDK device	Not lower than II group	
Grain of flour, %, maximum: - Oversize particles on GOST 4403, maximum	5 silk №43 or polyamide №45/50 PA or 2 silk №35 or polyamide № 36/40 PA	
- Undersize on GOST 4403	-	Not less than 80.0 made of silk №43 or of polyamide № 45/50 PA
Falling number, «FN», s, minimum	185	

**Note:**

1. Parameter “whiteness” replaces the parameter “ash content” on mills equipped with laboratory devices and machinery according to GOST 26361.
2. Parameter “Falling number” – FN is determined according to GOST ГOCT 27676, upon customer’s request.
3. To determine the grain of flour is allowable to use other mesh with equivalent sieving capacity.

## QUALITY REQUIREMENTS OR PARAMETERS OF HIGH EXTRACTION FORTIFIED FLOUR

Parameter	Description and standard	
Ash w/w on dry basis, %, maximum	1.25	
Whiteness, s.u. of whiteness meter RZ-BPL, minimum	12.0	
Wet gluten w/w, %, minimum	25.0	
Wet gluten quality, s.u. of IDK device	Not lower than II group	
Grain of flour, %, maximum: - Oversize particles on GOST 4403, maximum	2 silk №27 or polyamide №120 PA	
- Undersize on GOST 4403	-	No less than 65.0 of silk №38 or polyamide № 41/43 PA
Falling number, «FN», s, minimum	160	

**Note:**

1. Parameter “whiteness” replaces the parameter “ash content” on mills equipped with laboratory devices and machinery according to GOST 26361.
2. Parameter “Falling number” – FN is determined according to GOST ГOCT 27676, upon customer’s request.
3. To determine the grain of flour is allowable to use other mesh with equivalent sieving capacity.



The amount of vitamins and minerals added to the fortified flour shall be controlled **in the production process by feeding**, in accordance with formula regulating the weight of premix or pre-mixture to be added per unit weight of the flour stream to be fortified.

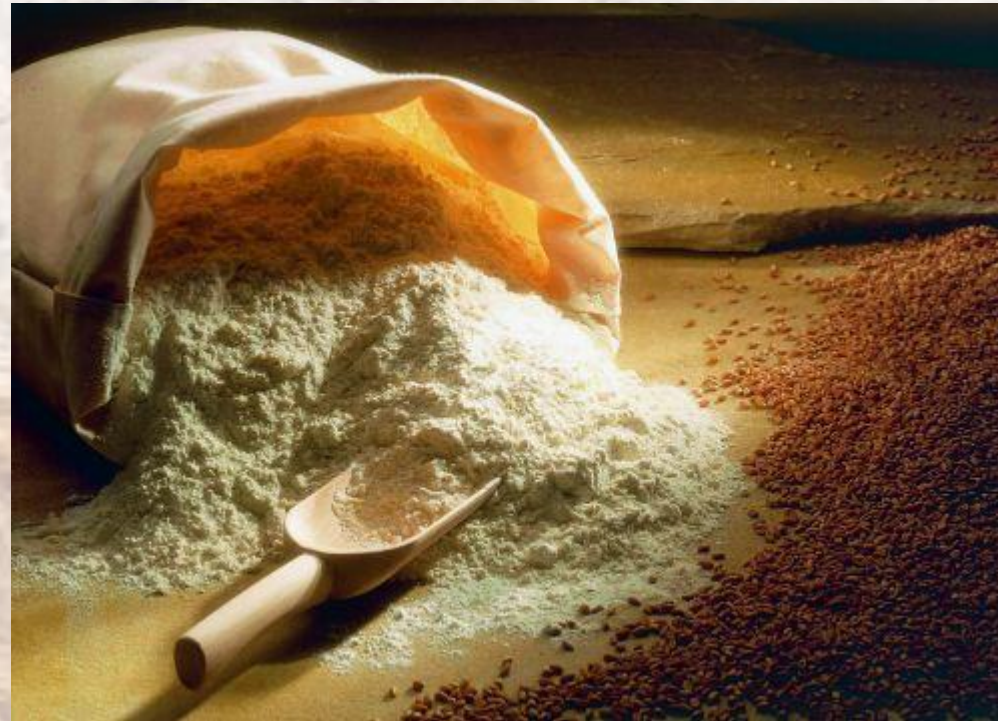
## PERMISSIBLE LEVELS OF VITAMINS AND MINERALS IN THE LOW EXTRACTION FORTIFIED FLOUR

<u>Parameters</u>	<u>Mg per 1 kg of flour</u>
B12 (given background value)	0.004-0.012
B9 (given background value)	0.6-1.9
B1 (given background value)	1.3-4.1
B2 (given background value)	1.8-5.2
B3 (given background value)	9.9-29.0
W/w of iron (given background value): - FeSO <sub>4</sub> dry; - NaFeEDTA	13.0-25.0 16.0-32.0
W/w of zinc (given background value)	26.0-50.0
Qualitative reaction of iron content	positive
<p>* the fortified flour may have a faint smell of vitamins and additives;</p> <p>** without added elemental electrolyte iron when fortifying (selected by sieve analysis from entire metal magnetic admixture of a sample).</p> <p>Note- Moisture content in fortified flour for long storage shall not exceed 14.5%.</p>	

## PERMISSIBLE LEVELS OF VITAMINS AND MINERALS IN THE HIGH EXTRACTION FORTIFIED FLOUR

<u>Parameter</u>	<u>Mg per 1 kg of flour</u>
B12 (given background value)	0.004-0.012
B9 (given background value)	0.7-2.0
W/w of iron (given background value):	36.0-70.0
W/w of zinc (given background value)	40.0-78.0
Qualitative reaction of iron content	positive
<p>* the fortified flour may have a faint smell of vitamins and additives; ** without added elemental electrolyte iron when fortifying (selected by sieve analysis from entire metal magnetic admixture of a sample). Note- Moisture content in fortified flour for long storage shall not exceed 14.5%.</p>	

In terms of content of toxic elements, pesticides, mycotoxins and of microbiological parameters the fortified flour shall not exceed levels permitted by requirements of TR TS 021/2011 (On safety of food products).



## SAFETY INDEXES FOR FORTIFIED FLOUR (TR TS 021/2011)

Index	Permissible levels, mg/kg, maximum
Lead	0.5
Arsenic	0.2
Cadmium	0.1
Mercury	0.03
Aflatoxin B1	0.005
Deoxynivalenol	0.7
	1.0
T-2 toxin	0.1
Zearalenone	1.0
	0.2
Ochratoxin A	0.005
-Hexachlorane ( $\alpha$ , $\beta$ , $\gamma$ - isomers)	0.5
-DDT and its metabolites	0.02
-2,4-D acid, its salts and ethers	Shall be absent
-benzachlor	0.01
-organomercury pesticides	Shall be absent
Grain products pests contamination (insects, mites)	Shall be absent

## **Acceptance of fortified flour according to the GOST 27668**

Flour shall be accepted by batch quantities. A batch means any quantity of product of the same type and grade, homogenous in quality, intended for simultaneous acceptance, shipment or storage, in package of the same type or in bulk.

When shipping, the quality data shall be entered into a document of prescribed form.

Each flour batch shall be accompanied by certificate obligatory containing indexes and standards of flour quality providing the safety of this products for life and health of people.

To check compliance of quality of the packaged product with regulations the sampling shall be made.

The sample size of the flour batch packed in bags in dependence on volume of the batch packed in bags is specified in next screen.

The sample size of flour batch in multiple packaging, distribution containers, boxes and cartons is 1% of packaging units, but not less than two.



# Acceptance of fortified flour according to the GOST 27668

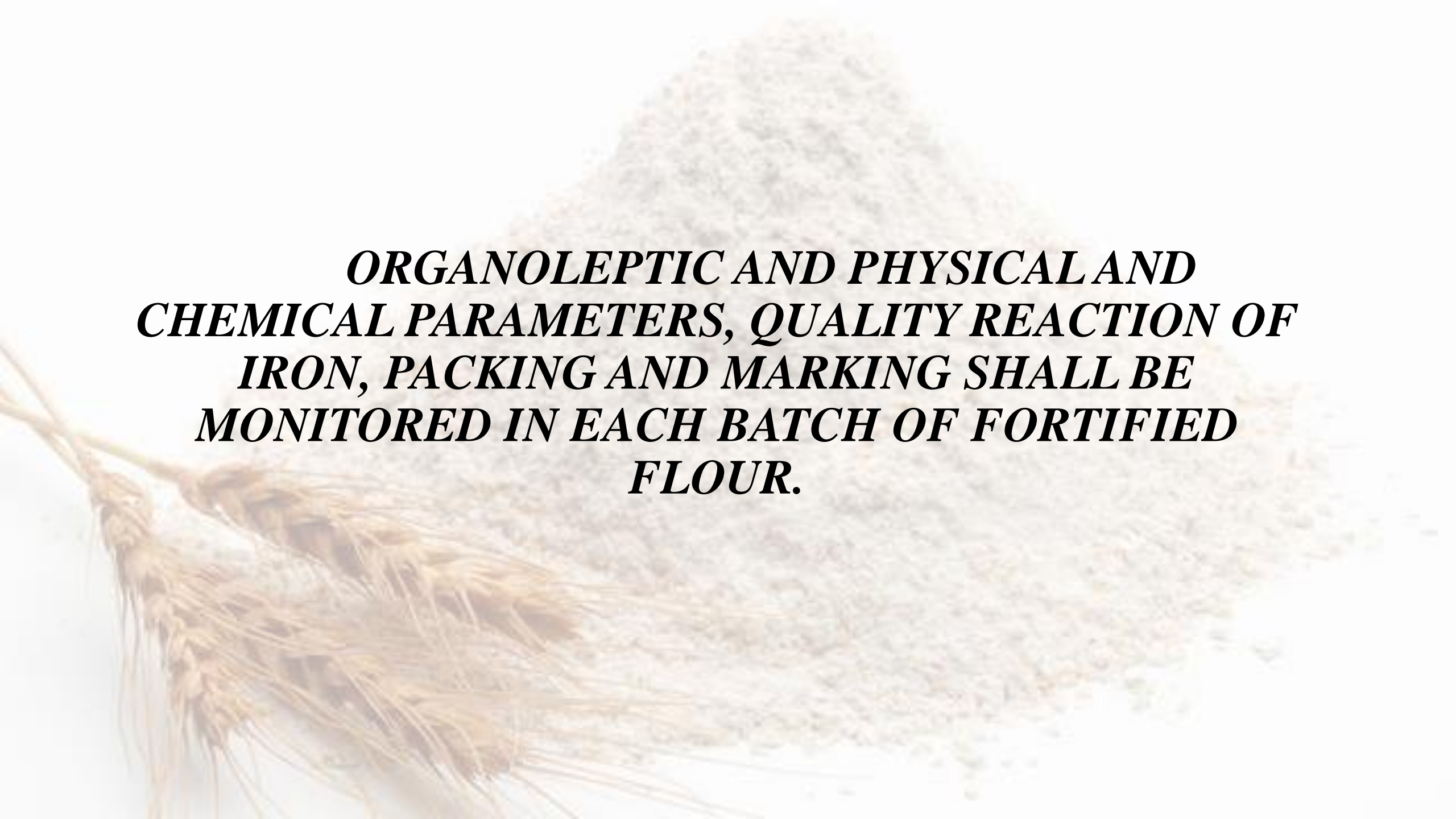
The verification of quality compliance with regulation requirements shall be made on combined sample.

Acceptance of flour batch containing in several bulk flour trucks shall be made on combined sample from each truck.

When accepting the packaged product, compliance of package and marking with regulation requirements shall be identified on sample.

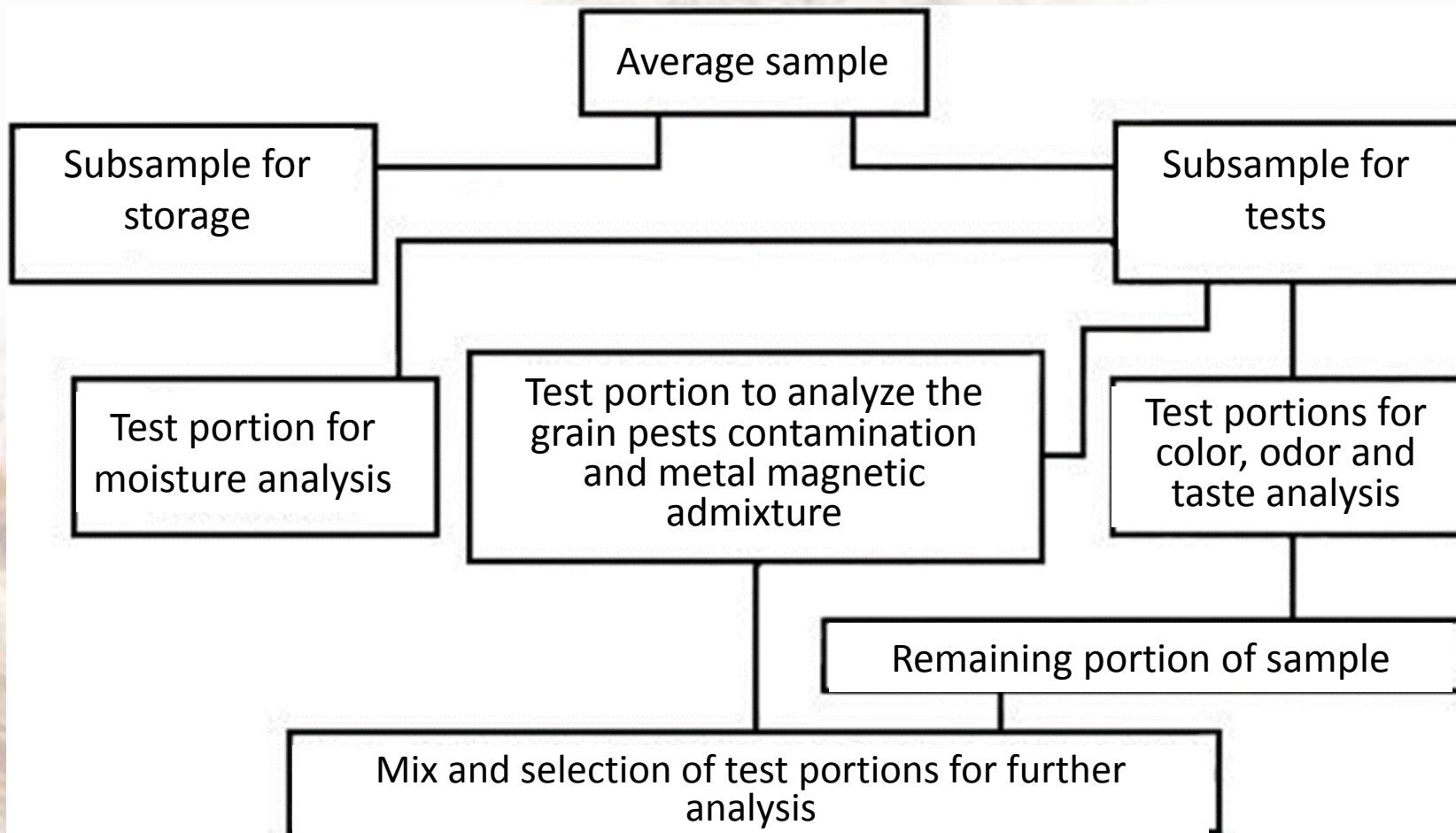
The test results shall be valid for the entire batch.

For delivery the product batch by bulk trucks and flour wagons, the document certifying the quality may contain average indexes on analysis data from all shifts during which this bin has been loaded.



***ORGANOLEPTIC AND PHYSICAL AND  
CHEMICAL PARAMETERS, QUALITY REACTION OF  
IRON, PACKING AND MARKING SHALL BE  
MONITORED IN EACH BATCH OF FORTIFIED  
FLOUR.***

# FORTIFIED FLOUR SAMPLING PROCEDURE GOST 27668-88



# **Organoleptic control methods for fortified flour**

## **Determination of odor, taste and crunch**

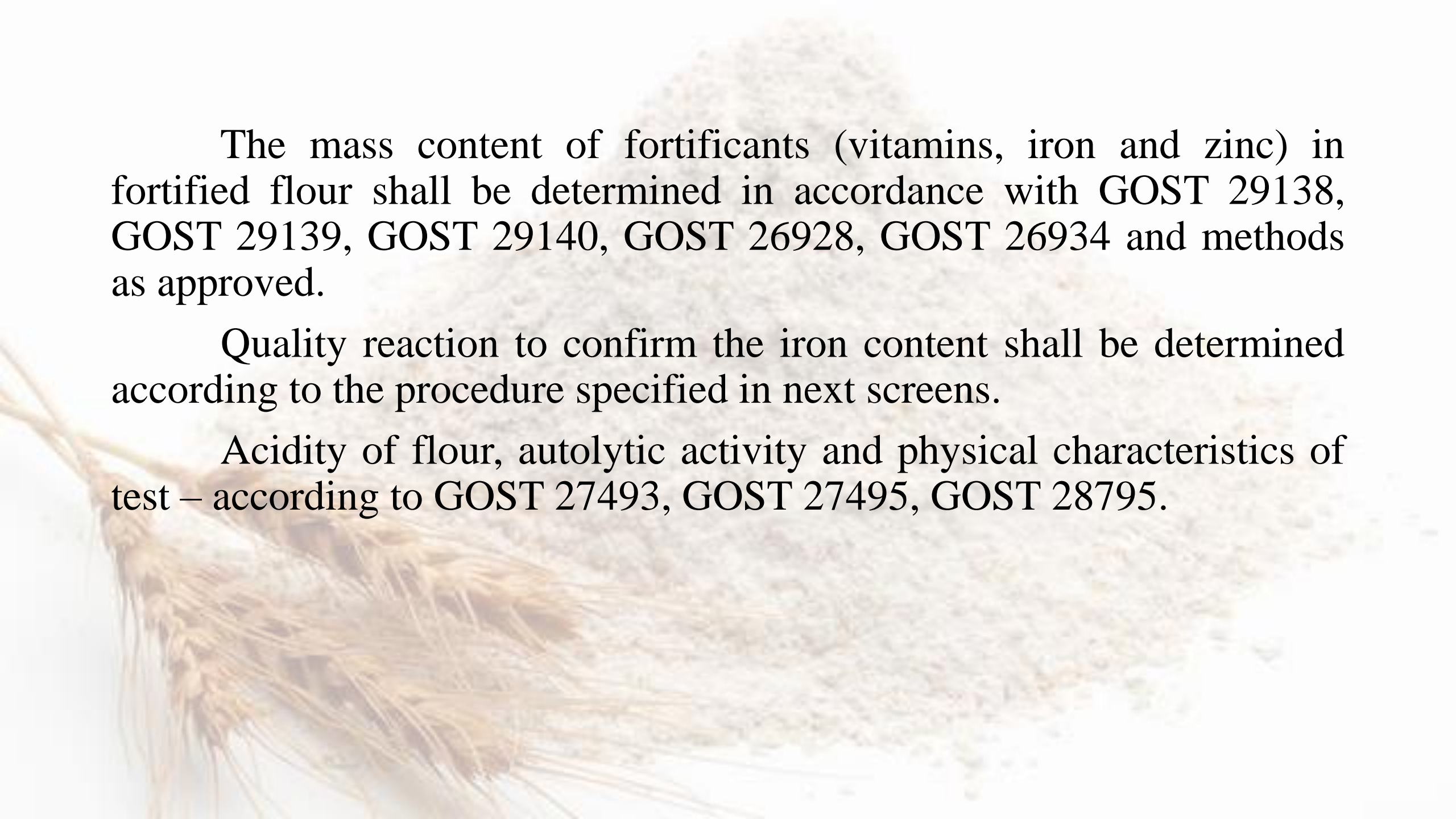
To determine the odor of tested sample select a test portion of flour or bran of about 20 g, strew it on a clean paper, warm with breathing and smell.

To activate the smell put the flour or bran test portion in a glass, douche with hot water of 60°C, drain water from the glass and smell the product.

**Taste and crunch determine by chewing 1 – 2 flour test portions of about 1 g each.**

Odor, taste and crunch are determined in accordance with parameters specified in standards for flour and bran.

In case of disagreements, the odor, taste and crunch in bakery and pasta flour shall be determined by tasting the bread baked from this flour.

The background of the slide features a soft-focus image of wheat stalks on the left side, with a fine, light-colored powder, likely flour, scattered across the right side and top of the frame. The overall aesthetic is clean and natural, emphasizing the agricultural origin of the product.

The mass content of fortificants (vitamins, iron and zinc) in fortified flour shall be determined in accordance with GOST 29138, GOST 29139, GOST 29140, GOST 26928, GOST 26934 and methods as approved.

Quality reaction to confirm the iron content shall be determined according to the procedure specified in next screens.

Acidity of flour, autolytic activity and physical characteristics of test – according to GOST 27493, GOST 27495, GOST 28795.



**Premix application rate shall be regulated by Processing instruction and is:**

- for low extraction flour – 240 – 250 g of premix per one metric ton of flour;
- for high extraction flour – 202 – 400 g of premix per one metric ton of flour.

## **Packing and marking of fortified wheat flour**

The fortified flour shall be packed and marked in accordance with applicable standard requirements. At the same time, together with specified requirements to package and marking, shall be applied the additions to marking of containers for fortified flour.

This addition is the standardized mark – Logo – developed by the Kazakh Academy of Nutrition. The logo «healthy food» can be applied to all kinds of fortified products. In particular, for the fortified wheat flour.

It is necessary to follow the terms of use for certification mark, because only in this case the mark will act as necessary – create awareness of consumers, satisfaction and confidence in products quality. The recommended combination of colors makes the certification mark visible and clear.

### **Rules relating to certification mark:**

1. If possible, the mark shall be printed in red on white background.
2. If the background is not pure white, but provides enough contrast (natural white color), use logo in red.
3. If the background does not harmonize with red color of the logo, choose one of the following solutions:
  - place the red mark on white rectangle,
  - use a white sign,
  - see recommendations for usage the certification mark.



**healthy food**  
**сапалы азық,**



# **Transportation and storage**

## **Transportation and storage of fortified flour**

The fortified flour can be transported by all transportation means in accordance with freight regulations applied for corresponding means of transport, with presence of duly executed sanitary passport for this transport.

The fortified flour shall be stored in dry place, under temperature not higher than 25°C and average humidity not more than 70%, without direct sunlight.

## **Manufacturer's guarantee**

Manufacturer guarantees the compliance of the fortified flour with requirements of this standard, if the consumer observes the storage and transportation requirements.

**Best before 12 months from the date of production.**

# Nutrition and energy value of the fortified flour per 100 g of product

<b>Proteins, g</b>	<b>Fat, g</b>	<b>Carbohydrates, g</b>	<b>Energy value</b>
10.3-10.6	1.1-1.3	68.9-67.6	334-331 kcal 1398-1385 kJ

# QUALITATIVE METHODS OF DETERMINATION OF IRON IN FLOUR

## PRINCIPLE

Ferric iron in acidic media reacts with potassium thiocyanate solution (KSCN) and forms the insoluble red color. Other types of iron like ferrous and elemental iron can also react similarly with oxidizing to ferric iron by means of hydrogen peroxide. **Presence of electrolyte or reduced iron** can be determined visually by placing a magnet in the flour sample and drawing of iron particles to it.

**Ferrous iron can be identified by creating insoluble light-blue color called Turnbull's blue or Berlin blue** by reaction with ferrocyanide. Reaction occurs very quickly with ferrous sulfate, but can be slow or even not occur with ferrous fumarate due to low solubility of this salt in water. Reaction can also occur with electrolyte iron after oxidation of iron to  $\text{Fe}^{2+}$ , but the rate of reaction is very low.

## MATERIALS

- Filter Whatman paper № 1
- Hand sieve
- Watch glass

## REAGENTS

- 2N HCl Hydrochloric acid solution. In 200 ml flask add 100 ml of distilled water. Then slowly add 17 ml of concentrated HCl, then add 83 ml of water.
- Hydrochloric acid solution- 0.003N (HCl). In 1 liter volumetric flask add 600 ml of distilled water, add 1.5 ml of 12N HCl- and make to volume with distilled water.
- Potassium thiocyanate-10%. Dissolve 10 g of KSCN in 100 ml of water. Before use mix 10 ml of this solution with 10 ml of 2N HCl.
- Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) - 3% (required if the fortification is being made with elemental iron). In 50 ml flask add 5 ml of concentrated 30% H<sub>2</sub>O<sub>2</sub> and make to volume of 45 ml with distilled water. To prepare daily, discard after finished tests.
- Potassium ferricyanide-10%. Dissolve 10 g of K<sub>3</sub>Fe(CN)<sub>6</sub> in 100 ml of water. Before use mix 10 ml of this solution with 10 ml of 0.003N HCl.

## **PROCEDURE**

### **Determination of iron in samples containing elemental iron (electrolyte, reduced iron and other)**

1. Take a magnet and put it into 1 kg flour sample.
2. Move the magnet inside the sample, then remove it.
3. The presence of electrolyte or reduced iron is confirmed by presence of small particles of iron on the magnet.

### **Determination of iron in samples containing NaFeEDTA**

1. Place the filter paper on a watch glass.
2. Wet the paper surface with potassium thiocyanate solution. The liquid shall infiltrate the paper.
3. By means of hand sieve sift a portion of flour sample so that a thin flour level cover the wet filter paper, remove the excessive flour.
4. Add to the flour surface the acidic solution of potassium thiocyanate, wait a few minutes until reaction.
5. Red spots indicate the presence of iron salt, particularly NaFeEDTA.

### **Determination of other iron sources including elemental iron**

1. Put the filter paper on the watch glass.
2. Wet the paper surface with potassium thiocyanate solution. The liquid shall infiltrate the paper.
3. By means of hand sieve sift a portion of flour sample so that a thin flour level cover the wet filter paper, remove the excessive flour.
4. Over the flour add a few of acidic potassium thiocyanate solution, wait for some minutes.
5. Add a small quantity of  $H_2O_2$  solution, wait a few minutes until reaction (formation of iron (III)).
6. Red spots indicate the presence of added iron. (Note: If the result for electrolyte or reduced iron is negative in tests with magnet, so more likely is added the iron in form of ferrous salt).

## **Demonstration of presence of ferrous salt (mainly ferrous sulfate)**

1. Place the filter paper on the watch glass.
2. Wet the surface of filter paper with potassium ferricyanide solution-10% and 0.003 N-HCl. The liquid shall infiltrate the filter paper.
3. By means of hand sieve sift a portion of flour sample so that a thin flour level cover the wet filter paper, remove the excessive flour.
4. Add a few of acidic solution of potassium ferricyanide over the flour.
5. Allow to stay a few minutes until reaction. Rapid reaction with clearly visible spots (during 2 minutes after addition of ferricyanide) indicates the presence of ferrous sulfate. Ferrous fumarate and some types of elemental iron also can have this reaction, but slowly (6-7 minutes and more). Elemental forms can be identified by procedure with magnet. For light brown-green spots the reaction for NaFeEDTA is positive.

### **Clarification**

Number of spots and their homogenous distribution shows the concentration of iron and homogeneity of sample. For comparative evaluation use samples with known amount of the same type of iron as a control sample.

## **Processing equipment for flour fortification**

- \* For fortification of wheat flour may be used volumetric and weight feeders, but since volumetric feeders provide the necessary metering accuracy and are cheaper, so they are preferable;
- \* All parts of feeders contacting with premix or flour pre-mixture shall be made of materials permitted for contact with food products;
- \* Volume of feeder bin shall hold the premix or flour pre-mixture not less than a shift requirement and not more than a day requirement;
- \* The feeder bin shall be closed and provide easy cleaning;
- \* The feeder flow adjustment shall be smooth;
- \* The remote control of feeder electric driver shall be equipped with electronic display in relative or absolute units.



\* It is recommended to apply premix or fortificans before feeding the flour to bagging section.

\* Less functional but quite satisfactory is the fortificant application to the flour on the stage of grades formations on collection screws.

\* The supply of fortificants is desirable on the front-end part of screw, so that while application of additional flows forming the flour grade they mix with initial flow of branched flour already partially mixed with fortificant.

\* Allowed is the application of fortificant to gravity feed repeatedly changing the direction and feeding the flour to the transport screw or to the pneumatic system.



# Safety requirements to fortification process

**First**— fortificant application shall be made to the closed transport flows.

Fortificant has a dusty consistence and is harmful if inhaled by staff. That's why the addition of fortificant to the open transport flows is not permitted.

**Second**— fortificant application directly before magnetic protection (magnetic separator) is not allowed. The fortificant shall be added either after magnetic protection or before it, but to provide the necessary mixture of fortificant with flour before it.

The fortificant contains elemental iron, micro-particles of which have natural magnetic properties. That is why flowing the fortified flour through the magnetic mill separators immediately after addition of fortificant to the flow results in loss of iron.

Careful mixing of flour mixture with fortificant enforces the surface bonding strength between particles of flour and iron. Thus, after mixing of flour and fortificant the loss becomes almost insignificant.

**Third**— the fortified flour shall not be directed to the pneumatic systems of a mill.

Deposition of unmixed mixture of flour and fortificant on discharger cyclones of pneumatic system results in inexcusable losses of dust particles of fortificant not adhered to flour particles.

## **Fortification process**

**Fourth**– point of fortificant addition shall be free for maintenance of feeder and fortificant application to the feeder.

**Fifth**- the feeder shall be assembled to provide free access for a lab technician to the feeding screw for monitoring sampling of fortificant during the operation. Quantity monitoring of fortificant shall be made as necessary.

**Sixth**– power supply of the feeder shall be as stable as possible.

The quantity of supplied premix shall be adjusted by change in feeder's motor speed. The feeder's motor is DC, its speed depends on supply voltage. By power surge in main line accordingly changes the speed of feeding screw, and this results in disproportional addition of fortificant to the flour.

**Seventh**– The remote control panel shall be installed directly near the feeder.

## Laboratory monitoring of flour fortification process

Current process monitoring of finished fortified baking flour at mill is performed **only for presence of iron** added to the flour.

On all other parameters the fortified flour shall fully comply with the monitored parameters of baking flour according to the interstate standard GOST 26574 – 85.

For process monitoring of flour fortification at mill is provided periodical weighing of premix or vitamin-mineral flour pre-mixture supplied by the feeder in time unit.

For this, the general laboratory equipment of mill labs is enough, including counter-balance class 4 or better, stopwatch and weighing cups.

Periodically, once per quarter (or from each large batch) at mill samples of fortified flour shall be taken and sent for quantitative assessment of additives **only for iron**.

According to test results, if necessary, correct the rate of actual premix addition to the flour at this mill.

## **Accounting of vitamin-mineral additives and fortified flour at the mill**

The premix at the mill shall be accounted by common accounting method for materials.

Additional accounting requirements include laboratory logbook controlling the weight of applied rates of premix in the flour fortification process.

The laboratory logbook form for accounting of application (requirement) of premix is shown in the next screen.

According to integration of data from laboratory logbook the laboratory manager or shift senior lab technician shall prepare the report on premix flow for one shift or day. The summary report on premix flow shall be transferred to the mill's person in charge who receives the premix from stock. Data of summary report is a basis for writing-off the premix from the charge of materially responsible employee.

The report on produced and shipped flour shall be prepared by shift supervisor and handed over to the head of mill after the shift. Based on this report the head of mill shall prepare summary report at the end of month and send it to superior Design organization.





**THANK YOU!**