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UTILIZATION OF COLLAGEN ISOLATE AS A CARRIER OF POTASSIUM IODIDE IN PRODUCTION AND STORAGE OF DISHES FROM TURKEY MEAT

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ABSTRACT

In the work an isolate of connective tissue (collagen) was used as a carrier of potassium iodide to increase the retention of iodine introduced into dishes made from turkey meat. Two kinds of dishes, it means cooked meat balls and fried meat balls which after thermal treatment were kept under chilling and frozen conditions were took into account. The selected variants of the thermal treatment have shown, that the cooking resulted in higher losses of iodine as the frying process. After the thermal treatment, almost 40% higher content of iodine in fried meat balls in comparison to its content in cooked meat balls was found. Type of iodine carrier, that is collagen

isolate or NaCl, did not influenced in essential way on the range of losses of this element during thermal treatment. However the storage of both types of dishes has shown, that collagen isolate impregnated with potassium iodide garantees about 30% greater retention of iodine in dishes than the use of iodized table salt.

Key words: collagen, iodized table salt, iodine carrier, iodine retention, food enrichment

INTRODUCTION

The average human diet is usually burdened by deficiency of essential nutritional components what is result of bad nutritional habits, low content of some components in vegetable and animal raw materials and their losses during technological treatment connected with transformation of raw materials into the product.

Iodine is one of important microelements, which deficiency in diet influences in essential way on the health of human population. The significant role of iodine in the physiology of man results from participation of this element in the synthesis of thyroid hormones (thyroxin and triiodothyronine), which control a lot of metabolic transformations, including among other energetic processes and development and working of nervous system. The deficiency of iodine leads to formation of various health troubles, which commonly are defined as Iodine Deficiency Disorders (IDD). To serious consequences of prolonged deficiency of iodine are especially subjected women, children and young people [14].

Basic method to eliminate iodine deficiency is the direct fortification of food products with iodized table salt (NaCl). As source of iodine in table salt are usually used potassium iodide, more seldom the potassium iodate or the sodium iodide. The potassium iodide possesses all advantages as enriching substance, it means it is inexpensive compound and easily absorbed from alimentary tract. However this compound is also unstable and easily can be oxidized to free iodine, what decreases its content in the table salt. The stability of potassium iodide content in iodized table salt can be significantly affected by the following factors: the moisture in the salt, the pH-value and presence of impurities. The humid and excessive aeration of environment and the exposure to sunlight, ultra-violet light or heat are undesirable factors for stability of this compound, too [2]. During production of iodized salt, in the aim to limit iodine losses, suitable protective packaging materials are used, and in some countries the use of stabilizing, buffering or drying additives is allowed. Losses of iodine as result of sublimation are connected also with preparing dishes and manufacturing food products [6]. For this reason, come into being the necessity to elaborate new solutions for decreasing iodine losses resulted from technological operations and/ or the storage of the enriched food products.

Collagen as fibrous protein of connective tissue, is commonly used in food processing industry in production of gelatin and sausages casings. Preparations produced from collagenous raw materials are used to form qualitative properties of meat products. Collagen used in form of grounded (raw or scalded) pieces of skin or preparations from skin of slaughter animals as additive to scalded sausages influences positively on functional and technological proprieties of meat batter and final product, too. Collagen binds water added to the batter and increases its waterbinding ability. Collagen limits also thermal losses and improves juiciness, tenderness and yield of final product [4, 12]. Collagen preparations are applied also in production of functional food, which diminishes risk of falling ill on so-called civilization diseases like arteriosclerosis and hypertension. The ability of collagen to bind and to keep added water was utilized in production of meat products with lowered content of fat [1,3]. The use of connective tissue hydrolyzates in production of sausages and the dishes

creates a possibility to reduce NaCl content in these products as result of profitable influence of hydrolyzates on their structure and sensory features [5, 9].

The work presented below is an attempt to estimate the possibility of collagen utilization in production of meat dishes enriched with iodine. The aim of work was to estimate the influence of collagen isolate on the retention of iodine during thermal treatment of dishes made from minced turkey meat and after their storage under chilling and frozen conditions. As factor of technological variability the process of cooking (cooked meat balls) and/or frying (fried meat balls) was selected.

MATERIALS AND METHODS

The turkey meat purchased from the retail – sale shop was used as raw material in this study. The choice of turkey meat resulted from more and more greater popularity of this kind of meat among consumers on Polish market. Carcass parts like breasts, thighs and shanks without bones were milled (diameter of mesh was equal to 3 mm). The minced meat from breasts and thighs with shanks was blended together keeping proportion as 1 : 1 (w/w). This raw meat was used to prepare two types of dishes cooked meat balls or fried meat balls.

Dishes of each type were prepared in three variants contained different additives (in % of meat mass):

- variant 1 - 2% of table salt iodized with potassium iodide
- variant 2 - 2% of collagen isolate and 2% of table salt iodized with potassium iodide,
- variant 3 - 2% of collagen isolate impregnated with potassium iodide and 2% of table salt.

The iodized salt used to preparation of dishes was produced in Salt-Mine Wieliczka (due to obligatory Polish standard PN-86/C-84081) and it contained 30±10 mg KJ/kg of salt. Collagen isolate was prepared from external epimysium of *m. longissimus dorsi* due to the method of Kopp [7]. Preparation of collagen isolate contained the following steps: cleaning of epimysium, grinding, removing of fat and freeze-drying. The obtained isolate was characterized with the following chemical composition: total protein - 91% (N×5.55), collagen - 80.5%, water -9.2%, fat - 0.3% and ash - 0.4%. Collagen isolate was introduced to the meat mass in the hydrated form and the relation of preparation to water was as 1: 4 (w/w). Part of collagen isolate was impregnated with potassium iodide. Impregnation has been done by saturation of isolate in solution of potassium iodide with concentration 7.5 mg KJ /100 g and weight relation of collagen preparation to solution was as 1 : 4. The process of impregnation was stopped when the total absorption of solution by the isolate was found. Impregnation parameters (concentration and quantity of potassium iodide solution) have been selected in this way, that the quantity of iodine introduced to products together with impregnated isolate was the same as quantities of iodine introduced with iodized salt.

To ensure identical conditions determining thermal treatment, all prepared dishes were characterized with similar mass (about 50 g) and with similar geometrical shape.

The process of thermal treatment was conducted using traditional methods. The cooking of meat balls was started after the water had been boiled and it was persisted by 15 minutes (the relation of water volume to mass of meat balls was as 3 : 1). Another part of meat balls were fried at 10 minutes using the plant origin fat "Planta" for frying. The cooked meat balls and

fried meat balls were next kept under chilling conditions (temperature +4°C) by the period of 6 days or under frozen conditions (-18°C) by 20 days. The choice of storage conditions of meat dishes resulted from increasing demand for products ready to eat after heating, which are kept under chilling or frozen conditions to their consumption.

In dishes, immediately after thermal treatment and after end of storage time, contents of iodine were determined. The content of inorganic iodine was determined due to the method elaborated by Kühne and Wagner [8]. This method based on the water extraction of iodine ions and their colorimetric determination with utilization of catalytic activity of iodides in the reaction of thiocyanate oxygenation by nitrite ions in presence of nitric acid (according to the method of Moxon and Dixon [10]). Content of iodine was expressed in micrograms per 100 g of product.

Obtained results were subjected to statistical analysis, using one factor analysis of variance and Tukey's test on significance level equal to p=0.01.

RESULTS AND DISCUSSION

The retention of iodine introduced in form of potassium iodide to the meat batter, which was used for preparation of cooked balls and minced fried balls, was evaluated based on changes of inorganic iodine content in products after thermal treatment and storage [Table 1 and 2].

Table 1.

TECHNOLOGICAL VARIANT	CONTENT OF IODINE IN MICROGRAMS PER 100 G OF PRODUCT								
	KIND OF USED ADDITIVE								
	2% of salt iodized with potassium iodide			2% of collagen isolate impregnated with potassium iodide and 2% of NaCl			2% of collagen isolate and 2% of salt iodized with potassium iodide		
	X	±S	%	X	±S	%	X	±S	%
Cooking	60.7[a*]	9.2	100	56.4[a]	2.7	100	53.8[a]	0.7	100
Storage under chilling conditions (+4°C, 6 days)	33.6[c]	3.4	55	45.3[a]	2.1	84	39.3[b]	1.1	70
Storage under frozen conditions (-18°C, 20 days)	35.2[b]	2.1	58	49.0[a]	2.9	87	45.8[a]	2.4	85

Legend:
*** - mean values in the same lines with different letters are significantly different (p<0.01);**
letters means: a- the highest content of iodine, c- the lowest content of iodine;
X - mean value (number of replicates: n=12);
S - standard deviation;
% - iodine content in relation to iodine content in product directly after thermal treatment.

Table 2.

TECHNOLOGICAL VARIANT	CONTENT OF IODINE IN MICROGRAMS PER 100 G OF PRODUCT								
	KIND OF USED ADDITIVE								
	2% of salt iodized with potassium iodide			2% of collagen isolate impregnated with potassium iodide and 2% of NaCl			2% of collagen isolate and 2% of salt iodized with potassium iodide		
	X	±S	%	X	±S	%	X	±S	%
Frying	95.6^{ab*}	8.6	100	99.2^{a}	9.9	100	88.6^{b}	1.9	100
Storage under chilling conditions (+4°C, 6 days)	56.6^{c}	3.1	59	89.5^{a}	3.9	90	75.5^{b}	3.0	85
Storage under frozen conditions (-18°C, 20 days)	47.3^{c}	0.8	49	88.5^{a}	2.4	89	67.4^{b}	0.8	76

Legend:
*** - mean values in the same lines with different letters are significantly different ($p<0.01$);**
letters means: a- the highest content of iodine, c- the lowest content of iodine;
X - mean value (number of replicates: n=12);
S - standard deviation;
% - iodine content in relation to iodine content in product directly after thermal treatment

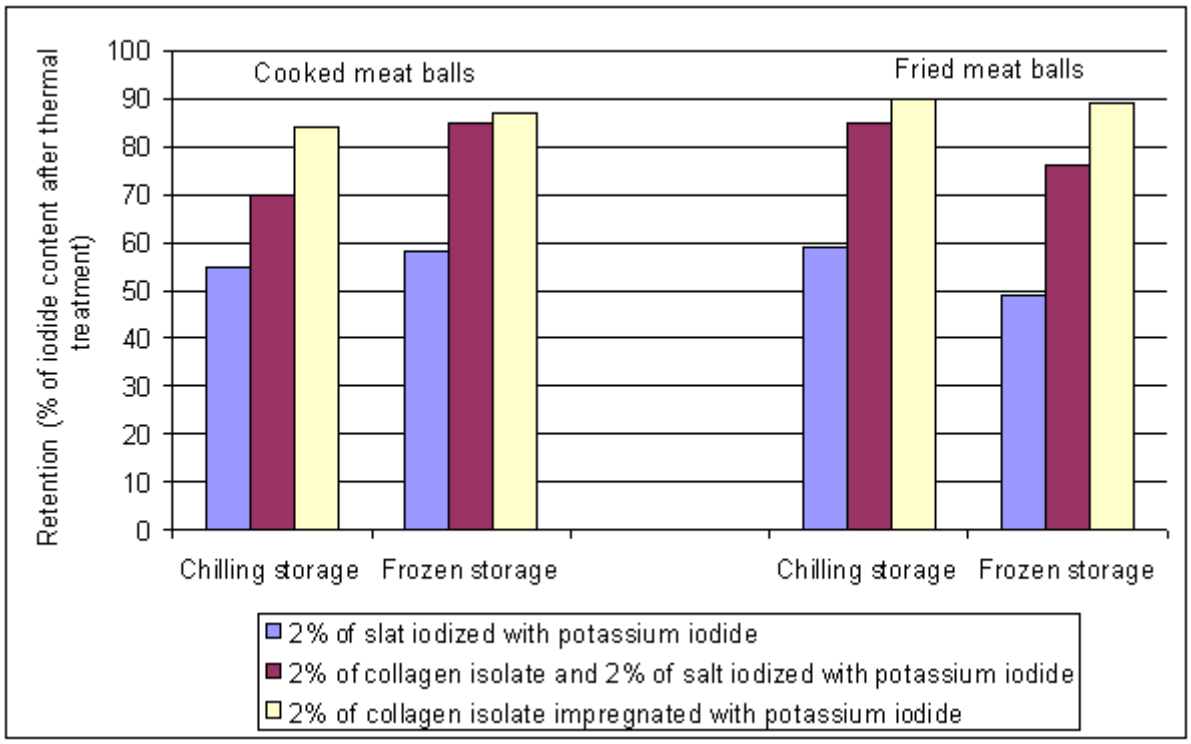
The content of iodine in meat dishes was first of all determined by the kind of thermal treatment. Changes which took place during cooking process caused higher losses of iodine in comparison to frying, so it resulted in about 40% lower content of iodine in cooked meat balls in comparison to its content in fried meat balls. The detrimental influence of cooking on retention of iodine in meat dishes should be explained by possibility of its ion migration from the product to external environment together with thermal drip. Traditional method of cooking in water is especially conducive to this phenomenon. Previous experiments indicated, that the replacement of water in process of cooking by aqueous vapour (*e.g.* in convection oven) influences positively on the retention of iodine in the cooked meat dishes [15].

Type of carrier of potassium iodide, that is collagen isolate or table salt, didn't affect on losses of iodine during cooking and frying. After thermal treatment no significant differences were found concerning contents of iodine among selected variants of cooked meat balls and fried meat balls.

The chilling and frozen storage of cooked meat balls and fried meat balls resulted in decreasing of the iodine content in both dishes. These loses could be due to oxidation of potassium iodide to free iodine and next iodine evaporation from products. However Kü hne and Wagner [8] showed, that some iodine introduced to meat system can be bound by organic compounds.

There was observed a distinct influence of collagen isolate on retention of iodine during storage under chilling or frozen conditions of both meat dishes. [tables 1 and 2, figure 1].

Figure 1.



Cooked meat balls and fried meat balls, which were enriched with this element be mean of collagen isolate impregnated with potassium iodide were characterized by highest retention of iodine. About 30% lower losses of iodine was observed in variants of dishes containing this additive than in one containing iodized table salt . In fried meat balls kept 20 days under frozen conditions the iodine retention was even about 40% higher.

The use of not impregnated collagen isolate and iodized table salt together resulted also in lowering of iodine losses during storage of dishes, however this influence was a little weaker. In comparison to variants containing iodized table salt only, after 6 days of storage of chilled cooked meat balls and fried meat balls iodine retention was higher about 15% and 26%, respectively. However, after 20 days of frozen storage in case of both dishes this value was even equal to 27%.

The above results shown, that the collagen isolate efficiently limited losses of iodine during storage of the meat dishes. Protective activity of collagen related to functional proprieties and specific structure of this protein. The characteristic property of collagen is the high waterbinding ability, which results from its primary structure. Numerous investigations of aminoacid composition of connective tissue proteins [11, 13, 16] show, that collagen contains large quantity of amino acids with hydrophil groups, which bind water by hydrogen - and ionic bonds. The potassium iodide used commonly as a source of iodine for enrichment of food products is not stable and can easily sublimate. One of essential factors, which is conducive to this phenomenon is the moisture of surrounding environment [2]. It should be suppose, that the collagen isolate which was introduced to the product absorbed and bound contained water, limiting in this way its contact with the potassium iodide.

An important part for efficient limitation of iodine losses probably had also the thermohydrolyse of collagen, which take place during thermal treatment of meat products. The process of thermohydrolyse led to unfolding protein structure, made functional groups of protein more accessible and caused an additional increase of collagen waterbinding ability. Second effect of thermohydrolyse was creating of framework from solubled collagen protein, which held the remaining compounds in a definite position. Thanks occlusion that is adsorption keeping iodine ions inside its structure, the collagenous framework created barrier which protected iodine against activity of external factors and limited its sublimation.

It should be supposed, that the impregnation of collagen isolate before its introduction to dishes made from minced meat, simplified the contact between protein and the iodine ions and increased the penetration degree of this ions into internal structure of collagen. This resulted in higher retention of iodine in dishes contained this form of isolate compared with dishes contained nonimpreganted collagen isolate used together with ionized table salt.

Taking into account the influence of thermohydrolyse also allowed to explain why the positive activity of collagen isolate occurred only when the meat dishes were stored, it means after their thermal treatment.

The desirable influence of collagen onto iodine retention should be treated as the next specific functional property of this protein, which can be utilized in technological practice for improvement of the quality of dishes and meat products. Change of society life style connected with the civilization progress, caused the increase of demand on convenient food intended to directly consumption. The use of collagen isolate in this type of products, fortified in iodine, would allow to improve not only their sensory properties, but also their nutrition value. The limitation of iodine losses during storage of the final meat dishes enriched in this deficit compound would also influence on more effective realization of tasks resulting from long term iodine deficiency control programmes carried on in many countries of the world.

CONCLUSIONS

1. Cooking of turkey meat (in form of cooked meat balls) result in about 40% higher iodine losses than its frying (as fried meat balls), independently from kind of potassium iodide carrier used, that is impregnated collagen isolate or iodized table salt.
2. Chilling or frozen conditions during storage of cooked meat balls and fried meat balls from turkey meat manufactured with 2% addition of collagen isolate impregnated with potassium iodide ensured the increasing iodine retention about 30% in comparison to the use of iodized table salt.
3. The use of collagen isolate impregnated with potassium iodide to prepare meat batter for cooked meat balls and fried meat balls guarantee not only technological advantages but also enrichment of these dishes with iodine, what is especially important in production and storage of the dinner dishes.

REFERENCES

1. Adamczak L., Ruciński M., Słowiński M. (1999): Nisko tłuszczowe produkty mięsne. Mięso i Wędliny 1, 26.
2. Diosady L. L., Mannar M. G. V., Stone T. (1997): Stability of iodine in iodized salt used for the correction IDD. Food and Nutrition Bulletin 18, 4, 388.
3. Eliert S. J., Mandigo R. W. (1996): Phosphate and modified beef connective tissue effects on reduced fat, high water-added frankfurters. Journal of Food Science 61, 5, 1006.
4. Haack E., Warnecke H.W. (1998): Verwendung von aufbereiteter Schwarte bei der Herstellung von Fleischerzeugnissen. Fleischwirtschaft 78, 1, 30.
5. Hofman K. Marrgarander K. (1989): Reducing the common salt content of meat products by using collagen hydrolyzates. Fleischwirtschaft 7, 1135-1138.
6. Janizt W., Szymandera-Buszka K. (1997): Wzbogacanie żywności w jod. Przemysł Spożywczy 7, 12.
7. Kopp J. (1971): Einfluss von Temperatur, Kochzeit und Kochsalzkonzentration auf Löslichkeit des Kollagens im Schweinemuskel. Fleischwirtschaft 51, 1647.
8. Kühne D., Wirth F., Wagner H. (1993): Jodbestimmung in jodierten Fleischerzeugnissen. Fleischwirtschaft 73, 2, 175-178.
9. Marrgrander K. (1996): Collagen proteins as excipients for the improvement of the technological and sensory properties of meat products and ready meals. Fleischwirtschaft 7, 725-726.
10. Moxon R. E. D., Dixion E. J. (1980): Semi-automatic method for the determination of total iodine in food. Analyst 105, 344-352.
11. Neuman R. E. (1949): The amino acid composition of gelatin, collagens and elastins from different sources. Archives of Biochemistry 24, 289-298.
12. Pietrasik Z., Duda Z. (1999): Wpływ preparatu kolagenu wytworzonego ze skór świńskich na wybrane wyróżniki technologiczne kutrowanych kiełbas parzonych. Mięso i Wędliny 4, 40.
13. Slack H. G. B. (1959): Some notes on the composition and metabolism of connective tissue. American Journal of Medicine 26, 113-124.
14. Stoś K. Respondek W. (1996): Zagrożenia zdrowia związane z niedoborem jodu i zapobieganiem im na drodze żywieniowej. Żywność, Żywienie a Zdrowie 3, 43-48.
15. Waszkowiak K., Szymandera-Buszka K. Janitz W., Górecka D. (1999): Comparative evaluation of nutritive and sensory value of selected raw materials and dishes after thermal processing in a convection oven and with conventional methods. Electronically Journal of Polish Agricultural Universities, Food Science and Technology 2, 2, 1-10.
16. Zarkades C. G., Yu Z., Zarkades G. C., Minero-Amador A. (1995) Assessment of protein quality of beefstock bone isolates for use as ingredient in meat and poultry products. Journal of Agricultural and Food Chemistry 43, 77-83.

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