Technical Sciences

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SPHERIFICATION AS A PROSPECTIVE TECHNIQUE OF PRODUCT PRODUCTION AT RESTAURANTS

Annotation. The paper presents the results of practical researches of spherification as an innovative technique of molecular gastronomy which enables to provide the traditional dishes and culinary products the unusual appearance without changing their nutritional and biological value.

Key words: spherification, molecular technologies, sodium alginate, calcium chloride, spheres, daily requirement, organoleptic evaluation.

I. Introduction. Molecular cuisine or molecular gastronomy is a scientific direction that researches the physical and chemical processes that occur in cooking and social, artistic and technical components of culinary and gastronomic phenomena in general, and from a scientific point of view. There are many techniques of molecular gastronomy including spherification.

The idea of molecular gastronomy is using the reactions that result is the decomposition product molecules (deconstruction – «breaking food apart»), then «putting» them together in a new way – feeling the usual taste in unusual form. However, the term «molecular gastronomy» is not quite correct, because the chef does not work with individual molecules but work with the chemical composition and the aggregate state of products [1].

Based on the price of other techniques of molecular gastronomy, spherification that does not require expensive equipment has been selected.

II. Statement of the problem. The main task of molecular technology is creating a whole new appearance culinary dishes and products with low energy value and high biological value.

Features of molecular technology: presentation the taste properties of products in non-standard form (foams, emulsions, gels, spheres), serving the several types of dishes (12 to 30) in small portions, and the impact of flavour (the quantities and concentration of aromatic substances) on the taste of the final product and the effect of cooking method on the organoleptic properties of the dish (taste, aroma, texture). It allows intensifying the sensations of taste, smell and texture of dish in the perception of the consumer and investigating how our enjoyment of food depends on factors such as environment, mood, show serving of dishes and more.

The aim of our researches has been the study of incorporation prospects of spherification technique at domestic restaurants, as well as establishing common organoleptic quality parameters for this technique.

With the aim of achieving this goal it has been necessary to solve the following problem: consider international experience of using spherification in restaurant product technologies; develop and prepare dishes with their subsequent organoleptic evaluation; study nutritional and energy value of food; compare the results with conventional qualities.

III. Results. Spherification as a technique of molecular gastronomy has been introduced by the famous executive chef Ferran Adria in the 2003s. It is a process of controlled jellification of a liquid that based on the reaction between calcium chloride and sodium alginate. The reaction probably occurs under the scheme [2]:

$$2NaA\lg + Me^{2+} \leftrightarrow MeA\lg_2 + 2Na^+,$$

Where Alg – residues of alginic acid.

There are two main kinds of spherification techniques such as the basic and reverse techniques and each of them has its advantages and disadvantages which make them more suitable for certain technologies at restaurants. It has been chosen the basic spherification for practical research.

The basic spherification technique consists of submerging a liquid (tea, juice, milk, etc.) with sodium alginate (in the amount to 1/3 of the main ingredient) in a bath of calcium (0,5 % respectively) and rinsing it with clean water. Blending is made with an immersion blender until the sodium alginate is dissolved before the adding the main ingredient. Then the solution is kept at 4-6 ^{o}C for 1 hour to eliminate the air bubbles created by the immersion blender.

For thick (puree) fluids before administration of sodium alginate to the main ingredient is added water to obtain the right consistency for spherification. The basic spherification process does not work if the main ingredient is too acidic (PH<5). The acidity can be reduced by adding sodium citrate to the main ingredient (if watery liquid) or the water used to reduce the main ingredient density (if thick liquid).

The mixture is carefully poured using a measuring spoon of the desired size (it depends on the shape and size of products such as ravioli, gnocchi, etc.) into the prepared bath of calcium in nearly horizontal position with the minimum distance between water and measuring spoon to create a perfectly round shape. The sphere is carefully removed from the calcium bath after obtaining the desired texture (1…2 min) using a slotted spoon and rinse it in the bowl with clean water (It isn't used tap water). The basic spherification technique is ideal for obtaining spheres with a very, very thin membrane that is almost imperceptible in the mouth. And the thinner the membrane is, the better the flavour properties. The main problem of this technique is that once the sphere is removed from the calcium bath, the process of jellification continues even after rinsing the sphere with water. This means that the spheres need to be served immediately or they would convert into a compact gel ball with no liquid inside [3-5].

It has been created the following dishes using the basic spherification:

- 1-dish – Pea boom;
- 2-dish – Spring mix;
- 3-dish – Apple temptation.

Ingredients for the 1-dish: frozen peas, carrot, greens and chicken broth. It is proposed to serve with a slice of tomato on a crust of bread (Figure 1). **Ingredients** for the 2-dish: tomato, carrot, cabbage, pepper, salt and boiled chicken. It is proposed to serve on a crust of bread (Figure 2). **Ingredients** for the 3-dish: apples, apricots, sugar syrup. It is served with biscuits (Figure 3).

Taking into account the results of experimental studies and common requirements we have developed a modified system of criteria for organoleptic evaluation indexes of cooked dishes (Table 1). Cooked dishes answered the developed requirements for organoleptic characteristics.

Figure 1 – Pea boom

Figure 2 – Spring mix

Figure 3 – Apple temptation

Table 1 **– Organoleptic evaluation criteria for developed dishes**

Index	Requirements for quality and design of dish
Appearance	small round sphere (capsule), uniform colour, characteristic for main product ingredient with a smooth elastic surface;
Flavour	flavourless that is associated with the presence of the membrane on the surface of dish;
Colour	characteristic for the ingredients of spheres;
Taste	inherent to ingredients without additional flavour of food additives (sodium alginate and calcium chloride);
Consistence	capsule, which has a thin film (membrane) on the surface of the main product (spheres), which is destroyed by interaction with the saliva in the mouth of the consumer, the liquid inside.

The next stage of researches has been the determination of nutrient content in developed dishes and compared their quantities with daily human needs (Table 2).

Table 2 – Comparison of nutrient content in dishes (100 g)

1-dish				**2-dish**			**3-dish**		
Nutrient	**Total content**	**Daily requirement**	**% daily requirements**	**Total content**	**Daily requirement**	**% daily requirements**	**Total content**	**Daily requirement**	**% daily requirements**
Proteins, g	7,3	85	8,6	5,99	85	7,0	2,211	85	2,6
Fats, g	0,796	80	1,0	0,96	80	1,2	0,40496	80	0,5
Carbohydrates, g	18,636	400	4,7	116,83	400	29,2	6,775	400	1,7
Na, mg	327,46	1300	25,2	46,2	1300	3,6	52,13	1300	4,0
K, mg	261,1	2500	10,4	2003,4	2500	80,1	361,92	2500	14,5
Ca, mg	39,14	1000	3,9	179,2	1000	17,9	37,46	1000	3,7

Mg, mg	33,89	400	8,5	114,6	400	28,7	25,31	400	6,3
P, mg	81,41	800	10,2	162	800	20,3	42,4	800	5,3
Fe, mg	2,248	10	22,5	5,66	10	56,6	1,04	10	10,4
β-carotene, mg	1908	5000	38,2	3530,9	5000	70,6	2808	5000	56,2
A, μg	318,2	1000	31,8	591,7	1000	59,2	468,1	1000	46,8
E, mg	0,567	15	3,8	5,73	15	38,2	1,614	15	10,8
B1, mg	0,1593	1,5	10,6	0,132	1,5	8,8	0,0834	1,5	5,6
B2, mg	0,0995	1,8	5,5	0,228	1,8	12,7	0,0837	1,8	4,7
PP, mg	0,909	15	6,1	3,32	15	22,1	1,061	15	7,1
C, mg	3,35	90	3,7	14	90	15,6	111,264	90	123,6
Energy value, kcal	110,75	2000	5,5	507	2000	25,4	59,07	2000	3,0

The results of theoretical calculations of nutritional and energy values indicate that the developed low-calorie dishes are a valuable source of macro- and micronutrients for the human body that provides the basic needs of nutrients, aesthetic satisfaction and guarantees a pleasant surprise (release the main ingredient in the mouth) during consumption of dish .

IV. Conclusions. Thus, the low-calorie dishes with high biological value using the basic spherification and according to current recommendations of healthy nutrition have been developed. Inclusion of molecular gastronomy dishes to the menu of domestic restaurants is an innovative direction which will increase their competitiveness in the market.

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