IMPROVEMENT OF PRODUCTION PROCESSES

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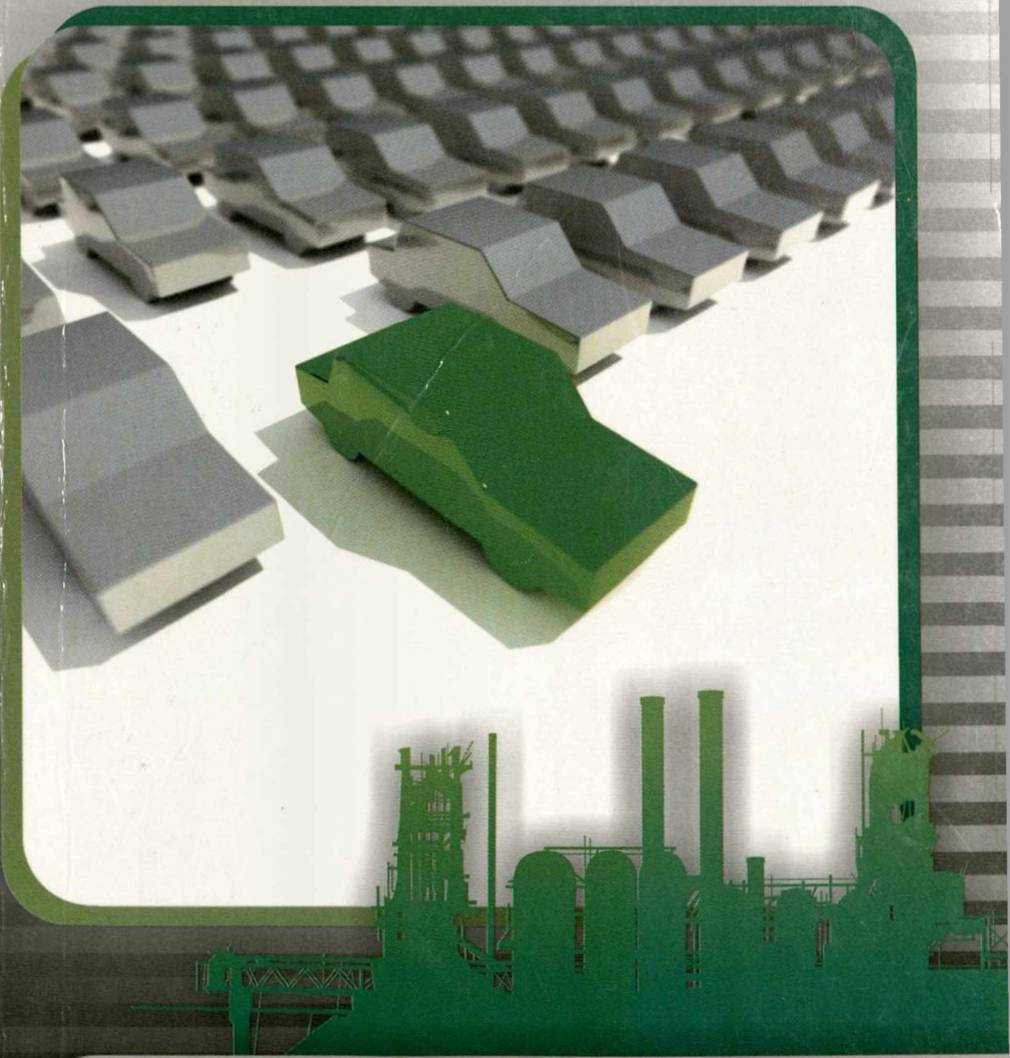

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Chapter 3

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APPLICATION OF FAM – FAIL ASSESSMENT METHOD – TO THE OPTIMIZATION OF UNIT COSTS OF PRODUCING FLOURS FOR SPECIAL PURPOSES[4]

Abstract: The FAM-FMC System[5] used in the production of flours for special purposes through mixing provides the opportunity to choose from among several variants of flours, relying on the criterion of unit cost involved in producing a given mixture, as well as on the variants' availability at the plant and their fulfilment of the conditions imposed by the consumer in terms of quality features of the achieved mixture (DZIUBA S.T. 2010). Through this, it is possible to achieve higher incomes on the one hand, and an optimized production process resulting in receiving top quality flour whose content has been predefined by the producer of the final product.

Key words: production of flours, mixing process, costs, economic, quality.

3.1. Introduction

The modified version of FAM (Fail Assessment Method) allows for its application to enhancing flour mixing process with accordance to the consumer's recipe, with a simultaneous possibility to calculate the unit

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[4] Flour for special purposes is a variety of flour the parameters of which are predetermined by particular consumers or flour used for the production of particular goods of secondary processing industries, e.g., baking, cake making.

[5] FAM-FMC:Fail Assessment Method, Flour Mixture Choosing

costs of the received special-purpose flour. The essence of the proposed programme – called FAM-FMC (Fail Assessment Method – Flour Mixture Choosing – might be described through symbols (DZIUBA S., T. ET AL. 2006).

$$\mathbf{S} \rightleftarrows {}^{M_y}_{M_z}\, \Omega\, (\mathbf{M}, \mathbf{R}, \mathbf{E})^{\mathbf{Q}} \qquad (2.1)$$

Where:

S – system of research and evaluation, M_z – theoretical flour mixtures indicated by the programme, M – collection of nine flours considered in the experiment, M_y – desired flour (indicated by the consumer), R – web of interrelations between flour parameters (features), E – economic objectives and consequences, Q – task realization, i.e., optimal quality of the received mixture, Ω - sign of representation, i.e., the features of the evaluation system and task fulfilment according to the proposed algorithm

Apart from technological factors, the system acknowledges also the influence of economic factors on a given endeavour. In formula (2.1) they figure under the capital letter E.

System verification terminates at the moment of reaching determined technological and economic outcomes, in this particular case it being the preparation of flour with consumer-satisfying parameters and the increase of profitability in a cereal-milling plant through using flours with the lowest unit cost.

3.2. Scientific objective

The present study aims at verifying the FAM – FMC System through a simulation of unit costs involved in the production of pizza flour from base flours in the process of mixing two, three or four lots of a varied technological value.

The objectives of the proposed investigation were to analyse unit costs involved in the production of particular mixtures and to compare their technological features in terms of basic parameters[6] consistent with consumer expectations. The objectives were realized through laboratory examinations determining the parameters of initial flours, as well as through simulating unit costs of the generated flours for the production of pizza.

3.3. Material and methodology

The investigation derived its biological material from wheat flours (Table 3.1) produced at the Diamant International Mill in Grodzisk Wielkopolski, Poland.

As regards simulation of unit costs involved in the production of pizza-type flour in the mixing process, the analyses relied on average net prices of wheat flours published in 2010 by the Ministry of Agriculture and Countryside Development, additionally made accessible by one of flour producers.

Parameters of initial flours were determined in accordance with the following methods and norms:

- PN-ISO 712:2002 – determining moisture level in wheat flour
- PN-A-74042-03:1993 – determining gluten and gluten index level in wheat flour
- PN-EN ISO 3093:2007 – determining falling number values of wheat flour with the aid of Hagberg-Perten's method
- NIR[7] method – determining protein and ash content in wheat flour.

Average values of wheat flour parameters and their interpretations are presented in Table 3.1.

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[6] Basic parameters include moisture, gluten, gluten index, falling number, protein and ash.

[7] NIR (Near Infra-Red) Technique – technique which uses radiation spectrum in near infra-red to measure the parameters of grain and wheat.

Table 3.1. Average parameters of wheat flours used in research

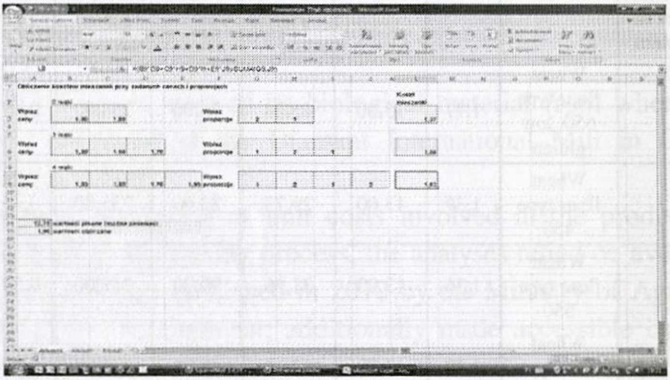
Flour number correspon d-ing to its number in the system	Mąki Wheat's commer-cial name	Net price [zł]	Mois-ture [%] A	Gluten [%] B	Gluten index [-] C	Falling num-ber [s] D	Ash [%] E	Prote-in [%] F
1	Wheat flour type 650, low gluten	1,77	13,00	25,28	73,00	254,00	0,65	09,80
2	Wheat flour type 450	1,39	13,00	29,73	83,00	335,00	0,45	11,60
3	Wheat flour type 550	1,36	13,00	31,96	90,00	349,00	0,55	12,30
4	Wheat flour type 700	1,80	13,00	32,78	78,00	373,00	0,70	12,40
5	Wheat flour type 700, low gluten	1,65	13,00	27,12	95,00	318,00	0,70	11,00
6	Wheat flour type 600	1,55	13,00	34,81	93,50	344,00	0,60	13,40
7	Wheat flour type 450, low gluten	1,89	13,00	26,67	72,73	306,62	0,45	10,30
8	Wheat flour type 650	1,95	13,00	37,21	89,66	372,00	0,65	14,50
9	Wheat flour type 550	1,45	13,00	32,20	94,00	348,00	0,55	12,20

Source: author's study results

Capital letters A, B, C, D, E, F denote parameters in the system (see: pictures 3.2, 3.3, 3.4, 3.5)

In order to conduct the simulation of unit costs involved in the production of special-purpose flours a special application in Excel MS was created (see Fig. 3.1).

Proportions necessary to conduct calculations were derived directly from the FAM-FMC System, which has been elaborated on further.



Write prices (2 flours; 3 flours; 4 flours) / write proportions / blend cost

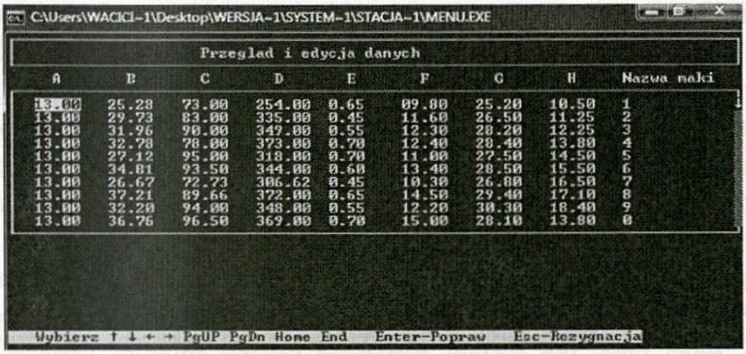
Fig. 3.1. Example of blend cost calculation on the basis of existent prices and demanded proportions.

Source: author's study results

Letters A, B, C, D, E, F symbolize paramaters, additional letters G and H denote additional parameters devised for the purpose of prospective research, but are not taken into account in the present study.

3.4. Research results

Fig. 3.2 illustrates the Excel application "Data review and edition". Parameter values from Table 3.1 were listed in positions 1–9. Position 0 lists parameter values of the required pizza-type flour. Letters A, B, C, D, E, F symbolize paramaters, additional letters G and H denote additional parameters devised for the purpose of prospective research, but are not taken into account in the present study.

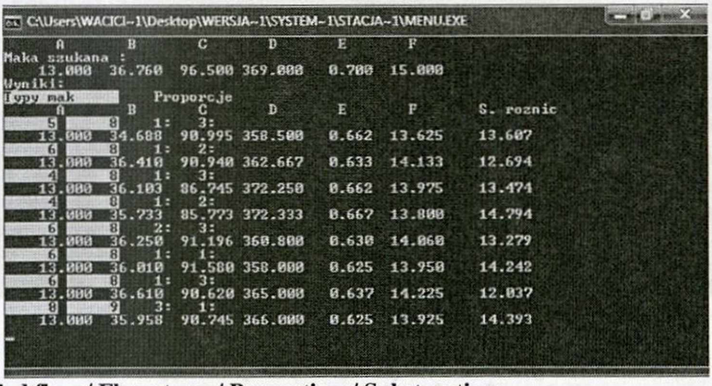


Data review and edition/ Flour name/ Choose/ Enter – correct/ Esc - withdraw

Fig. 3.2. Review and edition of source flours data prepared for composing pizza flour.

Source: author's study results

On the basis of data introduced in the application of the programme "Review and edition of data" (Fig. 3.2) the system generates eight two-composite mixtures which is presented in Fig. 3.3.



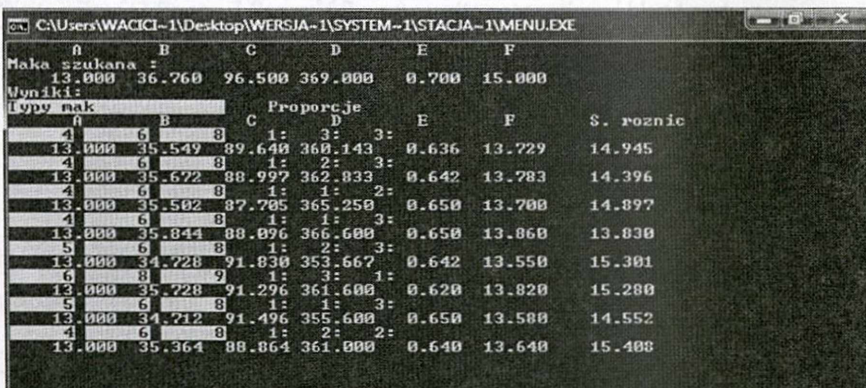
Demanded flour/ Flour types/ Proportions/ Substraction

Fig. 3.3. Two-composite blend: pizza type.

Source: author's study results

In Figures 3, 4, 5 the system reminds the parameters of the demanded flour listing them in position 1. Capital letters A, B, C, D, E, F denote parameters. Highlighted digits underneath the caption “Flour types” denote initial flours which – after having been mixed in appropriate proportions – should yield parameters positioned in, respectively, columns A, B, C, D, E, F. These parameters are however theoretical parameters, generated by the system. The final column with digits underneath the caption “Substraction” denotes divergence value of theoretical flour generated by the system on the basis of the demanded flour. Each time, the system generated several mixture variants from initial flours:

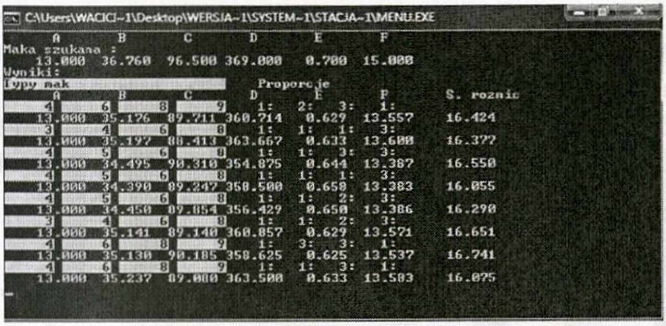
- 8 variants in the case of two-composite mixture (Fig. 3.3)
- 8 variants in the case of three-composite mixture (Fig. 3.4)
- 8 variants in the case of four-composite mixture (Fig. 3.5)



Demanded flour / Results / Flour types/ Proportions / Substraction

Fig. 3.4. Three-flour blend – pizza type.

Source: author’s study results



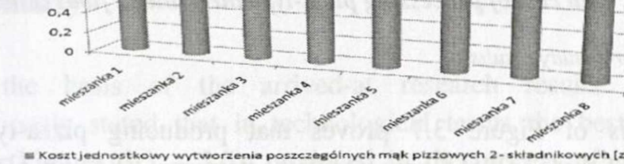
Demanded flour / Results / Flour types/ Proportions / Substraction

Fig. 3.5. Four-flour blend – pizza type.

Source: author's study results

On the basis of data coming from Table 3.1 and the numerical values generated by the FAM-FMC System (shown in Figures 3.3-3.5) simulation of unit costs of pizza-type flour was conducted. To this end, a specially devised Excel MS application was used (Figure 3.1).

The arrived-at results are given in Figures 3.6-3.7.

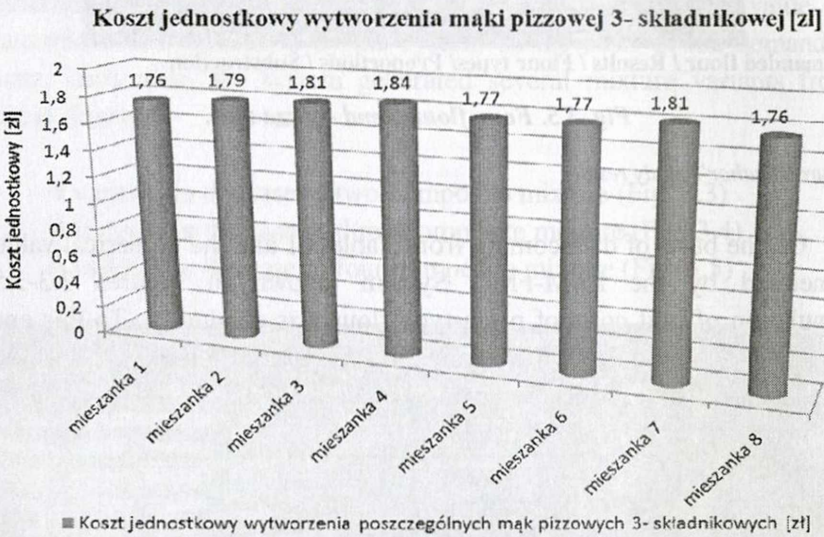


Unit cost of processing particular two-composite pizza flours [zl]
Unit cost [zl]/ Mixture 1 - 8

Fig. 3.6. Unit cost of processing pizza-type two-composite flour during mixing.

Source: author's study results

From Figure 3.6 it can be inferred that the cost of producing pizza-type flour made up of two initial flours oscillates between 1,91 and 1,75 zl. The high cost of producing mixture 3 (1,91 zl) results from the prices of initial flours making up its content. An opposite situation is observable in the case of mixture 6, with unit cost amounting to 1,75 zl.

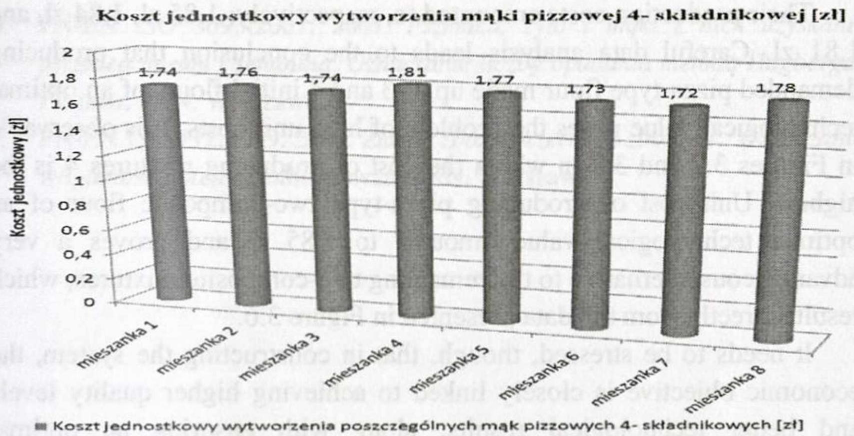


Unit cost of processing particular three- blend pizza flours [zl]
Unit cost [zl] / Mixture 1 - 8

Fig. 3.7. Unit cost of processing pizza-type three-blend flour in mixing.

Source: author's study results

Analysis of Figure 3.7 proves that producing pizza-type flour consisting of three initial flours oscillates between 1,84 and 1.76 zl. The highest cost is involved in the production of mixture 4 (1,84 zl) results from the prices of initial flours making up its content. Opposite situation is observable in the case of mixtures 1 and 8. Unit cost of their production amounts to 1,76 zl.



Unit cost of processing particular four- blend pizza flours [zl]
Unit cost [zl] / Mixture 1 - 8

Fig. 3.8. Unit cost of processing pizza-type four-blend flour in mixing.

Source: author's study results

Simulation of unit costs for pizza-type flour made up of four initial flours has shown (Fig. 3.8) its highest value to be 1,81 zl (mixture 4), and lowest – 1,72 (mixture 7). The high cost of producing mixture 4 results from the prices of initial flours making up its content. An opposite situation is observable in the case of mixture 7 composed of initial flours 4,6,8,9 in the proportions 1:3:3:1, with unit cost amounting to but 1,72 zl.

3.5. Summary

On the basis of the arrived-at research results it can be unambiguously stated that in technological terms the best pizza-type mixtures (Figures 3.3 – 3.5), produced in the process of initial flours mixing (Table 3.1) are:

- Mixture 7, composed of initial flours 6 and 8,
- Mixture 4, composed of initial flours 4, 6 and 6,
- Mixture 4, composed of initial flours 4, 5, 6 and 8.

Their production costs amounted to, respectively: 1,85 zl, 1,84 zl, and 1,81 zl. Careful data analysis leads to the conclusion that producing demanded pizza-type flour made up of 3 and 4 initial flours of an optimal technological value poses the problem of high unit costs. It is observable in Figures 3.7 and 3.8 in which the cost of producing mixtures 4 is the highest. Unit cost of producing pizza-type two-composite flour of an optimal technological value amounts to 1,85 zl and proves a very advantageous alternative to the remaining two-composite mixtures, which results directly from the data presented in Figure 3.6.

It needs to be stressed, though, that in constructing the system, the economic objective is closely linked to achieving higher quality levels and better technological results, along with ensuring an optimal profitability of initial flours designated for mixing in order to receive flour of the desired parameters.

However, the questions of the initial flour which will eventually make it to the production of the desired flour through mixing, along with issues of price and proportions, remain to be dismantled by the decision-makers. The FAM-FMC System is supposed to be but a device designed with the view to making these choices easier.

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