Key processes management in development and implementation of management systems at food enterprises

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Abstract. The goal of this paper is to analyse key processes management of biologically active additives (BAA) production by identification of the production's life cycle processes and assessment of their productivity. Following conclusions were drawn according to the conducted researches. The authors have been done the analytical review of scientific and technical literature on the process approach in development and implementation of the quality management system at food enterprises in domestic and foreign practice. They have done the analysis of a life cycle of BAA production and developed principles of identification of the quality management system's processes in accordance with ISO 9001:2008 standard requirements "Quality management system. Requirements". They determined responsible ones for processes, gave power for taking administrative decisions. They established an order in interaction between interfacing divisions participating in realization of processes. They identified key processes of a life cycle of BAA production, determined backbone factors in their decomposition.
[Surkov I.V., Ermolaeva E.O., ProsekovA.Y., Gorelikova G.A., Poznyakovskiy V.M. **Key processes management in development and implementation of management systems at food enterprises.** *Life Sci J* 2014;11(12):300-304] (ISSN:1097-8135). http://www.lifesciencesite.com. 57

Keywords: process, quality management system (QMS), food enterprise, biologically active additives, development of quality management system

1.Introduction

In modern Russia safety issues are becoming more important due to entry to the World Trade Organization. Technical regulations, accepted and being discussed now, focus food producers on development and implementation of quality management systems based on the principles of the ISO international standards of a 9000 series. One of the fundamental principles of creation of quality management systems is the process approach based on formation of a processes network of the organization and subsequent management of these processes. Meanwhile, organizational structure of the majority of Russian food enterprises represents division of system into subsystems that often causes emergence of cross-functional barriers between structural divisions. Therefore Russian enterprises are interested in recommendations about description, realization and assessment of separate processes' effectiveness considering specifics of the enterprise.

Theoretical bases of the process approach, assessment of processes' effectiveness are given in works of Deminga, J. Dzhuran, F. Crosby, K. Isikava, U. Akao, G. Niv, D. Norton, G. Taguti, A. Feygenbaum, V. Shukhart, R. Newman, etc. [1].

Current results show that implementation of the QMS leads to improvement in quality and safety of food. Results demonstrate increase in customers' satisfaction and enterprises' competitiveness including increase in sales volumes and market sharing [2].

Many authors indicate the need of implementation of the QMS adapted for requirements of small and medium-sized food enterprises for improvement of production technological processes' quality and increase of customers' satisfaction. There are a few studies devoted to implementation of the QMS among small and medium-sized food enterprises. According to Dora *et al.* (2013), size of the company is a significant factor concerning production quality management. Production branches of confectionery, chocolate and meat are more developed, than bread baking. The most significant advantages of the QMS are reducing of production cost and increasing in labour productivity. The main barrier to realization of FQMS is "absence of knowledge and training of specialists" in the food industry [3].

Implementation of the QMS at food enterprises is a reliable factor of ensuring quality and safety of production including biologically active additives [4-6]. In addition, key processes management issues are becoming more important [7].

2. Materials and methods

The authors used standard and specific methods during research including analytical, statistical, mnemonic method 4M ... 6M, modelling and decomposition of processes, experts' opinions.

The authors' technique of classification of enterprises' processes according to their significance test: key and auxiliary, was used. The key process

means the process during which added value and also a product for realization to external consumers and processes of life cycle of production according to ISO 9001 standard requirements are formed. The auxiliary process is the process necessary for key processes therewith added value and a final product are not formed. According to the requirements of ISO 9001 they are processes of management; monitoring, analysis, improvement and resources management.

3. Results

We used the method offered by foreign authors (Becker et al., 2003; Jacxsens et al., 2011) [8, 9], where key processes management in development and implementation of the QMS is realized when the following factors exist:

1. Manpower – (their qualification, work experience, gender, etc.).
2. Machine – machines, machining work stations, equipment.
3. Material – materials, raw materials, accessories (production place, manufacturer, run of materials, grade of materials, etc.).
4. Method – mode of production (temperature conditions, a processing technology, number of a shop, team, site, shift, workers, etc.).
5. Measurement – method of measurement, type of measuring tools, class of accuracy of the device, etc.
6. Media – temperature, air humidity in a shop, magnetic and electric fields, sunlight, etc.

On the basis of all these factors the authors offered, developed and approved the technique based on application of processes classification and method of their description with use of controlled parameters of safety of food production at different phases.

Development of processes at food and processing enterprises consists of nine phases.

1. Determination of a process type: provides ranging of processes on significance: key, auxiliary. It is necessary to determine the functional purpose of a process – technological, organizational, logistic, economic, financial etc.
2. Determination of purposes and principles of the process, its boundary which allow revealing inputs and outputs.
3. Planning of processed resources, their suppliers, output parameters of processes taking into account input and output requirements. At this phase all characteristics of the process are determined.
4. Appointment of the process owner responsible for further functioning of the process focused QMS who bears responsibility for quality of output characteristics.
5. Structuring of the process depending on its type and functional purpose. It is carried out by means of multilevel modelling:

- whole process is represented at zero level;
- subprocesses, involved in the process of zero level are determined on the first level;
- the detailed picture of the process is considered on the second level, the consequence of operations, responsibility of the performers, milestones, necessary documentation are specified, a fragment of monitoring controlling documentation is the route inspection sheet of the process (table 1).

6. Identification of the operating influences mechanism which provides quality of the process at the output. It is necessary to manage the personnel carefully because in many cases they have critical impact on quality of the process.
7. Determination of criteria of effectiveness, productivity and robustness (insensitivity of a product or process to the influence of "noise", i.e. variable factors which cause dispersion of parameter values and which rarely can be influenced) of the process. Process indicators including timing of orders, deficiency level, decrease in stocks, and minimization of resources are very important.
8. Determination of control parameters of key processes. The monitoring process is carried out by means of the process points monitoring system.
9. The repeated analysis of each operation of the process and identification of all connections between inputs and outputs of subprocesses.

In this paper we represent description of key processes to determine controlled parameters for ensuring stability of quality and safety of developed products on the example of one of the leading Russian producers of biologically active additives – JSC "ArtLife". You can see a general process model of the enterprise on the Fig. 1.

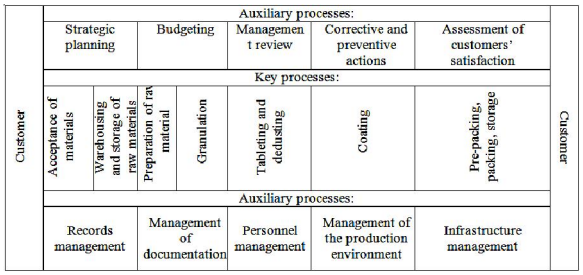

Figure 1. Process model of JSC «ArtLife»

One of such processes is "Production of tableted forms of BAA". It can differ on some parameters at different enterprises but usually it is carried out according to the similar process scheme: acceptance of raw materials, warehousing and storage of raw materials, granulation, tableting and dedusting; pre-packing, packing, storage.

Acceptance of raw materials. Raw materials and auxiliary materials delivered to the shop are unpacked in the special room equipped with necessary tools for unpacking of boxes, bags, packages, etc.: various weights, racks, cases. Raw materials and other materials are exposed to reweighing and sorting.

Warehousing and storage of raw materials. All raw materials delivered to the enterprise are classified on the raw materials which is directly a part of a finished product, and the packing materials providing safety of a product during transportation and storage. For prevention of interfusion and pollution of raw materials the warehouse is divided into five zones: acceptance, quarantine storage, sample collection, main storage, and spoilage. After materials delivered to the enterprise, the responsible person — the storekeeper – places the delivered material in the zone of accepting and carries out warehouse inspection which includes two phases. The quantity of put production relating to accompanying documents, integrity of packing, delivery terms according to a handling instruction on material packing, temperature conditions of transportation are checked on the first phase. This phase is carried out in the presence of the supplier of material. At the second phase the received material is identified according to the demand. Identification is carried out in a day of delivery. When warehouse inspection is done a material is placed in the zone of quarantine and the demand notice is sent to the quality control department (QCD) for further inspection. Materials receive the status: "Waiting for decision of QCD". The storekeeper records available information on materials in the Store card, attaches the copy of certificates, other documents on quality to the Card. For sampling materials are temporarily moved to the sample collection zone with special conditions of working environment which interferes with contamination, change of storage conditions and properties of materials when opening its packing. Sampling is carried out in the presence of the storekeeper. The status of materials is completely reflected by marking of its packing. Materials can be taken from various zones of a warehouse: from the quarantine zone – as the material which has not passed inspection of QCD; from the zone of the main storage – as the material demanded in production, or as the material expired and not received its extension from QCD. If the material is demanded in production, the storekeeper makes out the consignment note on its transfer on the basis of the requirement consignment note from the head of the relevant department.

Preparation of raw materials. In the preparing room, before the processing technology, the raw materials having increased humidity, integrated particles, mechanical impurities, are exposed to a pre-treatment. In this room there are various crushers and mills, and also other equipment for grinding, sifting and drying of raw materials. Monitoring of the process is reflected in the route inspection sheet (table 1).

Table 1. Route inspection sheet of the process "Preparation of raw materials"

Operation	Object of Monitoring	Control Method	Control Parameters	Inventory	The person responsible for control and filing in the document
Weighting of raw materials	Raw materials of the given weight	Raw materials of the given weight	Permissible variations in weight for the first run	Weights	Foreman. Single-phase inspection record
Magnetic cleaning	Cleared raw materials	Physical and chemical analysis	Purity of raw materials	Magnetic collector	Foreman. Single-phase inspection record
Raw materials crushing	Crushed raw materials	Screen test	Particle size	Grinders	Foreman. Single-phase inspection record
Screening of raw materials	Crushed and screened raw materials	Screen test	Particle size	Screen plates	Foreman. Single-phase inspection record
Receiving of galena semi-products	Extracts	Physical and chemical analysis	Extract of the given concentration	Extracts	Foreman. Single-phase inspection record Laboratory. Registration log book of analyses of finished semi-products of QCD. The analytical passport on a finished product.

Foremen are responsible for operations; a foreman and a production engineer are responsible in a closing phase. Monitoring of controlled parameters of quality is carried out daily with use of statistical processing.

Granulation. Granulation is necessary for improvement of flowability of the tableted bulk. Flowability improves as a result of the considerable decrease of a surface area of particles during their coalescing in granules and, as a result – the friction reduction arising between particles when moving. There are two types of granulation: wet and dry. Liquid solutions of aids are used in wet granulation. Liquids are not used, or used only at a particular phase of preparation of material to tableting in dry granulation.

Tableting and dedusting. The process of tableting of the received bulk is carried out in specific machines; the main working knot of them is the press tool consisting of matrixes and hobs. By means of the filling hopper, the tableted material which is pressed by squeezing moving of hobs is delivered to a matrix opening. Finished tablets are packed and moved to a warehouse or to the coating and packing zone.

Coating. In a coating room they prepare by-products and put specific coating on tablets. Tablets are covered with coating to protect them from adverse external effects, improve taste, and render marketable state.

Pre-packing, packing and storage. Finished tablets are packed in a packing room into strips, blisters and other packing, marked. Finished goods warehouse is intended for acceptance and storage of semifinished products and finished goods, made at the

enterprise. The warehouse is divided into a zone of storage of semifinished products and a zone of storage of finished goods. Packed semifinished products with the analytical sheet signed by the head of the department of quality control are accepted in the zone of storage of semifinished products of the warehouse and are stored until their demanding in production. Finished products packed into a transport container, with the certificate of conformity according to the consignment note, are accepted in the zone of storage of finished goods and are stored before sending to the customer. Sending of finished goods is carried out according to the delivery plan or on direction of the production manager.

Controlled parameters of finished goods are listed in a checklist (table 2).

Table 2. The list of controlled parameters in acceptance and preparation of raw materials, semifinished products and finished goods

Phase	Controlled parameters
Acceptance of raw materials, semifinished products and materials	• quantity of received raw materials, semifinished products and materials relating to accompanying document; • package integrity; • delivery conditions according to a handling instruction on a material packing; • temperature conditions of transportation relating to accompanying documents and packing; • identification of the material received on the demand
Delivery to a warehouse	• caution of transportation
Warehousing	• caution of transportation; • warehousing according to the type of goods; • warehousing in the corresponding zone
Sampling	• Specific conditions of working environment interfering with contamination, change of storage conditions, change of properties of a material when opening its packing
Storage of raw materials	• keeping of storage conditions; • visual review of a container's condition of stored raw materials • control of a period of validity
Acceptance of finished products	verification of documentation • for products – an analytical sheet; • for finished goods – the certificate of conformity
Storage of finished products	• keeping of storage conditions; • visual review of a container's condition of stored raw materials; • control of a period of validity
Sending finished products from a warehouse	verification of documentation : • for products – the sheet of the production manager; • for finished goods – delivery plan

Production with defects moves to a zone (place) of storage of spoiled raw materials. Access to this zone is limited.

4. Discussion

Repin in his works (2007) Tucek *et al.* (2013) showed the complex technique of implementation of the process approach to management, offered the technique of value chain schemes building (models of business processes of the company on the top level that is a systematizing material of experience of foreign and Russian companies [7, 10]. According to our results the critical factor of key processes management at food enterprises is forming of controlled parameters of each phase of the process to ensure stability of quality and safety of the finished product.

One of early studies (Avstriyevskikh, 2003) on development and implementation of the management system of BAA production has been conducted in Russia on the basis of the scientific and production association “ArtLife” (Tomsk) with participation of the certification authority NQA (UK) [4]. This association is certified according to the requirements of the international standards ISO 9001, GMP and HACCP. Usually, implementation of the safety management system for food products does not cause essential changes in the processes card or in types of events assumed by the considered organizations (Wang *et al.*, 2010) [11].

In the recent years this issue has been developed at other food enterprises, too (Kantere and others, 2008; Yermolaeva and Surkov, 2009) [5, 6].

Current works (Repin, 2007; Surkov и др., 2014) about processes description and their classification do not reflect completely approaches to ensuring safety of finished products including implementation and monitoring of controlled parameters [7, 12].

The offered technique of development and identification of processes has been implemented and is being used at the scientific and production association JSC “YUG” (Biysk), issuing biologically active additives.

5. Conclusion

Materials of the researches relate to such phase of development of the management system at an enterprise producing BAA as processes classification to determine controlled parameters.

The obtained data can be used in processes classification for improvement and development of quality management systems at food enterprises taking into account their specifics.

Prospects of further work concern determination of importance and risk of dangers in

production, creation of a software product for accounting and analysing of deviations from the given level of quality, assessment of efficiency level of BAA production with carrying out corrective actions.

Ensuring key processes management efficiency gives a chance to enterprises to improve quality of production, works and services, to optimize management processes and increase technological discipline, etc.

6. Acknowledgement

The authors express their appreciation and profound gratitude to professors Kantere V. M., Avstriyevskikh A.N., the leading expert on quality management systems Tsvetichanin V. for providing information and consultation in practical questions of management systems implementation.

All feedback will be accepted with gratitude and considered in further work.

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7/18/2014