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INFLUENCE OF PLANT FIBRE WITH A SOLUBLE FRACTION UPON STRUCTURE STABILISATION AND COLOUR CHANGES OF TWO-COMPONENT MEAT PRODUCTS

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Key words: structure and texture of minced meat masses, two-component product, food additives

Automatically prepared meat products of a different beef and pork content were subjected to research. Meat masses with addition of fibre with a soluble fraction and of a different degree of mincing were used for filling two-component products. The results of analysis showed a significant influence of beef and pork proportion, mincing degree and addition of apple fiber with a soluble frac-tion on the structure of minced meat masses (mmm). It was concluded that a differentiated content of these textural parameters allows to create a meat filling with increased biological parameters and of a defined hardness, elasticity and cohesiveness.

INTRODUCTION

The achievement of the market success makes it possible to introduce on the market of the high, satisfactory and accepted quality, which can satisfy consumer's needs and requirements. Con-sumer prefers natural and probiotic food (including fiber-rich), produced with traditional methods without applying food additives, but on the other hand, an increased interest is observed in the prod-ucts of high sensory values which can be produced only with various types of additives [Rutkowski, 2005].

Changes in the structure of meat products can result both from technological processing and functional additives [Makała, 1998; Tornberg, 2004]. The degree of the changes in the rheological textural quality and the degree of the product's combining depends essentially on the composition of meat and fat in the recipe as well as on the level of expected fat substitution [Ostrowska & Olkiewicz, 1999]. The proportions of the fat freeness of fat meat are the main factors influencing hardness and stability of the product. Therefore, mainly proportions of the protein part, to water and fat are very important [Makała, 1998].

Strengthening and maintenance of the stable structure of food products is possible due to the use of natural functional additives with textural-providing qualities. Appropriate combining of proc-essed meat product is essential for preservation of its high quality. The addition of non-meat proteins and carbohydrates is frequently used to improve the structure of a meat product [Parichat & Shai 1999; Kurach, 2001].

The highest water absorption among fiber fractions is characteristic for selected plant fibers (oat, wheaten) [Górecka, 2004]. The addition of fiber reduces the level of fat in the product, it also influences the quantity of thermal drip, the impression of saltiness, taste, general attractiveness and textural features [Makała, 2002].

MATERIALS AND METHODS

Minced meat masses of a different degree of mincing (ϕ 3 mm and ϕ 5 mm) and of different contents of apple fibre with a soluble fraction (0, 30, 60, 90, 120, 150 g/kg_{mmm}) were used in the study. The prepared masses had different contents of beef meat in comparison to pork (30, 40, 50% of beef). The beef and pork used in the study belonged to III class. Apple fibre with a soluble frac-tion contained 30% of soluble fraction, 93% of dry mass with a total content of fibre as a sum of soluble fibre of no less than 80%.

Analytical methods. Evaluation of physical properties of the meat masses was carried out with the use of an endurance machine – Instron 4301 by compression in the Ottaw's chamber with the propor-tion of holes to bottom (1:1) 50 cm^2/50 cm^2. The parameters of the compression test were as follows: head capacity – 1 kN, sample mass – 350 g, traverse speed – 90.0 mm/min, head movements – 100 mm. The tested parameters were as follows: F_{max} – maximal power during the compression test, co-hesiveness – proportion of head's movements (from the start of the test until the maximal power appeared) to the total height of the sample [Costell, 2002; Laweless & Heyman, 1999].

Instrumental measurements of colour were carried out using Minolta Chromameter Cr 310 in the L*a*b* system with the use of reflected light D65. The following parameters were

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evaluated: L* – spatial co-ordinate indicating brightness, a* and b* tri-chromatic coordinates. Each evaluation was carried out in three replications.

Sensory analysis was carried out using a scaling method according to the international ISO standard [PN – ISO 11036:1999], with a non-structured graphic scale in the form of a 10 cm long scale anchored from 0 to 10.

The sensory panel consisted of 15 previously trained individuals and their task was to mark on the scale the overall impression resulting form the evaluation process.

The following parameters of the product were evaluated at 45°C: colour, cohesiveness, hard-ness, taste and aroma.

RESULTS AND DISCUSSION

Minced meat masses (mmm) of different mincing degree – ø 3 mm and ø 5 mm – and chang-ing proportion of pork to beef (30%; 40%, 50% of beef meat) were subjected to analyses. The test samples were also characterised by various addition of apple fibre with a soluble fraction. The quantity of added fibre was changing within the range of 0-150 g/kg_{mmm}.

The results obtained from instrumental measurements of the selected textural parameters in-dicate a significant correlation between the amount of the fibre used and the maximal power (F_{max}) registered during the compression test, as shown in Figure 1. The results indicate that an increasing content of beef meat in the recipe causes an increase of the power necessary to compress the material in Ottawa chamber (Figure 1).

Relationships between F_{max} and the added fibre at the mincing degree of $\phi = 3$ mm are de-scribed with equations 1, 2, 3. Equation 1 shows changes in F_{max} at the beef content of 50% and at the mincing degree of 3 mm.

$$F_{max}(FQ) = 0.504e^{0.0038FQ} \quad (1)$$

for $0<FQ<150$ g/kg_{mmm} $R^2 = 0.984$

where: F_{max}=max force, FQ=fiber quantity.

Equation 2 shows changes in F_{max} at the beef content of 40%.

$$F_{max}(FQ) = 0.431e^{0.004FQ} \quad (2)$$

for $0<FQ<150$ g/kg_{mmm} $R^2 = 0.982$

Equation 3 shows changes in F_{max} at the beef content of 30% and at the mincing degree of 3 mm.

$$F_{max}(FQ) = 0.349e^{0.0044FQ} \quad (3)$$

for $0<FQ<150$ g/kg_{mmm} $R^2 = 0.981$

Figure 2 shows, as previously, changes in F_{max} depending on the amount of fibre with a changing percentage of beef content for a mincing degree of $\phi = 3$mm.

TABLE 1. Equations describing minced meat masses of a different content of beef meat and of different content of fibre with a soluble fraction, at the degree of mincing of ø 5 mm.

Beef percentage (%)	Equation	Domain of function (g/kg_{mmm})	R^2
50	$F_{max}(FQ)=0.34e^{0.0058FQ}$	0<FQ<150	0.974
40	$F_{max}(FQ)=0.319e^{0.0054FQ}$	0<FQ<150	0.955
30	$F_{max}(FQ)=0.284e^{0.0051FQ}$	0<FQ<150	0.939

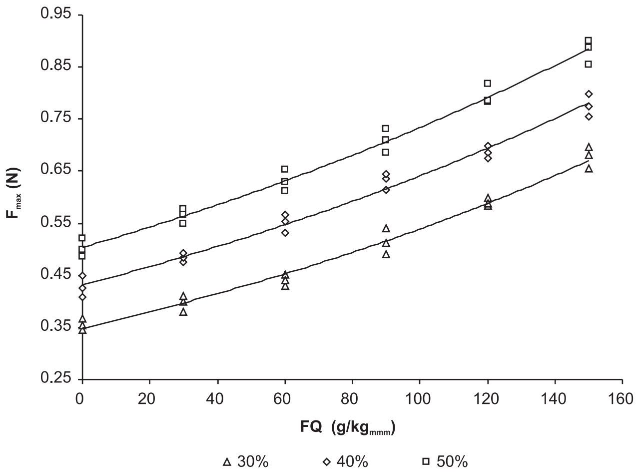

FIGURE 1. Changes in F_{max} (compression test) for minced meat masses depending on the amount of added fibre with a soluble fraction and on the percentage of beef in beef meat at the degree of minc-ing of ø 3 mm.

Approximation of the results obtained was carried out. The results obtained for particular per-centages of beef are show in Table 1.

Cohesiveness is a second measured feature of texture. Figure 3 shows changes in cohesiveness at a degree of mincing of $\phi = 3$ mm depending on the amount of added fibre. Particular series in Figure 3 show the percentage of beef content. The lowest cohesiveness was observed for samples with the lowest fibre content. An increase of pork percentage led to an increase in cohesiveness.

Cohesiveness tests carried out for a mincing degree of $\phi = 5$ mm are shown in Figure 4. As the addition of fibre in the recipe increased, the cohesiveness decreased. At a degree of mincing of $\phi = 5$ mm, higher values for cohesiveness were noted than at a degree of mincing of $\phi = 3$ mm.

The results of instrumental colour analysis of the minced meat with apple fibre with the addi-tion of a soluble fraction showed a decrease in colour as the amount of fibre content increased. The highest values of brightness parameter L* were obtained for samples with no fibre. Addition of fibre had a

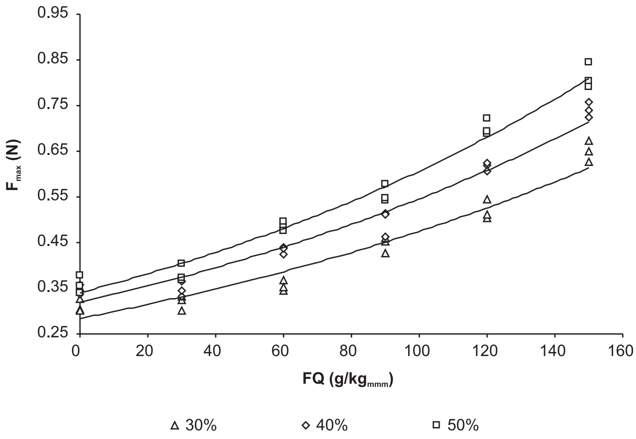

FIGURE 2. Changes in F_{max} (compression test) for minced meat masses depending on the amount of added fibre with a soluble fraction and on the percentage of beef in beef meat at the degree of minc-ing of ø 5 mm.

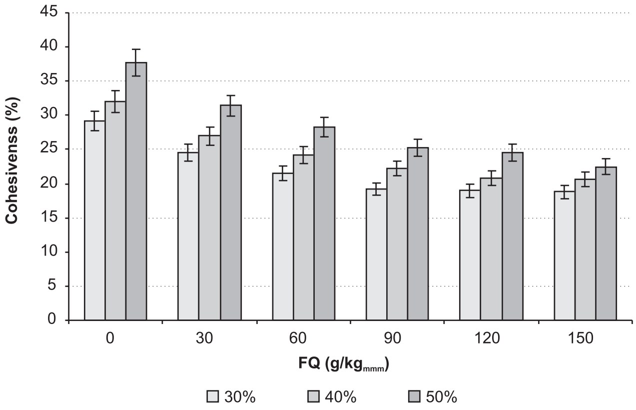

FIGURE 3. Changes in cohesiveness (compression test) for minced meat masses depending on the amount of added fibre with a soluble fraction and on the percentage of beef in beef meat at the de-gree of mincing of ø 3 mm.

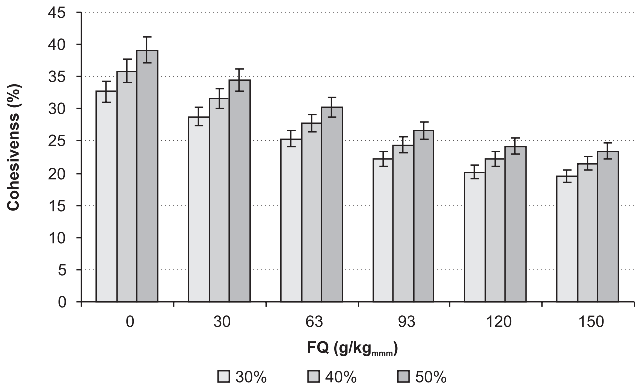

FIGURE 4. Changes in cohesiveness (compression test) for minced meat masses depending on the amount of added fibre with a soluble fraction and on the percentage of beef in beef meat at the de-gree of mincing of ø 5 mm.

significant influence upon a decrease in brightness. The value of correlation coefficient was -0.91. The more fibre, the darker the sample. L* value for samples without fibre was on average 45 for a meat mass before thermal treatment and 52 after thermal treatment. For samples with fibre con-tent of 150 g/kg_{mmm} this value was 38.

Colour parameter a* can have both positive and negative values. In the case of the analysed minced meat masses it can be concluded that a* values depended both on the content of fibre with a soluble fraction and on the proportion of beef to pork in the product.

The percentage of fibre in a sample had the effect one a* values. The higher the fibre content, the lower the values of a* parameter, with a correlation coefficient from -0.74 to -0.94, which con-firms the existence of an inverse correlation between the above discussed parameters. Parameter a* colour value was significantly lower for samples with fibre than in the case of samples without fibre. The value of a* coefficient for a raw meat mass was 20[-], and at the maximal fibre content it was 11.5. It can be concluded that both fibre addition and thermal treatment causes a decrease in parameter a* values.

Values of the colour parameter b* appeared to be significantly correlated with fibre content (0.96). The increasing amount of fibre addition caused an increase in parameter b* values. An aver-age value of b* parameter for samples without fibre before thermal treatment was 11.2 while it was the highest at 70% pork content (12.3), and the lowest at 50% pork content (10.5). Thermal treatment of these samples caused an increase in parameter b* values. Addition of fibre at 60 g/kgmmm caused a change in colour with an increase in b* value to 17.8 in minced meat mass and to 16 in thermal processed product. In the case of fibre content of 90 g/kg_{mmm} the described parameter was 19 The highest values of b* parameter were observed at addition of apple fibre of 150 g/kg_{mmm}. In the case of a raw meat mass, the value of colour b* parameter was 19.6, and for a ready product – it was 17.5. Based on the results obtained it can be concluded that the addition of fibre caused a gradual loss of red colour.

During the test it was observed that both the degree of mincing as well as the proportion be-tween pork and beef had a significant influence upon colour parameter b*. Similar relation was also observed by Arciszewska & Cegiełka [2003].

The content of fibre was the most important factor influencing yield and efficiency of the technological process. The correlation values were in the range from -0.75 to -0.96, which indicates that an increasing addition of fibre with a soluble fraction caused a decrease in mass loss during thermal treatment.

The results showed that mass losses during thermal treatment depend also on the proportion between pork and beef meat, which was really apparent in the samples with a mincing degree of ø 3 mm.

A sample with 30% beef content was characterised with higher mass losses, *i.e.* -5.19% at the maximal fibre content, while at no fibre content it was 16.79%. With 50% of beef, the losses were, respectively, 1.98% and 14.44%. In the case of samples with a mincing degree of ø 5 mm, no statistical correlation was observed between beef and pork proportion and mass losses during thermal treatment.

The products were subjected to sensory evaluation according to the methods [PN – ISO 11036:1999]. The panellists were rating samples with a degree of mincing of 5 mm in comparison to samples with a mincing degree of 3 mm in each case. During sensory evaluation, the highest scores were given to samples with 40% of beef, as shown in Figure 5.

During sensory assessment, textural parameters of hardness and cohesiveness received the highest scores at 90 g/kg_{mmm}. The increase in fibre content influenced the scores of hardness and cohesiveness. Parameters of sensory evaluation, such as colour, taste and aroma were decreasing together with an increase of fibre content.

CONCLUSIONS

1. The analysed parameters (degree of mincing, apple fibre addition) significantly influenced structural parameters of minced meat masses used for automatic forming of stuffed food products.

2. Increasing addition of apple fibre led to an increase in F_{max} for minced meat mass at the tested mincing degree. On the other hand, cohesiveness decreased with the amount of added fibre.

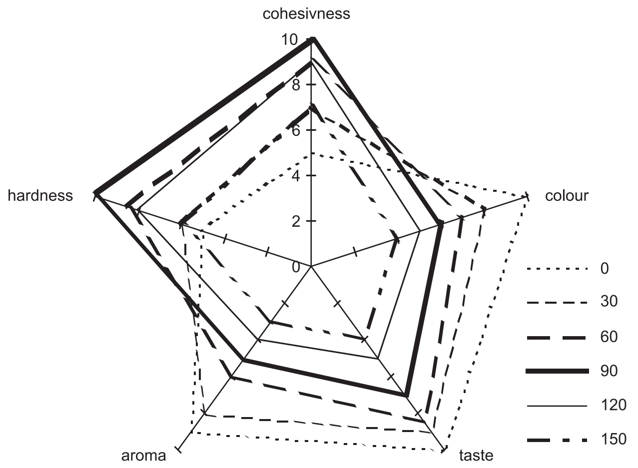

FIGURE 5. The results of sensory evaluation of minced meat products with 40% beef content with ap-ple fibre with a soluble fraction, mincing degree of ø 5 mm

3. Apple fibre content and thermal processing caused a decrease in brightness.

4. Apple fibre and thermal processing caused a decrease in a* colour parameter values, while a higher content of beef in raw meat mass and a higher particle size in a ready product caused an increase in a* colour parameter values.

5. Fibre addition caused an increase in colour b* parameter values, which was related with a better evaluation of a product's attractiveness.

6. During sensory evaluation products with 40% of beef with apple fibre together with a soluble fraction 90 g/kg_{mmm} and a mincing degree of ϕ 5mm received the highest scores.

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WPŁYW BŁONNIKA ROŚLINNEGO Z FRAKCJĄ ROZPUSZCZALNĄ NA STABILIZACJĘ STRUKTURY I ZMIANĘ BARWY MIĘSNYCH WYROBÓW DWURODNYCH

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Przedmiotem badań były wyroby mięsne formowane automatycznie o zróżnicowanym pro-centowym udziale mięsa wołowego i wieprzowego. Przygotowywano mięsne masy z dodatkiem błonnika z frakcją rozpuszczalną o zróżnicowanym stopniu rozdrobnienia, stanowiły wypełnienie wyrobów dwurodnych. W wyniku przeprowadzonej analizy stwierdzono istotny wpływ zróżnicowa-nego udziału mięsa wołowego do wieprzowego, stopnia rozdrobnienia i dodatku błonnika jabłkowe-go z frakcją rozpuszczalną na strukturę mięsnych mas mielonych. Stwierdzono, że odpowiednie zróżnicowany udział tych czynników strukturotwórczych pozwala na kreowanie jakościowych farszu mięsnego o podwyższonych parametrach biologicznych oraz określonej twardości, elastyczności i spoistości.