A design of the quality control and safety mechanism for convenience meat products

N I Dunchenko, S V Kuptcova, E S Voloshina, V S Yankovskaya, K V Mikhaylova and M A Ginzburg

Russian State Agrarian University – Moscow Timiryazev Agricultural Academy, 49, Timiryazevskaya st., Moscow, 127550, Russia

E-mail: yudakovaes@gmail.com

Abstract. The main aim of any company is consumer satisfaction. However, in order to promote a new product on a market, an analysis of consumer preferences is not enough, you must make sure that the product meets all safety requirements for this category of the product and guarantee its sustained quality. So, the producer has to create products according to consumer wishes. In this article a study of market of convenience meat products is established. The result of forms was drawn and a list of wishes of “active” consumers was provided for convenience chilled meat cutlets. Then, we used the Quality Function Deployment method, the mechanism for designing products or processes, and, based on the established and expected consumer demand, consistently transformed this demand first into technical characteristics of products, raw materials, and then into parameters of the technological process. This demand is transformed into chain of House of Quality. The final step was to develop a consumer demand target matrix. Scientists Vahouni G. V., Ross H. have studied the application of QFD in production in various industries [3,4].

1. Introduction

The main aim of Russia’s Food Safety Strategy till 2030 is to produce high-quality food, to provide adequate nutrition, prevent diseases, increase the life expectancy and quality of life of the population, stimulate the production and market of food products [5].

Improving the quality of food products today is impossible without involving consumers. With the use of consumer demand data we can formulate requirements for the properties of future food products according to modern food quality and safety standards, and acknowledge improvement and development of the national food market.

This problem is especially acute for producers of convenience meat products. The study of consumer preferences shows a strong consumer demand for products of this market sector. The modern consumer wants to limit time for cooking, but to eat healthier, which encourages manufacturers to produce ready meals. The proximity of these products to the products manufactured by catering companies sets a high standard of consumer requirements, and the question of meeting consumer requirements is particularly acute for manufacturers [6].

At the same time, we should not neglect that the products of this market sector are potentially dangerous because they are fit to be consumed right on the spot and come in a form that promotes rapid population growth of microorganisms that may fall into them. For this reason, requirements for
these products are rather strict.

For solving all these issues, a company needs to have effective mechanisms for quality and safety management, as well as mechanisms to quickly track changes in consumer preferences. Therefore, the purpose of our study is to develop a mechanism for quality and safety management at the product design stage [7].

2. Materials and methods
In order to obtain the actual values of monitored characteristics, laboratory tests of cutlets manufactured in the laboratory of the department of quality management and food sciences RSAU-MTAA and competitors’ products were conducted. The studies were conducted using the following methods:

- protein content as per GOST 25011;
- salt content as per GOST R 51480;
- moisture content as per GOST 9793;
- vitamins content as per GOST R 55482;
- histological identification of content as per GOST 31479;
- fat content as per GOST 23042;
- organoleptic properties as per GOST 9959,
- product elasticity determined using an Instron 1140.

The study uses Quality Function Deployment, a general methodology that provides means for converting consumer requirements into proper technical requirements at each design and production stage.

3. Results and discussion
The opinion of the consumer, the idea of the quality, that consumer expects of products determines what type of products manufacturers develop. Product user’s experience or changes in market conditions also adjust the quality assessment. Unfortunately, there are often disparities between how the manufacturer sees the quality of its products and how the consumer sees it. Customer feedback is one of the most important resources for an enterprise. A survey using questionnaires is a means to measure consumer preferences [8].

When processing the market research data, the manufacturer learns its place in the market, the position of competitors, the degree of consumer satisfaction with its own and competitors’ products, as well as consumer demands. The most important feature herein is the possibility to capture unspoken claims, based on the set of spoken ones.

We conducted the market research of ready-to-cook chilled meat cutlets in Moscow in March-July 2017. In total, we interviewed 200 respondents. The interviewed consumers were divided into 3 groups based on purchase frequency: active, passive and random.

As a result of data processing, the list of active consumer wishes for ready-to-cook cooled meat cutlets was made according to such characteristics:

- taste;
- safety;
- appearance;
- juiciness;
- freedom of preservatives and stabilizers;
- affordability;
- short shelf life;
- soy-freedom;
- healthy-unhealthy criterion.

After a brainstorm, the following properties were chosen as the monitored parameters of ready-to-cook products:
1. Nutrition and energy with regard to value:
   • protein content,
   • fat content,
   • content of plant origin components,
   • vitamins content.

2. Physical and chemical properties:
   • moisture content,
   • salt content,
   • elasticity.

3. Microbiological properties:
   • pathogenic microorganisms content (Coliform group, St. aureus, quantity of mesophyll aerobic and optionally anaerobic microorganisms, Proteus, yeast and mold).

4. Visual and organoleptic properties:
   • product colour,
   • product shape,
   • product thickness,
   • one product item weight.

This list represents the top rows in the target matrix and shows the degree of correlation between the monitored parameters of convenience products and consumer requirements.

The correlation matrix reveals a positive dependence between the protein content and moisture content and elasticity of products. The protein content depends on the quality and content of raw meat, as well as on soy ingredients added. The quality of raw meat also has a strong effect on the moisture content in convenience products. When using chilled raw meat (better water-binding and water-holding capacity compared to frozen meat), the quality of ready-to-cook products improves. Soy ingredients (isolates, flour, textures, etc.) can be water-holding agents, thus a great weight percentage augmentation of these ingredients will increase the amount of water retained in the product and, as a result, increase the elasticity, which makes the product keep its shape.

Raw meat with high water-binding capacity can retain more moisture in the product. Raw meat with alkaline pH values can have high water-binding capacity because the isoelectric point of the meat proteins sits in the alkaline range. The temperature of ground meat also has an effect on the moisture content in convenience products. Raw meat is salted at a temperature of (2±2) °C [9].

High temperature and long cooking time can cause significant loss of moisture, fat and a small amount of protein. The compressed bottom crumb layer can also occur along the crust. With the significant loss of moisture, the amounts of protein and fat can vary in the convenience product. The more intense the chilling (modern shock chilling methods), the less moisture the finished product will contain.

A positive dependence is found between the moisture content in the product and microbiological safety. The greater the moisture contents in the product, the better the conditions and, consequently, the higher the risk of developing pathogenic microflora. To prevent the growth of microflora the salt content, which has a preservative effect, is a subject to regulation.

At the market evaluation stage, a consumer survey was conducted to ascertain the degree of customer satisfaction with the quality of the products made today and to evaluate competitors. The expert method was used to compare and rate the quality indicators of own and competitors’ product samples using a scale: 1 - bad, 2 - satisfactory, 3 - average, 4 - good, 5 - excellent. The results are shown in Table 1.

Column 2 shows the importance of properties as estimated by customers in questionnaires B. Columns 3 and 4 shows the average customer satisfaction with the products of competitor companies. Column 5 shows the average customer satisfaction with the products of our company. The estimates in Column 6 are based on the following rule: the target quality value should not be lower than the product’s value to the customer (Column 2) and the average customer satisfaction with the products of
competitor companies (Columns 3 and 4). Column 7 shows the ratio of the target quality (Column 6) to the average customer satisfaction with the products of our company (Column 5). Column 8 shows the improvement factor (Column 7) multiplied by the value to the customer (Column 2). Column 9 shows the percentage ratio of the absolute weight (Column 8) to the sum of all absolute weights.

| Table 1. Ready-to-cook chilled meat cutlets |

| Customer requirements | Value to the customer | KventiImpex LLC | Essen Plus LLC | NSI Plus LLC | Target quality | Improvement factor | Absolute weight | Relative weight |
|-----------------------|-----------------------|-----------------|---------------|--------------|----------------|-------------------|----------------|----------------|
| Tasty                 | 4.28                  | 4               | 3.7           | 3.3          | 5              | 1.52              | 6.48           | 59.06          |
| Juicy                 | 3.46                  | 3.3             | 3.9           | 3.9          | 4.5            | 1.15              | 3.99           | 36.36          |
| Looking good          | 4.12                  | 4.6             | 3.9           | 3.9          | 5              | 1.28              | 5.28           | 48.10          |
| Affordable            | 3.14                  | 3.4             | 3.8           | 4            | 4.5            | 1.13              | 4.65           | 42.31          |
| Soy-free              | 3.12                  | 3.4             | 3.9           | 3.3          | 4              | 1.21              | 3.78           | 34.44          |
| Healthy               | 3.02                  | 4.1             | 3.1           | 4            | 4.5            | 1.05              | 3.16           | 28.78          |
| Safe                  | 4.48                  | 3               | 2.9           | 4.1          | 5              | 1.22              | 5.46           | 49.75          |
| Free of preservatives | 3.26                  | 3.3             | 3.1           | 3.4          | 4              | 1.18              | 3.84           | 34.93          |
| and stabilizers       |                       |                 |               |              |                |                   |                |                |
| Short shelf life      | 3.06                  | 3.2             | 3.8           | 3.2          | 4              | 1.25              | 3.83           | 34.83          |

The processed and analyzed data suggest that, first of all, it is necessary to improve the organoleptic properties, safety and price of the product, because they have high absolute weight, and thus are the most important for the consumer.

QFD is a quality model for convenience meat products. The results of laboratory research are shown at the bottom of the target matrix. They certify the data obtained from the consumer survey on the quality of our products and products of competitors.

The target matrix of consumer requirements for convenience chilled meat cutlets is shown in Fig. 1.

Based on the tests, we have identified the target values of the ready-to-cook products that need to be achieved in order for the customer demand to be met; besides, we have specified the properties for structuring:

- protein content,
- fat content,
- content of plant origin components,
- moisture content,
- salt content,
- microbiological properties.

In the modern economic environment, the successful operation of an enterprise largely depends on the marketing of its products and in order to reach new consumers and to represent the marketed product in the best way possible, it is necessary to anticipate the needs and wishes of the potential customers. Companies apply QFD for customer feedback to develop new or upgrade existing products. Quality Function Deployment helps to convert customer requirements into product specifications.

Sullivan L.P. in his 1986 work “Quality Function Deployment” encourages to improve the quality and competitiveness of products through the design and modernization of products and processes.
based on the extensive use of various types of information (knowledge) and identification of target values of product properties and process parameters with effective deployment of Quality Function Deployment (Structuring) [10].

Mazur G. recommends incorporating QFD and other quality management techniques with a view to improve the process of developing new products [11].

Yoji Akao advises considering QFD as a technique that increases the transparency in creating and improving a product and gives a start to working with the consumer needs in order to produce a new product or improve an existing one [12-13].

![Figure 1. The target matrix of consumer requirements for convenience chilled meat cutlets](image)

4. Conclusion
Based on the conducted research, we have identified target values for the properties of convenience products that must be achieved to meet the consumer expectations, and also have chosen the structuring characteristics: protein content, fat content, content of plant origin components, moisture content, salt content, microbiological properties. Besides, we have built a House of Quality for chilled meat cutlets. The results will be further used to develop a quality and safety production plan for meat convenience products.

Introduction of the large quantity of the modifier leads to its coagulation and reduction of its influence on the structure.
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