Management of competitiveness of organizations through improved product quality

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Abstract. Analysis and evaluation of approaches to management of quality of food products, development of directions of their management are shown. Also the goal is selection of tools for transformation of competitive position through the formation of a single evaluation model. The current economic situation in Russia, complicated by economic sanctions, shows the importance of studying consumer preferences for the analysis of product quality at a new level. The development of the market of domestic bakery products is mainly hampered by non-compliance with the basic parameters of non-price competition. Therefore, there is a need to systematize the factors affecting competitiveness, their analysis and ranking, decision-making, taking into account the capabilities of a particular enterprise. The methods of analysis of quality management of bakery products to ensure a competitive position at the regional level are implemented. The most significant parameters influencing formation of consumer preferences and perception of quality of bakery products are defined. The econometric model of dependence of parameters of quality of food products which description allows defining and carrying out coordination of strategic decisions on operational management competitiveness of the enterprises of the food industry is developed.

1. Introduction

Currently, the functioning of the consumer market is of great importance due to the increasing process of globalization and increased competition in the production of goods and services. The study of certain aspects of competition in the consumer market was conducted by representatives of various economic schools. It should be noted that modern economists believe that today the development of the consumer market of goods and services is an important indicator of many economic and transformation processes carried out in Russia. Achievement of competitiveness of various segments of the consumer market characterizes the ability of economic entities to operate in a dynamic competitive environment, to ensure a high level of business processes, the degree of satisfaction of the needs of the population in various goods when achieving their financial stability [1].

The review of economic literature allowed determining that ensuring the competitiveness of finished bakery products largely depends on the quality characteristics of the products. Regional factors have a great influence on the ability of organizations to produce goods that are in demand
among buyers. From this, it should be noted the relationship between the long-term technological development of the regions and the adopted effective financial policy that contributes to the development of the processing industry and the growth of its economic potential. Indicators of regional economic innovation policy are the volume of production, diversification of production and production of new products, the share in the segment of the consumer market, the level of competition, obtaining financial resources, subsidies. Thus, optimal results in the processing industry can be achieved if the development of quality management policies [2].

According to decree No. 204 of the 7-th of May, 2018, the President of the Russian Federation Vladimir Vladimirovich Putin identified the key tasks of the Russian economy in the near future: our country's joining the top five economies of the world; ensuring GDP growth rates above the world; development of new technologies in export-oriented sectors of the manufacturing sector; increasing labor productivity by at least five percent per year [3]. Sectors of the economy are about 30 industries, the number of enterprises is 51.5 million, and the total number of employed people is 1.3 million. In the formation of revenues of the Federal budget tax revenues amount are 16%, with a significant share of tax deductions in regional budgets [4]. The positive development of the agricultural sector is characterized by the growth of the index of agricultural production. The object of the study is the development of the grain industry. It can be noted that in the Russian Federation there were 105.3 million tons in 2014, 135.4 million tons is in 2017. Increase is 127.4 %. It should be noted that bread products, including the range of bread, pasta in terms of flour are included in the consumer basket based on the volume of consumption in the amount of 126.5 kg on average per person per year. Currently, domestic scientists note in their research insufficient state funding of agricultural organizations, which led to a decrease in the quality of grain produced. It is defined the ambiguity of the development of grain production in the country in recent years, insufficient support for the agricultural sector of the economy. All this has a negative impact on the decline in the quality of finished products from agricultural raw materials [5].

Bread and bakery products are one of the main goods in the food market of Russia. For the development of the enterprise and the product is extremely important consumer opinion. Customer satisfaction it is possible to determine the degree of satisfaction of customer expectations with real results. The purpose of the enterprise in the course of its development is to attract as many customers as possible, and the formation of regular customers among them. Control of formation of the market of bakery products, improvement of the assortment market, as well as overexposure of a certain level of competition, will help the company to develop properly in the modern market. The management of competitiveness and food quality has been the responsibility of economists such as S Jayanthi, B Kocha, R B Leslie, H W Kinnucan, B O Tutu, L Message Costa and others [6-9]. Analysis of regional strategies for assessing competitiveness in modern conditions involves the development of structural transformation with the participation of stakeholders on the basis of improving product quality. This is an important point in solving the problems of economic development of the food industry and contributes to the productivity of collective action of business representatives [10]. Analysis of the quality of bakery products independently by consumers is of practical importance for enterprises because, in the modern production of bakery products, it is necessary to take into account various aspects of the impact on supply and demand.

The purpose of the study is defined as the search for new tools and available techniques in the field of quality management at the strategic and tactical level for the food industry to ensure a competitive position. The development of methodological methods for making informed decisions of quality management taking into account strategic prospects makes it possible to increase the competitiveness of the business.

The scientific significance of the work is to develop an algorithm for the analysis of quality management in terms of ensuring the competitiveness of organizations. The basis for the implementation of the proposed procedure is the formation of a comprehensive assessment of quality factors and the decomposition of the analysis into separate stages, establishing the relationship of individual groups of indicators of each stage and determining the sequence of its implementation.
The hypothesis of the study is based on the objective need in modern conditions for food industry organizations to improve the assessment of the quality of products, which includes the modernization of existing theoretical and methodological approaches to improving the quality of analysis through economic and mathematical modeling.

The goal of research is to find the ways of improving management of competitiveness of organizations through the rising of goods quality.

To achieve this goal the following tasks were posed:

1. To determine the features of the conceptual apparatus for the management of competitiveness and identify the main features of its development to improve product quality.
2. To develop methodological recommendations and solutions for improving the process of competitiveness management through the use of economic and mathematical modeling methods.
3. To analyze the results of the study.
4. Based on the analysis of the data to formulate conclusions and proposals.

2. Materials and methods

The relevance of the selected factors is to form the perception of quality. The purpose and objectives of the study: to develop a model for assessing the quality of food products on the example of bakery products in order to improve competitiveness.

Our study involves determining the relationship of the evaluation result with the quality parameters. The proposed model allows not only the quality of bakery products, but also to identify the ratio of the incoming resource as a result of the interaction of the elements of the system. The construction of a model based on this proposal will identify the main directions of food quality management, which is important in terms of food security.

The procedure for building a model involves the following steps: 1) Selection of parameters used to build the correlation matrix. 2) Aggregation of indicators into homogeneous groups using the factor analysis procedure. 3) Selection of the study period and prototypes. 4) Conducting an experiment on quality analysis, laboratory tests. 5) To build a response function. 6) Development of strategic and tactical solutions for managing the quality of bakery products to improve the competitiveness of the organization.

In relation to the market of bakery products as the basis for the study of the parameters of improving the competitiveness of bakery organizations include: the definition of the list of the main components of the competitiveness of bakery products that can form an impact on the perception of the consumer. The list of main components is formed at the initial research stage at the beginning of the project. The score of the variables selected in the initial survey is based on expert assessments. The expert evaluation method is aimed at attracting an audience of a limited number of consumers.

According to the results of the expert survey, 22 components of the competitiveness of bakery products that determine the perception of quality were identified ($X_1 - X_{22}$).

The results of the survey components are further subjected to factor analysis, in the course of data processing, you can get the most important areas of development that are needed in the implementation of projects on the program to improve the competitiveness of the enterprise [11].

3. Results and discussion

According to the results of factor analysis of the data, there are three factors that were identified as” the Quality of Bakery Products"," Social Responsibility", "the Image of the Enterprise". The focus on the selected factors can play a significant role in the formation and maintenance of enterprise competitiveness. To implement the key factor, we will conduct research on quality optimization as a way to analyze the competitiveness of the bakery industry [12].

Also, the main problem of the competitiveness of Russian goods at the moment is the quality, stability and high level of consumer characteristics, the ability to attract new customers, the issues of monitoring the quality of food products are of particular importance.
We conducted an experiment to analyze the quality, and as a result, the definition of a more competitive type of bakery products. The object of the study was selected bakery products - black bread, as it is included in the basic diet of the population and is a daily purchase; according to a survey 36% of the population prefers the name of black bread "Borodinsky". The experiment was based on data from 18 major manufacturers in the Nizhny Novgorod region. The factors were the volume of products sold and the price, since these factors, as the survey showed, are the main ones when choosing bakery products in the retail network. The optimization criterion was chosen organoleptic evaluation, as an indicator of the quality of the product and available to each consumer. A point scale was developed to assess the quality of organoleptic indicators, taking into account the requirements of normative documentation (GOST 2077-84). Organoleptic evaluation was carried out by professional experts.

For the analysis of competitiveness, one of their main directions is to increase the quality score of organoleptic evaluation, based on the price level and the volume of the product unit. It is necessary to determine which combination of initial factors will lead to an increase in the quality score, as a consequence will help to determine the most competitive products. To solve this optimization problem, a statistical program package was used; the initial data are presented in Table 1.

| Sample No. | X1 – purchase volume (purchase weight) | X2 – purchase price | Y – quality score (results of organoleptic evaluation) |
|------------|--------------------------------------|---------------------|-----------------------------------------------------|
| 1          | 400                                   | 20                  | 92                                                  |
| 2          | 350                                   | 17.69               | 98                                                  |
| 3          | 400                                   | 24                  | 98                                                  |
| 4          | 350                                   | 18                  | 100                                                 |
| 5          | 360                                   | 21                  | 93                                                  |
| 6          | 350                                   | 20                  | 73                                                  |
| 7          | 300                                   | 20                  | 92                                                  |
| 8          | 350                                   | 19                  | 100                                                 |
| 9          | 300                                   | 25                  | 96                                                  |
| 10         | 450                                   | 24                  | 97                                                  |
| 11         | 350                                   | 23                  | 94                                                  |
| 12         | 400                                   | 18                  | 97                                                  |
| 13         | 350                                   | 18                  | 76                                                  |
| 14         | 350                                   | 19                  | 96                                                  |
| 15         | 300                                   | 20                  | 88                                                  |
| 16         | 300                                   | 20                  | 99                                                  |
| 17         | 350                                   | 18                  | 100                                                 |
| 18         | 300                                   | 19                  | 97                                                  |

From Table 1, it can be seen that the average volume of black bread "Borodinsky" is 300-450 g, which is explained by the fact that this category of food refers to the goods of daily demand and is consumed fresh. The price for this name varies from 17.69 to 25 rubles, depending on the manufacturer.

As a result of generation and creation of the plan of a random sample the following picture was received. For control we will use five samples.

To analyze the competitiveness of one of the main directions is to increase the quality score of organoleptic evaluation, based on the level of prices and volume of a unit of product. It is necessary to
determine which combination of initial factors lead to an increase in the quality score, will as a result, will help to determine the most competitive products

Next, we need to re-examine to confirm the opinion of experts on the basis of random sampling. Thus, the results of sampling for repeat surveys, samples were taken of manufacturers under No. 6,17,3,4,10. Laboratory studies of the selected samples were carried out on the basis of an accredited production laboratory. The quality of the bakery product-black bread “Borodinsky” was determined by physical and chemical parameters-acidity of the crumb, crumb moisture, the mass fraction of protein, the mass fraction of fat in terms of dry matter.

There we present the methodology of the experiment. The previous step is the process of creating an experiment plan. We have chosen the type of plan as factor with 2 factors, so the full experiment should be conducted on four tests (4 combinations of factors). The number of repetitions for corner points in our example is 3. Factor 1-X1 (volume), 300 lower limit and 450 upper. Factor 2-X2 (unit price 17.69 (lower) and 25(upper).

Next, the teams analyze the factor plan and factor schedules. Next, build the model. Specify the following combinations: A:X1, B:X2 and AB.

As a criterion of compliance, we present the indicator P-probability to determine the significance of the effects. If $p = 0.05$ or less, the factor $X2$ is statistically significant, since the corresponding probability values are less than 0.05 $P2 = 0.003$. Factor 1-volume ($X1$) and interaction $X1 \times X2$ are statistically insignificant, where $p1 = 0.851, p = 0.003$.

Assess the significance of factors by plotting the impact. In terms of graphics effects set the check boxes for normal and Pareto’s Law. The absolute values of the influence of factors are clearly traced on the influence graph, and the red control line indicates the tabular value of the Student's criterion. Those factors for which the calculated value of the student test exceeds the table value (i.e. the column of the histogram crosses the control line) are statistically significant. We conclude that only the "Price" factor is statistically significant (figure 1).

**Figure 1.** Evaluation of the influence of factors (Pareto's law).

**Figure 2.** Evaluation of the influence of factors (general distribution law).

In figure 2 the squares indicate significant factors, and the roundels – insignificant. Next, we present a graph of effects based on the law of normal distribution, this type of graph can be built only for the factor plan. The normal distribution graph also shows that only factor 2 is statistically significant.

Modeling procedure using the obtained factors. We present a model of the dependence of food quality assessment on the given factors.

To assess the adequacy of the presented model we use the coefficient of determination R-Sq. Since the coefficient of determination is $91.6\%$, which makes it possible to assert to a high degree that the obtained model corresponds to the experimental values. Thanks to the regression equation obtained, we can predict the score of quality with certain accuracy, which is especially important for consumers when choosing bread products.

Virtually the task is to find such values of factors $X1$ and $X2$, at which the $AC (Y)$ quality score will be the maximum. Let's present the results of optimization. According to the results of search
experiments found that the best performance organoleptic evaluation is achieved with the following indicators. The response function takes the lowest value equal to 92, with the values of factors $X_1 = 399$ and $X_2 = 23$. We conclude that for consumers the optimal combination is the volume of the product 400 g at a price of 23, with the highest level of quality.

To determine the influence of factors on the indicators of organoleptic evaluation of bakery products, a plan for the planning of the experiment for two factors was implemented. The factors varied within the following limits:

- $X_1$ – volume of purchase (300-400 gram);
- $X_2$ – price for one unit (17.69-25 €);

During the research the influence of the factors on was assessed:

- $Y$ – quality score according to organoleptic assessment (73-100 scores).

After carrying out the experiments and processing the results obtained regression model of the quality assessment process (minor factors excluded), the results are presented in Table 2:

| Important indexes for | Image – factor plan $2^2$ |
|-----------------------|---------------------------|
| Regression equation for real values of factors | $Y = 89.8750 - 0.1250 X_1 + 4.1250 X_2 + 0.1250 X_1 X_2 + 1.76777$ |
| Optimal factor meaning | $X_1 = 399$ and $X_2 = 23$ |

After carrying out the experiments and processing the results, regression models for optimizing the quality assessment were obtained (minor factors were excluded).

According to the results of search experiments found that the best performance organoleptic evaluation is achieved at the maximum value of indicators $X_1$, $X_2$.

### 4. Conclusion

Analyzing the obtained models, we can conclude: Thanks to the experiment in the field of quality control, a mathematical model of the type of regression equation $Y = f(X_1, X_2, \ldots, X_k)$ was built, which connects the studied parameter with the values of factors, according to the results of the study, the adequacy of the model was 91.6%. Thus, it is possible to note advantages of the offered methodical approach to management competitiveness of the enterprises of the food industry by improvement of quality of production: 1) has practical applicability in the optimization of food quality assessment; 2) characterizes the versatility in the application: the evaluation is based on the use of the system as the generally accepted parameters characterizing the competitive position of the food sector organizations; 3) has methodical and organizational unity. This method allows determining the key parameters, to clarify the importance of factors that take into account the characteristics of enterprises and the specifics of the market under study, to forecast the key parameters of quality management and as a result to determine the main directions of quality management organizations to improve competitiveness. Improving the organizational mechanism of quality management of the organization's products provides additional benefits. The developed methodological tools are available for use by owners and managers of enterprises, consumers are based on the available information about the products. This technique is the tool allowing taking into account planning of experiment to improve process of quality management and, therefore, and to increase efficiency of management of competitive position of the organization that will allow strengthening a financial condition and a position of the enterprise in the market.

### References

[1] Klein R G, Dooley D, Lapierre K 2020 Trait perfectionism and competitiveness: Conceptual similarities and differences in a lab-based competitive task. *Personality and Individual Differences* **153** 109610 doi.org/10.1016/j.paid.2019.109610
2 Lafuente E, Leiva J C, Moreno-Gómez J, Szerb L 2019 A non-parametric analysis of competitiveness efficiency: The relevance of firm size and the configuration of competitive pillars. *BRQ Business Research Quarterly* Available 8 doi.org/10.1016/j.brq.2019.02.002

3 Esponda I, Pouzo D 2019 The industry supply function and the long-run competitive equilibrium with heterogeneous firms. *J. of Economic Theory* 184 104946 doi.org/10.1016/j.jet.2019.104946

4 Gorb O A, Yasnolob I A, Protsiuk N Y 2016 Organizational-economic mechanism of management of food industry enterprises competitiveness. *Annals of Agrarian Science*, 14(3) 191 doi.org/10.1016/j.aasci.2016.07.004

5 Turi A, Goncalves G, Mocan M 2014 Challenges and Competitiveness Indicators for the Sustainable Development of the Supply Chain in Food Industry. *Procedia - Social and Behavioral Sciences* 124 133 doi: 10.1016/j.sbspro.2014.02.469

6 Jayanthi S, Kocha B, Sinha K K 1999 Competitive analysis of manufacturing plants: An application to the US processed food industry. *European J. of Operational Research* 118 217 doi.org/10.1016/S0377-2217(99)00022-3

7 Leslie R B, Oliveira J C, Medina A G 2000 Food Forum: a research forum for an innovative and globally competitive European Food Industry. *Food Res. Int.*, 33 295 doi.org/10.1016/S0963-9969(00)00039-9

8 Kinnucan H W 2003 Optimal generic advertising in an imperfectly competitive food industry with variable proportions. *Agricultural Economics* 29 143 doi.org/10.1016/S0169-5150(03)00046-X

9 Tutu B O, Anfu P O 2019 Evaluation of the food safety and quality management systems of the cottage food manufacturing industry in Ghana. *Food Control*, 101 24 doi.org/10.1016/j.foodcont.2019.02.028

10 Message Costa L B, Filho M G 2018 Lean, six sigma and lean six sigma in the food industry: A systematic literature review. *Trends in Food Science & Technology*, 82 122 doi.org/10.1016/j.tifs.2018.10.002

11 Nechaeva M L, Kutaeva T N, Borovitskaya M V, Semenova A N, Abrosimova M S 2019 Management of competitiveness of organizations through improved product quality. In the book: Prospects for the development of agrarian sciences Materials of the Int. Sci. and Practical Conf. pp. 161-163

12 Savinyh P, Nechaev V, Nechaeva M, Ivanovs S 2016 Motion of grain particle along blade of rotor fan of hammer crusher. *Engineering for Rural Development* 1072