ACTA SCIENTIARUM POLONORUM *Acta Sci. Pol., Technol. Aliment. 5(2) 2006, 65-72*

THE EFFECT OF COMMINUTION DEGREE AND FAT CONTENT IN MEAT BATTERS ON THE PASTEURIZING *P* AND STERILIZING *F* VALUE OF MODEL CANNED MEAT PRODUCTS

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Abstract. The main objective of this study was to evaluate the influence of fat content and degree of chopping of meat batters on the dose of heat which is delivered to meat during pasteurization and sterilization processes of canned meat products. Four types of canned meat were produced: coarse and finely chopped and with different meat and fat content in the formulation in each of five series. Products with lower content of fat – around 10% were concerned as "lean" while with 30% of fat as "fatty". All types of canned meat were heated for 40 minutes in 100°C (pasteurization) and in 121°C (sterilization). During heating temperature in the core of canned meat was measured every 30 seconds. Based on that the heating dose for each type of canned meat was calculated. Independently of heating and degree of chopping, higher doses were delivered to samples with lower content of fat. The degree of chopping had significant effect on pasteurization value *P* and sterilization value *F* both in "lean" and "fatty" canned products. Higher values were obtained for coarse ground that for finely chopped meat batters.

Key words: value *F*, value *P*, fat level, degree of chopping

INTRODUCTION

Thermal processing affects production costs, energy requirements, weight losses and sensoric properties and thus has a general effect on the quality of processed meats. The optimum parameter of thermal processing and especially the level of temperature applied, depend principally on the coefficient of heat penetration (resulting from the recipe used) and size of cans [Warunki... 1996, Ibrahim 2003]. This coefficient decreases during thermal processing with the progressing denaturation of proteins and changes in water binding within the product [Grabowski 2003]. In order to obtain conditions for

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pasteurization and sterilization that would be optimum as regards both quality and economy, it is necessary to find a measure, which will make it possible to determine univocally the degree of sterilization of the final product, without the necessity of conducting costly and time-consuming post-production analyses [Michalski 1999, Carciofi et al. 2002]. It is assumed that the sterilization and pasteurization value will replace the parameters of thermal processing (temperature and time), currently obligatory in the production of canned meat. According to Kowalski et al. [1998] the use of sterilization and pasteurization values will introduce more objectivity to the thermal processes.

The studies presented aimed at determining the effect of the degree of comminution and of fat content in meat batters on the pasteurization *P* and sterilization *F* values for model canned meat products.

MATERIAL AND METHODS

Pork class I, IIA and IIB as well as fat trimmings and emulsion from pork skins were used as raw materials. It was purchased before each, individual series of analyses and was ground in a laboratory grinder (holes 8 mm in diameter). The quantity of emulsion, necessary for all five series of production, was purchased once, divided into portions weighing 2 kg each, vacuum packed and frozen at a temperature of –18°C. Before undertaking each series of production the emulsion was thawed for 24 hours at temperature of +4°C.

Four canned meat variants were tested: medium or fine minced, produced according to two recipes (Table 1). Products with a lower fat content – about 10% were called "lean" canned meat, while those with a fat content of about 30% "fatty" canned meat.

A curing brine was prepared as follows: all the curing salt components were mixed with water for about 2 minutes using a mixer. Sodium ascorbate was added during the last stage of mixing. For the preparation of the brine for medium ground batter all the water from the recipe was used. In turn, to the curing brine prepared for the finely minced batter, only half of the water was added and the rest was supplemented as ice during chopping of meat.

In order to obtain a medium ground batter, the pork skin emulsion and all meat components (pork I, IIA and IIB in the "lean" batter and pork IIB in the "fatty" batter), were minced in a grinder with holes of 8 mm in diameter, than placed in a mixer and mixed for about 10 minutes together with the curing brine and spices until the batter was of a uniform and compact texture and the temperature reached about 14°C.

To produce finely ground batter containing about 10% fat the emulsion from skins, pork class I and IIA, half the ice and brine were minced in a high speed vacuum cutter Stephan UM5 for 1 minute (the maximum knife speed being 3000 rev./min). Next the rest of the ice, pork class IIB and spices were added and the batter were minced once more for about 1-1.5 minutes, until the temperature reached 14°C. For the production of finely minced batter containing 30% fat (i.e. "fatty") first the emulsion, pork class IIB, curing brine and half of the ice were minced for about 1 minute and next, after adding fat trimmings and spices, for another 1-1 minutes, until the temperature of the batter reached 14°C.

Cans 73 × 28 mm in size were filled manually with meat batter (95 ±2 g in each). Inside cans Ellab loggers were placed and used for the measurement and registration of

Table 1. Composition of batters
Tabela 1. Skład surowcowy farszów

Components Składniki	Share, % – Udział, %	
	"lean" batter farsz „chudy"	"fat" batter farsz „tłusty"
Pork class I Mięso wieprzowe kl. I	30	–
Pork class II A Mięso wieprzowe kl. II A	30	–
Pork class II B Mięso wieprzowe kl. II B	10	30
Raw emulsion from pork skins Emulsja surowa ze skór wieprzowych	30	30
Fat trimmings Tłuszcz drobny	–	40
Total for meat and fat **Razem surowce mięsno-tłuszczowe**	**100**	**100**
Water* Woda*	50	15
Curing salt* Peklosól*	2	2
Soy protein isolate* Izolat białka sojowego*	2	2
Phosphate* Fosforan*	0.2	0.2
Sodium ascorbinate* Askorbinian sodu*	0.05	0.05
Potato flour* Mąka ziemniaczana*	2	2
Pepper* Pieprz*	0.1	0.1

*In relation to the mass of meat and fat.
*W stosunku do ilości surowców mięsnych i tłuszczowych.

temperature at the geometric centre of the canned meat every 30 seconds. Eighty in all measurements were made. Cans were closed and pasteurized in a water bath at temperature of 95°C, or sterilized in an autoclave (temperature of 121°C). The time of both heat treatments was 40 minutes. The thermal processing was performed for 40 minutes, and than cooled in water with ice for about 2 hours.

After sterilization the loggers were removed from cans and the data were read using a base station connected to a computer. The sterilization value F and pasteurization value P were calculated on the basis of the temperatures registered. The results were subjected to a statistical analysis evaluating the effect of the product type used at each measurement time point ($\alpha = 0.05$).

RESULTS AND DISCUSSION

The temperature changes at the geometrical centre of cans during pasteurization were presented on Figure 1. The statistical analysis confirmed a significant differentiation ($p < 0.05$) of the average temperature of meat batter already 2 minutes after starting of the thermal processing. Batters with a lower fat content, irrespectively of the degree of comminution, were characterized by significantly ($p > 0.05$) higher temperatures. Higher temperatures were observed for minced "lean" batters than for the medium ground "lean" batters. In the case of "fatty" canned meats the degree of comminution had no effect on the temperature of the batter. After 25 minutes of pasteurization the mean temperature of all batters was similar, not differentiated significantly ($p > 0.05$) either by the degree of comminution or the fat content. Figure 2 presents the pasteurization value *P* for individual types of canned meat. A significant differentiation ($p < 0.05$) of this value was observed 6 minutes after starting the thermal processing. Higher heating doses were received by canned "lean" meat, both in the case of minced and those medium ground. Irrespectively of the batter fat content, higher pasteurization values *P* were observed for products obtained from medium ground batter than from minced batters. With the progressing pasteurization process the absolute values of the observed differences increased.

One should emphasize that a temperature of 69-70°C (recommended as the final temperature for the preservation process) at the geometrical centre of pasteurized canned meats was registered 7-8 or 10-11 minutes, in "lean" or "fatty" batters, respectively. In turn, the pasteurization value *P* of about 80 min, considered as the value ensuring stability of pasteurized products [Warunki... 1996], was obtained after thermal processing of 14-15 minutes for "lean" and after 18-19 minutes for "fat" canned meats. This indicates that conducting pasteurization until the required temperature is reached at

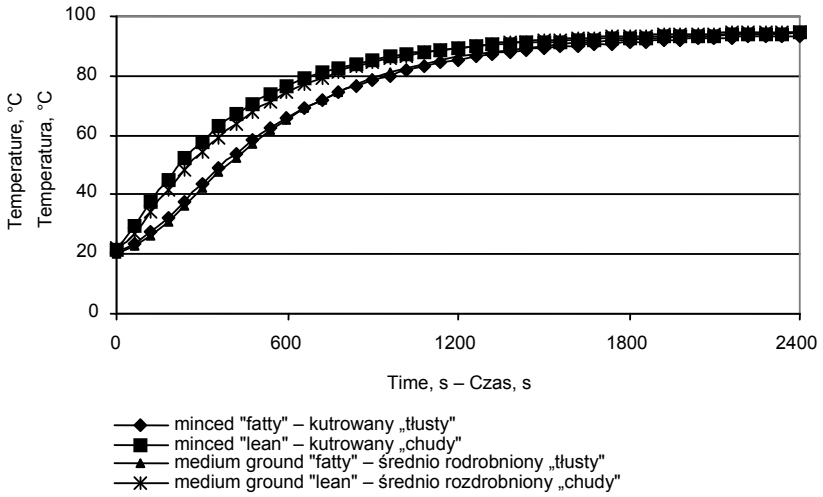

Fig. 1. Temperature changes at the geometric centre of canned meats during pasteurization
Rys. 1. Zmiany temperatury w centrum geometrycznym konserw podczas pasteryzacji

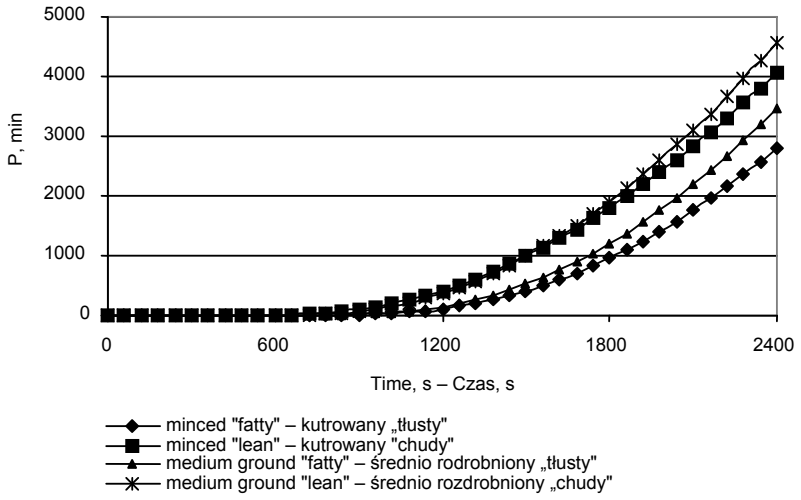

Fig. 2. The pasteurization value *P* for model canned meats
Rys. 2. Wartość pasteryzacyjna *P* modelowych konserw mięsnych

the geometrical centre does not correlate with the heating dose received by the canned meat. Also Cierach et al. [1999], examining the effect of the chemical composition of the batter on the heat penetration during thermal processing of sausages observed, that in the case of sausages with a higher fat content the temperature curves were much more differentiated between different layers than in sausages with a lower content of this component. The desired temperature of 75°C at the geometric centre of a sausage link with a lower fat content was reached 25 minutes quicker.

The temperature changes occurring at the point of the lowest heating of sterilized canned meats were presented on Figure 3. It was observed that the fat content had a significant ($p < 0.05$) effect on the temperature at the geometric centre of the canned meat already after one minute of thermal processing. The differentiating of mean temperatures within batters, caused by the degree of comminution, was not significant ($p > 0.05$) throughout the time interval analysed. The calculated sterilization value (*F*) was presented graphically on Figure 4. It took 13 minutes of sterilization before the calculation of the heating dose exceeded 0.01 min. This was in agreement with the observations reported by Danyluk et al. [1999], who compared the traditional and automatic sterilization methods. After about 10 min sterilization at 121°C the F values obtained by those authors were equal or only slightly above zero. After 20 minutes of thermal processing it was observed that the fat content had a significant ($p < 0.05$) effect on of the heating dose received by the canned meat. Similarly as in the case of pasteurized canned meat, canned meat produced from "lean" batters received higher heating doses than those from "fat" batters. Moreover, after 25 minutes of thermal processing one could also observe the effect ($p < 0.05$) of the degree of comminution on the sterilization value *F*, but only in the case of products produced from "lean" batters. In "fatty" products obtained from medium ground batters a higher *F* value than that recorded for minced batters, was not observed till after 34 minutes of thermal processing ($p < 0.05$). After 40 minutes of sterilization the heating dose in "lean" products increased to 3.43 and

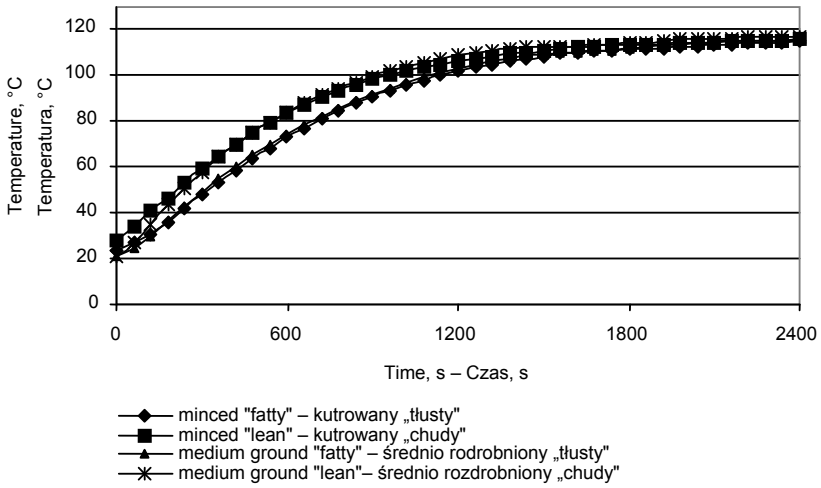

Fig. 3. Temperature changes at the geometric centre of canned meats during sterilization
Rys. 3. Zmiany temperatury w centrum geometrycznym konserw podczas sterylizacji

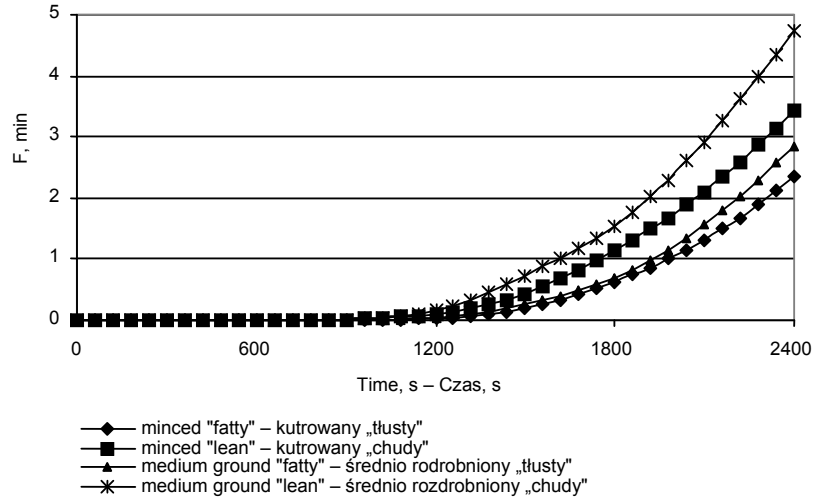

Fig. 4. The sterilization value *F* for model canned meats
Rys. 4. Wartość sterylizacyjna *F* modelowych konserw mięsnych

4.74 min for minced and medium ground batters, respectively. In turn, the *F* value for products with a higher fat content, irrespectively of the degree of comminution, did not exceed 3 min, what according to the PN-A-82022 [1998] standard (not obligatory) determines a sufficient stability of the product.

CONCLUSIONS

1. Irrespectively of the type of thermal processing (sterilization and pasteurization) and degree of comminution, canned meats with a higher fat content received higher heating doses. The degree of comminution had a significant effect on the pasteurisation value *P* and sterilization value *F*, both in the case of "fatty" and "lean" canned meat products.

2. After different period (according to the formula), higher values for those parameters were obtained for canned meats produced from medium ground than from minced batters.

3. Appropriately adjusted conditions of heat treatment are necessary according to meat particle size and fat content in the canned products.

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WPŁYW STOPNIA ROZDROBNIENIA I ZAWARTOŚCI TŁUSZCZU W FARSZACH NA WARTOŚĆ PASTERYZACYJNĄ *P* I STERYLIZACYJNĄ *F* MODELOWYCH KONSERW MIĘSNYCH

Streszczenie. Celem badań było określenie wpływu stopnia rozdrobnienia i zawartości tłuszczu w farszach na dawkę cieplną otrzymywaną podczas pasteryzacji (*P*) oraz sterylizacji (*F*) modelowych konserw mięsnych. W pięciu seriach badań wyprodukowano cztery warianty konserw: średnio i drobno rozdrobnione oraz o zmiennym składzie surowcowym. Produkty o mniejszej zawartości tłuszczu – ok. 10% to tzw. konserwy „chude", natomiast o większej zawartości tłuszczu – ok. 30% to tzw. konserwy „tłuste". Wyprodukowane konserwy poddawano 40-minutowej obróbce cieplej: pasteryzację prowadzono w temperaturze ok. 100°C, a sterylizację w temperaturze ok. 121°C. W czasie procesów termicznych co 30 sekund mierzono temperaturę w centrum geometrycznym konserw. Na tej podstawie wyliczano dawkę cieplną otrzymaną przez treść konserwy. Niezależnie od rodzaju prowadzonej obróbki termicznej i stopnia rozdrobnienia większe dawki cieplne otrzymywały konserwy o mniejszej zawartości tłuszczu. Wpływ stopnia rozdrobnienia wpływał istotnie na wartość pasteryzacyjną *P* i sterylizacyjną *F* w konserwach zarówno „tłustych", jak i „chudych". Wyższe wartości tych parametrów uzyskiwały konserwy wyprodukowane z farszów średnio rozdrobnionych niż z kutrowanych.

Słowa kluczowe: wartość *F*, wartość *P*, poziom tłuszczu, stopień rozdrobnienia

Accepted for print – Zaakceptowano do druku: 23.10.2006

For citation – Do cytowania: Adamczak L., Słowiński M., Pisula A., Tomaszczyk E., Borysiak M., 2006. The effect of comminution degree and fat content in meat batters on the pasteurizing P *and sterilizing* F *value of model canned meat products. Acta Sci. Pol., Technol. Aliment. 5(2), 65-72.*