CHEMICAL ENGINEERING TRANSACTIONS Volume 17, 2009
Editor Sauro Pierucci

DOI: 10.3303/CET0917158

Effect of addition of dietary fiber in coating mixtures on a textural properties and oil uptake in deep fried chicken meat

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In this study instrumental analysis of various different coating mixtures for coating of chicken meat (pectoralis major) was conducted. As dietary fibers, Fibrex (0.5 %, 1.5 % and 2.5 %) and pectin (0.5 %, 1.5 % and 2.5 %) were added in the mixtures. After frying of meat at 180 ^{o}C for 5 minutes, effects of addition of dietary fibers were evaluated. Analysis of oil uptake and main texture properties of meat (hardness and elasticity) were performed. Addition of pectin or Fibrex to mixtures shows significant decrease in oil uptake (up to 30 %). Water loss from meat was decreased, and consequently elasticity was much larger for samples coated with pectin or Fibrex coatings than for sample without dietary fiber coatings. Hardness of samples decrease up to 38 % with the increase of addition of Fibrex, and up to 47.5 % for samples coated with coatings which contain pectin. It can be concluded that the addition of dietary fiber to coating formulations have positive influence on textural properties of meat, as well as known health benefits.

Keywords: texture analysis, hardness, elasticity, oil uptake, dietary fiber

1. Introduction

As one of the basic sensory properties, texture has large influence in determining of quality of foodstuff (Drewnowski, 1997.). Texture and colour of coating are first things noticed during observation and chewing of fried chicken meat. From consumer point of view, sensory properties of foodstuff, as well as nutritive characteristics are main factors in buying decision. In this light, it is important to maintain consistent textural and other physical as well as chemical characteristics, while trying to improve the nutritive value of food. This paper will show if addition of dietary fibres to coating mixtures will fulfil this task and at the same time lower the energy content of food by decreasing the oil content.

Please cite this article as: Karlovic S., Jezek D., Tripalo B., Brncic M. and Bosiljkov T., (2009), Effect of addition of dietary fiber in coating mixtures on a textural properties and oil uptake in deep fried chicken meat, Chemical Engineering Transactions, 17, 945-950
DOI: 10.3303/CET0917158

Dietary fibres consist mostly of non-starch polysaccharides such as cellulose and hemicellulose. Rest of the dietary fibre structure consist of other plant components such as dextrin. Pectin as one of the most common dietary fibre is linear chain of galacturonic acid units linked with α-(1-4) glucosidic bonds. It is usually extracted from citrus fruits. Fibrex is commercial product made from sugar beet. Hemicellulose and cellulose make 75 % of Fibrex and the rest of it consist of pectin from citrus. It has very high water holding capacity and stability on high and low temperatures (frying, freezing, etc.). Fibrex is also gluten free, so it can be used in broad variety of applications.

Samples coated with mixtures containing dietary fibres should have lesser oil content, which drastically reduce energy content of food. Dietary fibres also contribute to lipid metabolism, stool volume and decrease risk of some cancers and cardiovascular diseases (Langkilde et al, 1993.; Overton et al, 1994.).

Rice starch was used as a substitute for eggs which act as a binding agent. It increase adhesivity of coatings to meat and consequently increase amount of coating in the final product after frying. By eliminating eggs from list of ingredients, coatings have better nutritive characteristics, which include less cholesterol and fat content. At the same time, safety of food is greater and shelf life is increased.

This work was oriented on determining influence of dietary fibres mixed in coatings on textural properties of coated chicken meat. Texture analysis was performed and oil content for 7 different coating mixtures was analyzed.

2. Materials and methods

For the manufacture of coating mixtures, extruded corn flour (Naše klasje d.o.o., Croatia) and rice starch (Pen-prom d.o.o, Croatia) were used in all mixtures. High ester Grinsted XSS pectin on the citrus base (Danisco A/S, Denmark) and Fibrex (Danisco A/S, Denmark) were used as dietary fibres. As a frying medium, palm oil was used (Zvijezda d.o.o., Croatia). Meat used for coating was chicken breasts (pectoralis major) (Konzum, Croatia).

Table 1. Ingredients used in preparing of coating mixtures.

Mixture label	Corn flour [g]	Rice starch [g]	Fibrex [g]	Pectin [g]
C	96.0	4.0	0.0	0.0
1P	95.5	4.0	0.0	0.5
2P	94.5	4.0	0.0	1.5
3P	93.5	4.0	0.0	2.5
1F	95.5	4.0	0.5	0.0
2F	94.5	4.0	1.5	0.0
3F	93.5	4.0	2.5	0.0

Mixtures were labelled in such way that C is control sample, numbers (1, 2 and 3) represent number of mixture, P stands for mixtures which contain pectin and F for Fibrex.

All ingredients were homogenised in mixtures using Retsch NM 301 homogenizer. Weighing of ingredients and mixtures was conducted on Sartorius GP 4102 (Great Britain) balance.

Chicken breasts were sliced on pieces with dimensions of 3 cm x 3 cm and 1 cm of thickness. Meat was uniformly coated in mixtures and left on room temperature for 30 minutes. Frying was conducted using deep fat fryer (Philips HD 6180) on 180 °C for 5 minutes. After drying and cooling of samples on room temperature, instrumental analysis was conducted. Oil was changed every 30 minutes, and mass ratio of meat in oil was 100 g in 3000 g (3167 mL) (Christensen et al, 2000; Bejerholm and Aaslyng, 2003; Saguy and Dana, 2003).

Instrumental analysis was performed on texture analyzer (Stable Micro Systems, TA.HDPlus, Great Britain). Data for hardness and elasticity of samples was collected. Hardness is defined as force needed for penetration in the sample. It is analyzed using the blade set. Depth of penetration was set at 5 mm (half of sample thickness), penetration speed was 0.5 mm/s. On obtained graph, hardness was calculated using value of force in the maximum peak. Elasticity of fried samples was tested using the P/6 probe. Penetration time was set at 8 s and penetration depth at 10 mm. For elasticity, maximum force applied for breaking of surface and penetration in sample, as well as depth of penetration before breaking were measured (Cavitt et al, 2005).

Oil content was measured using Soxhlet method. Samples were weighed, before and after 4 hours of continuous extraction using organic solvent. After drying, weight of flask was measured. Content of oil was calculated using the equation:

$$\%\ oil\ content = \frac{(b-a)\cdot 100}{m}$$

a – mass of empty flask [g]

b – mass of flask with oil [g]

m – mass of sample [g]

For every mixture, 5 samples were prepared and analyzed. Statistical analysis was conducted and samples coated in dietary fiber were compared to each other and to control sample.

3. Results

From Figure 1 it can be concluded that increase of the amount of pectin or Fibrex in mixtures used for coating of samples leads to increase in oil uptake of samples after deep fat frying. Results show that samples with Fibrex (1F – 3F) absorb smaller quantities of oil than samples 1P, 2P and 3P which contain pectin. Nevertheless, all samples show lower absorption of oil than control sample (58.27 %) without any dietary fiber in mixture composition. It can be concluded that addition of dietary fibres (specifically Fibrex and pectin) in coating mixtures significantly reduce amount of oil uptake in samples, which is considerable gain from sensory and health aspects (García et al, 2002.; Abdul-Hamid and Luan, 2000.). Increase in oil uptake with increase of dietary fibre content can be explained with physical characteristics of fibres. During the frying process, fibres swell and block oil from absorbing into meat. At the same time, fibres block water in meat, which contribute to softness of samples.

Texture analysis data presented in Figure 2 show that hardness rise with increase of pectin content in samples, with maximum value in sample 3P. This is also evident in samples coated with mixtures which include Fibrex, where maximum value have sample 3F. All samples coated with dietary fibres are significantly softer than control sample. The same mechanism of water retention and uptake of oil is responsible for decrease in hardness. Increase in fibres content in mixtures leads to increase in oil absorption and at the same time oil molecules close pores in mixture microstructure. This succesively leads to retention of water, which evaporates during frying, but in larger part it is unable to cross through the coating.

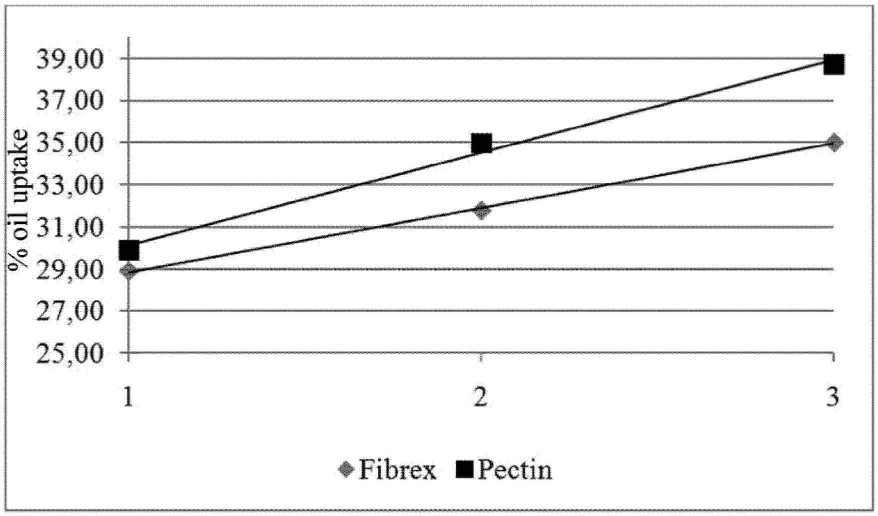

Figure 1. Oil uptake in samples 1F-3F and 1P-3P.

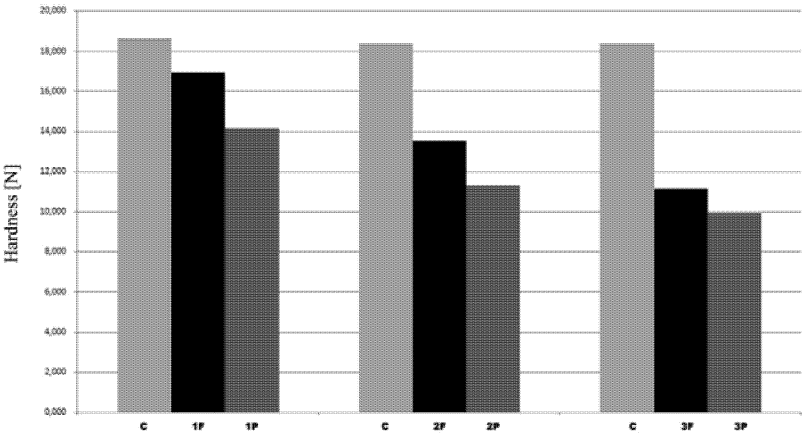

Figure 2. Hardness of samples.

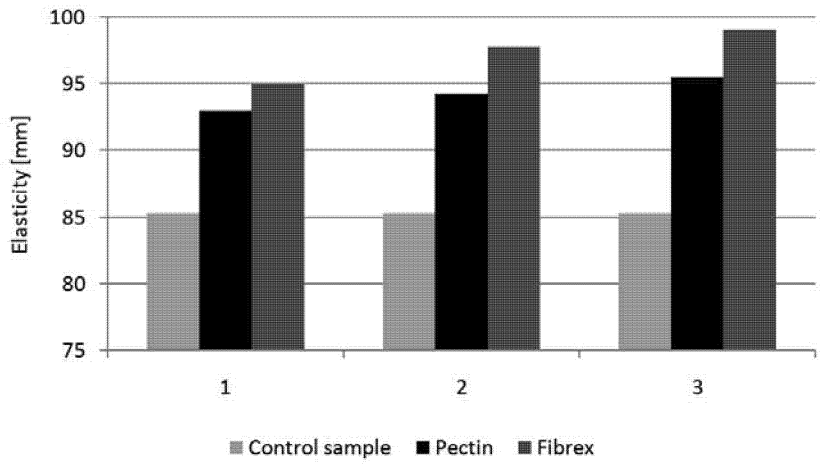

Figure 3. Elasticity of samples

Despite of the lower oil absorption of Fibrex, in Figure 3 is visible that samples 1F to 3 F are more elastic than samples 1P to 3P and control sample. This is result of better water retaining capability of Fibrex, which prevent drying of meat and preserve elasticity. Generally, all samples which contain dietary fibres have more elasticity than control sample. Increasing the amount of dietary fibres in coating mixtures lead to increase in elasticity, so maximum elasticity is reached in sample 3F.

Significantly softer and more elastic samples coated with dietary fibres still satisfy all sensory demands from consumer point of view. It this view, decrease of oil uptake has meaningful health and other improvements, without impact on sensory characteristics of final product. Thus, it can be concluded that the addition of dietary fibre in coating mixtures is beneficial and desirable.

4. Conclusion

Hardness gradually drops with increase of Fibrex or pectin in samples.
Fibrex absorbs more oil than pectin and consequently hardness of samples containing Fibrex is lower than samples with pectin.
Both dietary fibres absorb lower amount of oil than control sample. Water loss is evidently higher in control sample, so its hardness is highest.
Elasticity is greatest in samples which contain Fibrex and its value increase with increase in Fibrex content.

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