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# Developing a Pate with Branch Chain Amino Acids and Identifying It Using a QR Code

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**Abstract.** The growing planet population requires manufacturing more products to replete nutritional deficiency, including those enriched with amino acids to maintain the balance of nutrients in the human body. Pate is an option of an alternative energy-dense meat product, ready-to-eat from a container by plastering on a bakery product as is or using as a side dish for the main course. A pate enriched with BCAAs, microbial proteinase, and goose liver conferring flavor and stabilizing the product has been developed. A solution has been proposed for ensuring food safety through identifying goods using a QR code, in which data on the type of feed, breeding meat cattle on farms, transportation, meat processing plant, meat product processing, and storage until the sale at a retail outlet to the end consumer are encrypted in a table format. The proposed measures contribute to the trust relations between the seller and the consumer and convenient delivery of information to the executive authorities, which will allow obtaining complete information on the goods purchased through the retail network with the supply chain.

## 1. Introduction

According to experts' forecasts, by 2050, the world population will approach 9.7 billion people, and estimates for 2100 suggest an additional population growth of up to 11 billion people [1]. Along with population growth, the level of income will also increase over the next few decades, including in developing countries until 2030 [2], and according to experts, an increase in family income will cause a growth in the consumption of meat and dairy products [3]. The growth of the population and its income affects the increase in life expectancy. The data indicate that by 2050, the population over 60 will more than triple as compared to the present day [4]. Such demographic changes lead to the need to produce more food. According to experts, food production should be increased by at least 70 % [5]. To meet the growing demand, annual meat production should be increased by 200 million tons [6].

The research objective is developing a pate enriched with essential amino acids (leucine, valine, and isoleucine).

The research subject is identifying a pate enriched with essential amino acids by entering data available through a QR code.

The research objective is developing a pate with essential amino acids and ensuring its identification using a QR code.



Food safety is a component of consumer properties of goods, along with the nutritional value and culinary, process, ergonomic, and ecological characteristics. This is a product property ensuring its consumption without any harm or danger to human health.

Indicators standardizing product safety include organoleptic (appearance, color, taste, smell, consistency), physicochemical (mass fractions of moisture, dry matter, fat, sugar, salt, and other product ingredients, acidity), and sanitary and hygienic parameters (potentially dangerous xenobiotics, oxidative spoilage of fats, radionuclides, microorganisms, harmful impurities of vegetable origin in food grains, contamination and pest infestation, parasitological indicators).

## **2. Research techniques and materials**

Animal products are a valuable source of complete, high-quality, and easily digestible protein containing iron, zinc, calcium, vitamin A, and vitamin B12. These high-quality protein foods promote juvenile growth and prevent chronic malnutrition in young children [7].

Scholars such as Mariko Kawabata, Andrea Berardo, Paolo Mattei, and Saskia de Pee have developed food systems meeting the new requirements and proposed a structure for a systematic analysis of all components, i.e. food supply chains, ensuring reflection of any interventions to change food systems in the program. The results of their studies contribute to the continuation of the initiative to develop a National Integrated Approach to Nutrition, as well as promoting and implementing the Law on Food Fortification [8].

Meat and dairy products are among the most biologically available sources of protein, amino acids [9], vitamins [10], and minerals [11] for humans.

Scholars such as Chau Darapheak, Takehito Takano, Masashi Kizuki, Keiko Nakamura, and Kaoruko Seino have found that a varied diet, including both meat and dairy products, reduces the growth retardation factor. Dietary diversity, like specific foods, is an important determinant of human nutrition and development [12].

Pate can be an alternative meat product option since it is energy-dense food, ready-to-eat from the container as is, which does not require much time for preparation.

Meat pate is both plastered to bread and used as a filling for bakery products. Changes in the population lifestyle and pace lead to less and less time for cooking. Consumers are shifting their demand to pre-cooked foods and canned meats and pates that ensure quicker preparing meals at home and are suitable for lunch breaks or travel, which allows reducing cooking time and diversify meals.

Pates differ in heat treatment (boiled, baked), appearance (in a sausage casing, dough-enclosed, canned), composition (liver or various raw meats), taste profile (spices, fruits, nuts, various types of alcohol), texture (spreadable, cut, coarsely ground), and special purpose [13].

According to experts' forecasts, the global meat industry will reach a turnover of USD 21.23 billion by 2025 [14]. This indicates that the meat product market will continue to develop, and products will improve in terms of their quality and nutritional purpose [15].

The canned meat market development tendencies are determined by the course taken towards import substitution of meat products and the growth of domestic production, and an increase in the range of canned meat products offered by manufacturers [16].

Gorlov I.F., Slozhenkina M.I. et al. suggest introducing honey-nut extract and glycine into the standard meat pate formulation; this contributes to the enrichment of the meat product with a mixture of useful amino acids, vitamins, and tannins. The component introduced into the pate endows it with a pleasant taste and flavor. The inclusion of glycine in the recipe will increase the competitiveness of the meat product by increasing its shelf life. The developed pate allows replenishing animal proteins in the diet [17].

## **3. Practical significance**

The authors have developed a meat pate including beef trimmings as a source of fat and connective tissues. Goose liver gives taste and flavor, emulsifies fat, and acts as a stabilizer for minced meat emulsion. Pork jowl as a fat gives a spreading consistency to the pate for appearance. The broth is

required to replenish lost protein and aromatic compounds. Girasol was added as a special inulin-containing ingredient, which helps to lower blood cholesterol, increase the population of Bifidus bacteria in the colon, and lower blood sugar, lipoproteins, and triacylglycerols, and has a hypoglycemic effect, which is important for people with impaired metabolism [18]. It also contains branch chain amino acids such as valine, leucine, and isoleucine – essential acids of the BCAA group. These three amino acids make up about half of the human dietary reference protein intake. By creating a synergistic effect, they regenerate body tissues (except for bone and adipose ones) and protect them from natural decay. Branch chain amino acid (BCAA) additives taken before and after damaging resistance exercises increase protein synthesis and decrease muscle protein destruction, reduce the muscle damage rates, and accelerate recovery [19]. The use of BCAAs reduces fatigue and improves physical performance [19, 20].

**Table 1.** Composition of Pate Enriched with Branch Chain Amino Acids.

Raw material	Quantity, g
Beef trimmings	15
Goose liver	200
Pork jowl	5
Girasol of 'Interest' variety	7.5
Valine	2
Leucine	2
Isoleucine	1
Sodium nitrite	0.105
Cooking salt	0.7
Glutamic acid	0.5
Microbial proteinase (Staphylococcus carnosus)	75
Broth	50

The organoleptic technique used in the study gave the following properties to the product: pasty consistency, spreadable, homogeneous, without grains, beige color, pronounced sweet smell, typical girasol taste, the appearance of light brown mass with speckles. The pate mince is prepared in a hot process, where the required components are added in the below order: beef trimmings, raw goose liver, pork jowl, and girasol. Ready pate mince is enriched with valine, leucine, and isoleucine. The nutritional value of the pate developed is as follows: proteins – 32.3-34.5; fats – 82.0-83.3; carbohydrates – 1.1-2.1. The energy value of the product is 432/1,807 kcal/kJ.

The finished pate is packed in 150 g glass cans, which allows preserving the taste, quality, and safety of the goods. Pasteurization allows preserving the pate quality in glass cans for up to 90 days. The shelf life after opening the can is 24 hours.

The meat pate developed belongs to special food products since it contains BCAAs, glutamic acid stimulating protein metabolism, normalizing metabolism, and participating in the assimilation of other amino acids, and microbial proteinase (Staphylococcus carnosus) to tenderize meat products and creates a new food culture with the inclusion of essential amino acids to the typical semi-finished meat foods.

The analysis of the food safety study results has shown the need to implement a modern technique to comply with the current legal and regulatory documents for the provision and communication of information related to the type of feed, breeding of meet cattle on farms, transportation, meat processing plant, meat product processing, and storage until the sale at a retail outlet to the end consumer. Such measures will contribute to trust relations between the seller and the consumer and convenient delivery of information to commodity experts, veterinary and sanitary inspectors, and customs authorities. The author's solution is to create a data table containing information about the product with access by a QR code.

Table 2 provides a list of the meat pate data, which meets the requirements of regulatory documents and is posted in electronic format as a way to identify the product. The left and the right columns contain the identification parameters and the required information of them, respectively.

**Table 2.** Identification Information Exemplified by Meat Pate.

I Identification marks	Packer and/or Shipper: Name and physical address (e.g. street/city/district/postal code and country, if different from the country of origin) or a code mark officially recognized by the competent national authority
II The product nature	The product name specifying 'meat [meat-containing] product of (A, B) category'
III The product food chain	Information on nutrient additives containing antibiotics, xenobiotics, steroids. Type of processing the meat products at a meat processing plant. The product storage conditions
IV Commodity characteristics	Nutritional value according to Appendix B of GOST R 55334-2012 Meat and Meat-Containing Pates. Specifications. The product composition according to Appendix B of GOST R 55334-2012 Meat and Meat-Containing Pates. Specifications. Nutrient additives. Packing date. Net weight. Inscription: 'Vacuum packed' or 'Modified atmosphere packed' (if available in the package).

#### 4. Conclusion

The growing population requires manufacturing more products to replete meat nutrition deficiency in the human body. The pate developed is an alternative meat product with a high nutritional value: proteins – 32.3-34.5; fats – 82.0-83.3; carbohydrates – 1.1-2.1, and energy value of 432/1,807 kcal/kJ. Meat pate contains beef trimmings, goose liver, pork jowl, girasol, and branch chain amino acids (valine, leucine, isoleucine). This product will be relevant for people who support an active lifestyle, are professionally engaged in sports activities, or do not have enough time to prepare a complete meat dish.

As a solution to the issue of food safety of the product, it has been proposed to use a QR code, in which data are encrypted in a table format that allows providing comprehensive information to the consumer and thereby strengthen control over the traceability system and increase the responsibility of manufacturers in providing the product information. Consumers will be protected from falsification and obtain access to complete and reliable product data, comprehensive product information with a well-readable font.

The advantages of consumer information in a tabular format encrypted in a QR code are reduced area on the package, the lack of dependence on the package size, and posting data constituting 2.5 sheets of A4 paper in a link accessible via a QR code. Scaling the content on the smartphone screen is available. A QR code will display text even if 60 % of the image is damaged, while the label may have bends and folds that prevent reading.

An insignificant negative factor may be the need for connection to the Internet to display data encrypted in the QR code on a smartphone or a retail terminal.

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