THE STUDY OF THE PREMIX DOSING IN THE FORTIFICATION PROCESS OF WHEAT FLOUR

***[1]Bălan Iurie, [1]Bernic Mircea, [2]Şapovalenco Oleg, [1]Ciobanu Eugeniu, [1]Guţu Marin**

[1]Technical University of Moldova – Chişinău, Moldova
[2]National University of Food Technologies – Kyiv, Ukraine

***Bălan Iurie, iuriecereale@gmail.com**

Abstract: In the present paper is examined the premix dosing in the process of wheat flour fortification, specially is looking for productivity of the volumetric dozer, the dosage error and factors of influence on dosing operation.
Key words: volumetric feeders, flour fortification, micronutrients.

Introduction

Process of fortification involves the addition of micronutrients in flour up to the level that exceeds their initial content and recovers losses in the production process of flour and preparation and cooking of food, and that is necessary for the healthy development of the human body, and also, is safe for the body.

Given the fact that today wheat flour with other grain products are an important part in human alimentation, the following criteria underlying wheat flour fortification are listed:

- Increasing intake of micronutrients to the required level for the healthy development of the body;
- Additional cost for flour fortification must be affordable for the consumer;
- Existence of test methods and control of fortification technology and fortified products.

Flour fortification is made by adding powdered mixtures which contain micronutrients in dosed quantities. Depending on their shape can be distinguished two types of particle in mass of powdery products: uniform particles (*spherical shaped*) and irregular (*flat shapes*, etc.). Mixtures of powders (*such as flours and premixes*) usually tend to form flow stops [2; 8; 10].

Characteristics of powdery mixtures products which must be taken into account in dosing processes are mainly the following:

- moisture, particle size and shape;
- particle size distribution;
- settlement angle, flow angle and angle of natural slope;
- density of the bulk material and at vibrations;
- compressibility of the bulk material under pressure;
- ability to fluidization and internal friction angle
- effective friction angle between particles and the friction angle with wall;
- flow coefficient and value the flow;
- resistance of powdery product;
- adhesion, abrasion, corrosivity, fragility;
- dustiness, adherence, hygroscopy;
- toxicity.

Characteristic properties of mixtures of powders, especially those that affect the flow and density, are essential for the dosing process. Good flowing powder products will fill the removal spaces of dispensers developing slopes and flow disturbance by compaction, in a manner different than liquids, which readily and completely will fill the available spaces.

Homogeneous composition of fortified flour can be obtained by meeting the following requirements:

- raw material quality (*is taken into account the period of validity of premix*);
- technological equipment with high precision in operation;
- qualified personnel with experience in this area.

Homogeneity is obtained by uniform distribution of micronutrients in flour and assumes that the concentration of micronutrients incorporated into flour is the same in each analyzed samples of batch under examination.

Premix is incorporated into flour flow at the end of milling process or immediately before packaging, provided adequate mixing with flour.

On the market of dispensers' producers for flour fortification these equipments are available in different versions of operating principles, dimensions and productivity. The required number of dispensers in technological line for production of flour depends largely on the production capacity of the mill. Volumetric dispensers are widely used in small capacity mills and for high capacity mills are used mainly weight dispensers. Mill capacity determines the type of dispenser and various adjustments done in its functioning (*choosing the suitable snail, toothed belt, the premix dilution recipe etc*.) Once installed and adjusted, dispenser operation matches the flour flow from mill with average dosing values and minimal errors.

Materials and methods

Investigations were carried out at the company S.A. „Combinatul de Produse Cerealiere din Chişinău", on volumetric dispenser manufactured by „Teknoloji Makina Ltd. Şti" Turkey, with productivity of 20 kg/h.

According construction principles, in comparison with ponderal dispenser, volumetric dispenser is simpler, cheaper and more reliable, but has a greater measurement error which is influenced by density, humidity and granularity of mixture and the method of charging of the container (drop height, degree of compaction, etc.) [9; 12].

Electronic equipment power-control allows speed adjustment of dosing motor. Visualization of programmed speed and actual achieved speed is on a liquid crystal display.

Characteristics of premix used in flour fortification:

- Manufacturer - company "Muhlenchemie", Germany
- Trade name - SternVit SF 10316
- Dosing rate of premix in flour - 0.160 kg / tonne flour;
- Diluent - wheat starch;
- Ingredients - 30 g iron fumarate and folic acid 1.4 g;
- Humidity - 11.2%.

Quality parameters of diluent used for preliminary mix composition:

- Product name - first quality flour of soft wheat with vitrescence of 45%;
- Humidity – 14,2%;
- Granularity – residue on a sieve with holes of 180 microns of maximum 5% and sifting through the 140 micron sieve with at least 80%.

Manufacturing process characteristics of flour fortified in mill:

- Mill productivity - 7 tons wheat/hour;
- Extraction of high quality flour - 35%;
- High quality flour flow stream - 2450 kg / hour;
- Feeding dispenser premix flow - 20 kg / hour;
- Required amount of premix necessary for preliminary mix composition - 0,392 kg / hour;
- Required amount of diluent necessary for preliminary mix composition – 19,608 kg / hour.

Experimental results

To achieve the proper process of fortification is desirable to ensure a constant flow of premix incorporated into a constant flow of flour [1; 3; 12]. When there is no correlation between flour flow and operation premix dispenser arise problems in the fortified flour quality.

Dosage rate of premix was checked repeatedly as a component part and essential of good practice of quality control of technological process of flour fortification. This was achieved by implementing a "dosage rate control" of dispenser and modified in accordance with any change in flour flow [6; 7; 11].

Immediately after startup, for the correct functioning and setting dispenser productivity, three rounds of tests were performed. Obtained average value is productivity of dispenser [1; 4; 5; 12; 13].

When commissioning of dispenser was preceded as follows:

- Dispenser container was fueled with preliminary mix;
- Dispenser was started and checked if there is evacuation preliminary mix;
- Dispenser was adjusted for a maximum flow (at snail speed 100%) and samples were collected over 2 min;
- Samples were weighed;
- Preliminary mix flow was calculated;
- The same test was repeated for snail speed of 80%, 60%, 40% and 20%. The fortifier flow was calculated every time. This operation was repeated three times for each value;
- Dispenser feeding was stopped;
- Used preliminary mix was recovered in container;

Obtained values are presented in Table 1

Table 1. Volumetric dispenser operation results

Snail rotation speed	Sampling time, min.	Weight of collected preliminary mix, kg				Dosing flow of preliminary mix		Dosing error
		M_1	M_2	M_3	M_{aver}	kg/min	kg/h	
100%	2	0,70	0,65	0,66	0,67	0,33	20	7%
80%	2	0,50	0,57	0,52	0,53	0,27	16	13%
60%	2	0,36	0,39	0,45	0,40	0,20	12	23%
40%	2	0,26	0,24	0,31	0,27	0,13	8	26%
20%	2	0,09	0,17	0,13	0,13	0,07	4	60%

Following research it was found, if that changes the physical characteristics of preliminary mix the dosing flow is changing. With snail speed reduction increases dispenser dosing error which denotes the fact that dispenser operation in productivity of 40% and 20% is inefficient and does not ensure qualitative flour fortification.

When using as a diluent Dunst the preliminary mix dosing accuracy has decreased from 28% to 15%.

Conclusions

1. Premix batches manufactured by the same manufacturer differ in composition of extenders which have different physicochemical properties. Therefore miller will pay attention on verification of dispenser operation when switching from one to another batch of premix. In this context, dispenser operation requires frequent calibration and verification by miller, especially in case of premix density change.
2. Dosing accuracy is reduced with decreasing snail speed, increasing premix granularity, increasing the degree of compaction and with increasing the height of the container fall. Thus, the operation of volumetric dispenser is effective for dosing premixes with constant granularity with characteristics that less depends on variation in relative air humidity.

References

1. Amal Lahbabi, M.Abdel Iiah Jib, M.Yahya Moussa, Guide pratique de la fortification de la farine, Federation Nationale de la Minoterie, Octobre 2004, web site: www.fnm.org.ma
2. American Ingredients Co., web sites: www.caravaningredients.com
3. Elieser S.Posner, Arthur N.Hibbs, Wheat flour milling, AACC, St.Paul, Minnesota, USA, 1997, 340 pag.
4. Flour fortification millers best/enhanced practices, Prepared by Coordinator, Technical Training and Support Group Flour Fortification Initiative, Supported by The Micronutrient Initiative, web site: www.foodquality.wfp.org
5. Глебов Л.А., Демский А.Б., Веденьев В.Ф., Темиров М.М., Огурцов Ю.М., Технологическое оборудование предприятий отрасли, Москва, ДеЛи Принт, 2006, pag.810
6. Karen Codling, Flour Fortification in the Region, Flour Fortification Initiative, 2009, web site: sph.emory.edu/wheat flour
7. Lindsay Allen, Bruno de Benoist, Omar Dary, Richard Hurrel, Guidelines on food fortification with micronutrients, World Health Organization and Food and Agriculture Organization of the United Nations, 2006
8. International Association of perative Millers, web sites: www.aomillers.rog
9. International Grains Council, web sites: www.igc.org.uk
10. Milling and Baking News, web sites: www.sosland.com
11. MOST – The USAID Micronutrient Program, web sites: www.mostproject.org
12. Quentin Johnson, Feeders and Mixers for Flour Fortification, A guide for selection, installation and procurement, The Micronutrient Initiative, February 2005, web site: www.fortaf.org/files/feedermanual.pdf
13. Quentin Johnson, Venkatesh Mannar, Peter Ranum, Fortification Handbook, Vitamin and Mineral Fortification of wheat flour and maize meal, The Micronutrient Initiative, 2004, web site: www.sph.emory.edu/wheat flour