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IODINE RETENTION IN GROUND PORK BURGERS FRIED IN FAT FREE CONDITIONS

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Abstract. The aim of the work was determination of the effect of the conditions of thermal processing and storage of ground pork burgers with an addition of iodized salt and soy hydrolizate on quantitative and qualitative changes in iodine and sensory parameters of the product. Conditions of thermal processing, traditional frying with fat and fat free frying with enforced circulation of hot air were taken as variable. The results indicated that heat processing of the ground meat, irrespective of the used method, lowered total and inorganic iodine content within the range of 18-30%. Application of the traditional frying caused greater losses of the total iodine by about 7%, and of the inorganic one by 5% as compared to fat free processing. During storage of the samples at 4°C greater stability of the total iodine was observed as compared to freeze storage. Addition of soy hydrolizate brought about lowering of the losses of both total and inorganic iodine during thermal processing by 8%, and during storage by about 5%. Sensory analysis did not reveal significant differences between the burgers fried in a traditional and fat free way.

Key words: pork, iodinated salt, soy hydrolizate, fat free frying, storage

INTRODUCTION

In the diet of a contemporary man there are deficits of many mineral components, particularly of iodine, the element necessary for correct synthesis of thyroid hormones. The negative results of this deficiency are particularly harmful for newborns, infants and youths in which it causes the greatest metabolic disturbances resulting in retarded mental development and even irreversible changes in the nervous system. The deficiency of this element occurs also in Poland. A common way to overcome iodine deficiency on the areas where it naturally appears in low quantities is iodination of kitchen salt. In Poland iodine is introduced into table salt among others as potassium iodide (in the amount of 30 ± 10 mg/kg salt). Potassium iodide besides having many advantages as an enriching substance is little stable and can be easily oxidized to free iodine which lowers its content in the kitchen salt. Losses of iodine also take place during production of

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dishes and products to which iodinated kitchen salt is added [Janitz and Szymandera-Buszka 1997, Waszkowiak et al. 1999]. These phenomena lower the effectiveness of the salt iodination method in elimination the iodine deficiency disorders. Therefore a need appeared to determine the degree of iodine retention during technological processes and storage of products, and to work out new solutions which would limit its losses.

The aim of the work was to determine the effect of the conditions of thermal processing and storage of ground pork burgers with an addition of iodinated salt and soy hydrolizate on quantitative and qualitative changes in iodine and sensory parameters of the product. As variable, conditions of thermal processing traditional frying with fat and fat free frying with enforced circulation of hot air were taken.

MATERIAL AND METHODS

The test material was pork – neck – bought from an anonymous producer. To obtain tissue homogeneity of the material it was ground and then the remaining components were introduced according to recipe [Waszkowiak et al. 2001]. The salt iodinated with potassium iodide (containing 30.22 mg KJ/kg) was added to the meat mass in the amount of 2% of the mass. The test material prepared in such a way was divided into two parts. To one part soy protein hydrolizate (with the total nitrogen content of 1.96% and the amino nitrogen 1.70%) was added, also in the amount of 2% of the mass.

To maintain uniform conditions determining kinetics of thermal processing the samples of similar mass (50 g ± 1 g) and geometric shape were formed, and then they were subjected to thermal processing using traditional and fat free frying. The traditional process was carried out for 10 min using hardened plant fat "Planta", and fat free frying in an appliance (Elektrim type AX-707A) using enforced circulation of air at 210^{o}C for 15 min.

Hence the following variants of the product were obtained:

– traditional frying
  – NaCl+KJ,
  – NaCl+KJ+soy hydrolizate,
– fat free frying
  – NaCl+KJ,
  – NaCl+KJ+soy hydrolizate.

The prepared samples were stored in cool (temp. 4°C) and freeze (–18°C) storage for 5 and 30 days. Directly after production and storage time quantitative changes in the total and inorganic iodine were determined with a macro chemical method with potassium thiocyanate [Kühne et al. 1993, Moxon and Dixon 1980]. The chemical composition (that is water, fat and protein content) of the raw meat mass and burgers prepared by both frying methods was also estimated. The water content was determined with a drier method [PN-ISO 1442], the fat one with extraction – weight method according to Soxhlet using petroleum ether as a solvent [PN-ISO 1444], and the protein content with the Kjeldahal method [PN-75/A-04018]. Total nitrogen was recalculated into protein using 6.25 multiplier.

To determine the possibility of using fat free frying, after thermal processing a sensory evaluation of the burgers with triangular method with indication was taken. For the evaluation, a panel of 8 persons was selected in which each was given three sets of

randomly coded samples [Baryłko-Pikielna 1975, Gawęcka and Jędryka 2001, ISO 4120 1983, PN-ISO 6658 1998].

The results were subjected to variance analysis [Gawęcki and Wagner 1984] with Tukey's test using the STATGRAPHICS software.

RESULTS AND DISCUSSION

From the results it can be stated that the kind of a heating medium affects retention of both the total and inorganic iodine, as well as chemical composition of burgers.

In case of chemical compositions of burgers the greatest influence of the kind of thermal treatment on fat content was observed. The introducing of fat during traditional frying increased fat content from 13% in raw meat mass to 20% in burgers. However the use of frying by hot air as heating medium caused in flowing out of fat from products and decreasing its content to 8%

During traditional frying, the iodine losses were observed up to 30% in the samples without soy hydrolizate and 29% in the ones with it (Tab. 1). In the case of inorganic iodine these losses were 29% and 20%, respectively. Frying without fat enabled a significant lowering of the losses of both the total and inorganic iodine. In the samples without addition of soy hydrolizate it was found that the losses of the total iodine fell by 4% and of the inorganic one by 5% as compared to traditional frying, while with an addition of soy hydrolizate these losses fell by 10% and 12%, respectively.

The results support the trends observed in earlier studies on the effect of heating medium on iodine retention during thermal processing, stating that application of hot air in frying process (e. in a convection oven) significantly lowers iodine loss [Waszkowiak et al. 1999].

Table 1. Quantitative changes in total and inorganic iodine in ground pork burgers during heat processing
Tabela 1. Zmiany ilościowe jodu ogólnego i nieorganicznego w mielonych kotletach wieprzowych podczas ogrzewania

Technological way, meat fried Warunki obróbki, mięso smażone		Iodine content – Zawartość jodu			
		total – ogólny		inorganic – nieorganiczny	
		µg/100 g	%	µg/100 g	%
Traditionally Tradycyjnie	NaCl + KJ	49.86^{d}	70	29.50^{d}	71
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	55.86^{b}	71	34.45^{b,a}	80
Without fat Beztłuszczowo	NaCl + KJ	52.36^{c,b}	74	31.24^{c}	76
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	63.73^{a}	81	35.53^{a}	82

% – iodine content in comparison with iodine content in raw meat.
The means marked with different letters in the same column are statistically significantly different at $p < 0.05$.
% – zawartość jodu w odniesieniu do zawartości jodu w mięsie smażonym.
Średnie oznaczone różnymi literami w tych samych kolumnach różnią się statystycznie istotnie ($p < 0,05$).

During storing ground pork burgers in cool and freeze storage conditions for 5 days, a significant effect of the storage type, as well as introducing of hydrolizate into products, on iodine retention was found (Table 2).

Table 2. Quantitative changes in total and inorganic iodine in ground pork burgers during cool and freeze storage
Tabela 2. Zmiany ilościowe jodu ogólnego i nieorganicznego w mielonych kotletach wieprzowych podczas przechowywania chłodniczego i zamrażalniczego

Technological way, meat fried Warunki obróbki, mięso smażone		Iodine content – Zawartość jodu			
		total – ogólny		inorganic – nieorganiczny	
		µg/100 g	%	µg/100 g	%
Storage, 4°C/5 days – Przechowywanie, 4°C/5 dni					
Traditionally Tradycyjnie	NaCl + KJ	47.60^{d}	95	13.79^{d}	47
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	52.33^{b,c}	94	17.63^{b,c}	51
Without fat Beztłuszczowo	NaCl + KJ	50.81^{c}	97	15.43^{c}	49
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	62.37^{a}	98	18.68^{a}	53
Storage, –18°C/5 days – Przechowywanie, –18°C/5 dni					
Traditionally Tradycyjnio	NaCl + KJ	43.50^{d}	87	28.03^{d,c}	95
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	50.29^{b,c}	90	31.52^{b}	91
Without fat Beztłuszczowo	NaCl + KJ	47.18^{c}	90	29.27^{c,b}	94
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	59.52^{a}	93	34.51^{a}	98
Storage, –18°C/30 days – Przechowywanie, –18°C/30 dni					
Traditionally Tradycyjnie	NaCl + KJ	30.50^{d}	61	24.92^{d}	84
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	39.25^{b}	70	28.06^{b,c}	81
Without fat Beztłuszczowo	NaCl + KJ	36.23^{c}	69	26.56^{c}	85
	NaCl + KJ + soy hydrolizate NaCl + KJ + hydrolizat soi	47.16^{a}	74	30.37^{a}	86

% – iodine content in comparison with iodine content in raw meat.
The means marked with different letters in the same column are statistically significantly different at $p < 0.05$.
% – zawartość jodu w odniesieniu do zawartości jodu w mięsie smażonym.
Średnie oznaczone różnymi literami w tych samych kolumnach różnią się statystycznie istotnie ($p < 0,05$).

In cool storage the losses of the total iodine in the burgers fried in a traditional way reached 5%, while in the fat free variant 3%. Similar situation was observed during the storage of burgers which was prepared with addition of soy hydrolizate, but in the variants the losses of iodine was lower about 1% in case of total iodine and 4% in case of inorganic one.

Evaluation of the inorganic iodine indicated that during storage at 4°C there is a high fall in its content despite lower losses of the total one. A similar trend was not observed in freeze storage of the burgers. This phenomenon should probably be related to transformations during which the inorganic iodine binds to organic compounds, e.g. proteins [Kühne et al. 1993].

Freeze storage increased the losses of total iodine as compared to the cool one. In the variants frying by traditional method the losses of the total iodine increased to 13% in burgers without soy hydrolizate and 10% with it.

The using of free fat frying as thermal treatment caused the decreasing of total iodine losses to 10% in burgers without soy hydrolizate and 7% in burgers with it.

Investigations into the effect of storage time at –18°C on iodine retention revealed that prolongation of the storage to 30 days deepens the losses in the burgers fried traditionally from 13% to 39%, and in the samples with soy hydrolizate to 30%. In the variants with fat free frying these losses were less and amounted to 31% and 26%, respectively. In the case of the inorganic iodine an increase in the losses of the studied element by about 11% were observed irrespective of the variant used, as in cool storage, is probably connected with conversion of inorganic iodine to forms binding with proteins,

The results of sensory analysis of the burgers did not show a significant effect of the applied frying method on the product quality. Nor a significant effect of an addition of soy hydrolizate was found.

These sensory analysis results indicate that fat free frying using hot air as heating medium can successfully replace traditional process securing at the same time higher retention of iodine in meat products. Limiting iodine losses due to application of this method would enable more effective program for elimination of iodine deficiency disorders.

CONCLUSIONS

1. Thermal processing – frying – causes lowering of the initial content of the total and inorganic iodine within the range of 18 to 30% depending on the used processing method and the kind of additives.

2. Application of frying where the traditional heating medium – fat – was replaced by hot air with enforced circulation, significantly lowered iodine losses.

3. An addition of soy hydrolizate to meat mass caused lowering of the losses of the total and inorganic iodine during heat processing and freeze storage of the burgers.

4. Sensory analysis of meat products did not reveal a significant effect of fat free frying as compared to the traditional one.

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RETENCJA JODU W MIELONYCH KOTLETACH WIEPRZOWYCH SMAŻONYCH BEZ TŁUSZCZU

Streszczenie. Celem pracy było ustalenie wpływu warunków obróbki cieplnej i przechowywania kotletów z mięsa mielonego z dodatkiem soli jodowanej i hydrolizatu soi na zmiany ilościowe i jakościowe jodu oraz cechy sensoryczne gotowego produktu. Jako zmienne warunki obróbki cieplnej przyjęto smażenie tradycyjne, z użyciem tłuszczu oraz smażenie beztłuszczowe z wykorzystaniem wymuszonej cyrkulacji gorącego powietrza. Na podstawie uzyskanych wyników stwierdzono, że obróbka cieplna mięsa mielonego, niezależnie od jej rodzaju, wpłynęła na obniżenie zawartości jodu ogólnego i nieorganicznego w granicach 18-30%. Zastosowanie metody tradycyjnego smażenia powodowało większe straty jodu ogólnego o około 7%, a nieorganicznego o 5% w porównaniu z obróbką beztłuszczową. Podczas przechowywania prób w temperaturze 4°C zaobserwowano większą stabilność jodu ogólnego w stosunku do przechowywania zamrażalniczego. Wprowadzenie hydrolizatu soi powodowało zmniejszenie ubytków jodu ogólnego i nieorganicznego w trakcie obróbki cieplnej średnio o 8%, a podczas ich przechowywania o około 5%. Analiza sensoryczna nie wykazała istotnych różnic pomiędzy kotletami mielonymi smażonymi metodą tradycyjną i beztłuszczową.

Słowa kluczowe: mięso wieprzowe, sól jodowana, hydrolizat soi, smażenie beztłuszczowe, przechowywanie

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