JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2017, *23* (3), 148-150

Journal of Agroalimentary Processes and Technologies

The Effect of Temperature on Soluble Dietary Fiber Fraction in Rice

Adrian Căpriţă[1], Rodica Căpriţă[2*]

[1] *Department of Food Technology, Banat's University of Agricultural Sciences and Veterinary Medicine ''King Michael I of Romania'' from Timisoara, 300645-Timişoara, Calea Aradului 118, România*
[2] *Department of Biotechnologies, Banat's University of Agricultural Sciences and Veterinary Medicine ''King Michael I of Romania'' from Timisoara, 300645-Timişoara, Calea Aradului 118, România*

Received: 05 July 2017; Accepted: 30 August 2017

Abstract

Dietary fiber (DF) consists of components with different degrees of solubility. Thermal treatment can modify both the chemical composition and the physical properties of DF. The study was conducted to evaluate the effect of thermal treatment of rice flour on the aqueous extract viscosity values. Rice samples were heated for 5, 10 and 15 minutes at 100ºC. The soluble DF fraction was separated by a single extraction at a ratio 1:2, at 40°C for 60 minutes. Thermal treatment of plant tissues alters the physicochemical properties of the plant cell wall. The experimental data revealed that thermal processing increased the extract viscosities, which are correlated with the proportion of soluble DF in rice, suggesting a redistribution of the total DF content from insoluble to soluble components. An influence of the time interval elapsed since the separation of extracts by centrifugation to measurement was also observed.

Keywords: rice, dietary fiber, water extract viscosity

1. Introduction

Dietary fiber (DF) is defined as the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine.

DF includes cellulose and lignin, pectins, gums, hemicellulose and other polysaccharides and oligosaccharides, which are associated with the plants. DF is also defined as "edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the small human intestine" [1]. DF is classified according to their water solubility in insoluble dietary fiber (IDF) such as cellulose, part of hemicellulose, and lignin, and soluble dietary fiber (SDF) such as pentosans, pectin, gums, and mucilage [2]. SDF dissolves in water to form a gel-like material [3].

It can help lower blood cholesterol and glucose levels. SDF is found in oats, peas, beans, apples, citrus fruits, carrots, barley and psyllium. IDF promotes the movement of material through the digestive system and increases stool bulk, so it can be of benefit to those who struggle with constipation or irregular stools. Whole-wheat flour, wheat bran, nuts, beans and vegetables, such as cauliflower, green beans and potatoes, are good sources of insoluble fiber.

Intake of fiber through various foods such as nuts, whole-grain flour, fruits, and vegetables is now associated with decreased low-density lipoprotein (LDL)-cholesterol, lower insulin demand, increased stool bulk, softening of fecal contents, and improved laxative properties [4-6]. Fiber has also been associated with body weight regulation [7]. Fiber increases mucin secretion for lubrication

Corresponding author: *e-mail:* rodi.caprita@gmail.com

purposes and deficiency of fiber results in colonic mucosal fragility [8]. Epidemiological studies have correlated high consumption of DF with lower incidence of certain diseases such as cardiovascular and cancer of colon and rectum. Such findings boosted searches for DF. Several conditions such as diabetes, atherosclerosis, breast cancer, diverticulitis, hemorrhoids, and also the presence of obesity have been connected to a low intake of fiber [9-11]. Fiber has now become the 3rd most sought-after health information in supermarkets, in countries like India, Australia, in Western Europe, and North America [12].

Most of food processes are essentially based on heating for a certain time, and thermal processing of plant tissues alters the physical and chemical properties of plant cell wall and modifies fiber solubilization [13], which modifies the water extract viscosity (WEV).

Even if total DF content is relatively unaffected, the functional properties of the fibers may be changed [14]. During heating, glycosidic linkages may be broken and the DF polysaccharides depolymerised. The extent of polymerization is strongly dependent on the extent of the heat treatment [15,16].

The study had in view the effect of thermal processing on WEV of rice flour.

2. Materials and Methods

The effect of temperature on WEV (which is correlated with the soluble DF content) obtained from rice flour was determined. The influence of the time elapsed after extract separation on WEV was also determined.

Rice samples were milled to 500 μm granulation, and heated for 5, 10 and 15 minutes at 100ºC in a Froilabo AC60 forced air oven.

The water-soluble fractions were obtained by a single extraction at a ratio 1/2 (flour/water), by shaking the tubes at 150 rpm, for 60 minutes at 40ºC, using a LabTech LSB-015S water bath.

The extracts were centrifuged for 10 minutes at 5,000 rpm and 25°C, using a Hettich 320R centrifuge.

The dynamic viscosity was determined using a cone/plate viscometer Brookfield Model DVIII Cone CP-40, at 100 rpm and 25°C, immediately after separation, and at 30 and 60 minutes after centrifugation. The relative viscosity was calculated [17].

3. Results and Discussion

The experimental data revealed that thermal processing at 100ºC increased the extract viscosities, which are correlated with the proportion of soluble DF in rice, suggesting a redistribution of the total DF content from insoluble to soluble components. An increased temperature breaks weak bonds between polysaccharide chains and split glycosidic linkages in the DF polysaccharides. As consequence, the architecture of the fiber matrix may be modified and insoluble fiber solubilized.

The relative viscosity values of water extracts from rice increased up to 1.39 cP (18.34% increasing) when heating at 100ºC for 10 minutes (Figure 1).

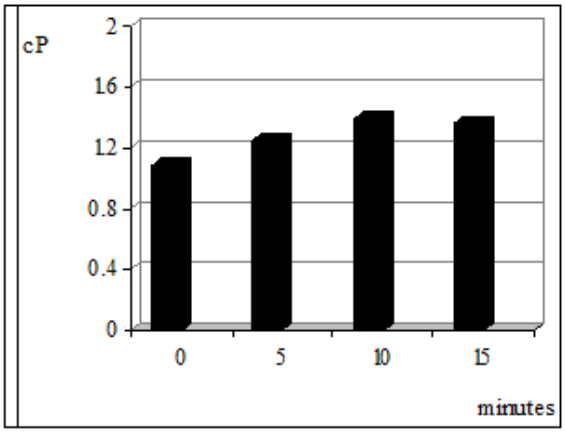

Figure 1. Relative viscosities of water extracts from rice flour heated at 100ºC for 5, 10 and 15 minutes

An influence of the time interval elapsed since the separation of extracts by centrifugation to measurement was also observed.

Determinations of WEVs at different time intervals elapsed after extract separation, show that heating rice flour at 100°C for 15 minutes deactivated the endogenous hydrolytic enzymes, when no significant decrease of WEV values with the time elapsed after extract separation was observed (Figure 2).

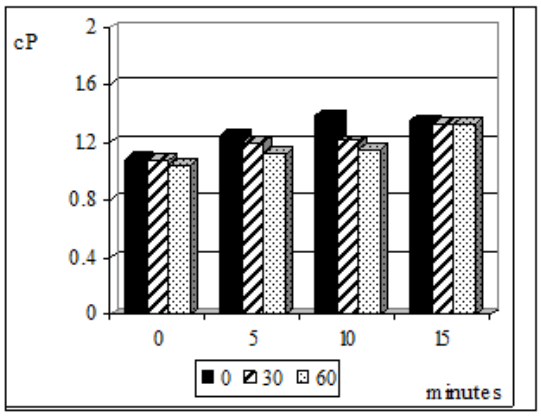

Figure 2. WEVs of the rice samples heated at 100°C, at different time intervals elapsed after extract separation

4. Conclusions

Thermal treatment of rice flour at 100ºC produced an increase of water extracts viscosities, suggesting a conversion of the insoluble dietary fiber into soluble dietary fiber.

The increasing of relative viscosity values of water extracts was up to 18.34% when heated at 100ºC for 10 minutes.

Heating rice flour at 100°C for 15 minutes deactivated the endogenous hydrolytic enzymes, so no significant decrease of WEV values with the time elapsed after extract separation was observed.

References

1. Mongeau, R., *Dietary fiber.* In*: Encyclopedia of food science and nutrition*, Macrae R, Robinson RK, Sadler MJ (eds), Academic Press, New York, **2003**, pp. 1362–87.
2. Esposito, F,; Arlotti, G.; Bonifati, A.M.; Napolitano, A.*;* Vitale, D.; Vincenzo, F., Antioxidant activity and dietary fiber in durum wheat bran by- products, *Food Res. Int.* **2005**, *38*,1167–73.
3. Căpriţă, R.; Căpriţă, A., Chemical methods for the determination of soluble and insoluble non-starch polysaccharides-Review, *Scientific Papers Animal Science and Biotechnologies* **2011**, *44*, 73-80.
4. Gordon, D.T., 1989. Functional properties vs. physiological action of total dietary fiber, *Cereal Foods World* **1989**, *34*(7), 517–25.
5. Brown, M.C.; Faludi, A.A.; Batlouni, M., Evaluation of the effects of a new fermented milk product (Gaio) on primary hypercholesterolemia, *Eur. J. Clin. Nutr*. **1999**, *53*, 97–101.
6. Park, Y.; Hunter, D.J.; Spiegelman, D.M.; Bergkvist, L.; Berrino, F.; Van Den Brandt, P.A.; Buring, J.E.; Colditz, G.A.; Freudenheim, J.L.; Fuchs, C.S.; Giovannucci, E.; Goldbohm ,R.A.; Graham ,S.; Harnack, L.; Hartman, A.M.; Jacobs, D.R.; Kato, I.; Krogh, V.; Leitzmann, M.F.; McCullough, M.L.; Miller, A.B.; Pietinen, P.; Rohan, T.E.; Schatzkin, A.; Willet, W.C.; Wolk, A.; Zeleniuch-Jacquotee, A.; Shumin-Zhang, S.M.; Smith-Warner, S.A., Dietary fiber intake and risk of colorectal cancer, *J. Am. Med. Ass*. **2005**, *294*(22), 2849–57.
7. Howarth, N.C.; Saltzman, E.; Roberts, S.B., Dietary fiber and weight regulation, *Nutr. Rev.* **2001**, *59*(5), 129–39.
8. Strugala, V.; Allen, A.; Dettmar, P.W.; Pearson, J.P., Colonic mucin: methods of measuring mucus thickness, *Proc. Nutr. Soc*. **2003**, 62, 237–43.
9. Gutkoski, L.C.; De Bonamigo, J.M.A.; De Teixeira, D.M.F.; Pedo, I., Development of oat-based cereal bars with high dietary fiber content, *Ciencia e Tecnologia de Alimentos* **2007**, *27*(2), 355–63.
10. Alfieri, M.A.; Pomerleau, J.*;* Grace, D.M., Anderson, L., Fiber intake of normal weight, moderately obese and severely obese subjects, *Obes. Res.* **1995**, *3*, 541–7.
11. Van Itallie, T.B., Dietary fiber and obesity, *Am. J. Clin. Nutr*. **1978**, 31, S43–52.
12. Mehta, R.S., Dietary fiber benefits, *Cereal Foods World* **2005**, *50*(2), 66–71.
13. Căpriţă, A.; Căpriţă, R., The effect of thermal processing on soluble dietary fibre fraction in wheat, *Journal of Food, Agriculture & Environment* **2011**, *9*(3&4), 14-15.
14. Nyman, E.M.G.L., Importance of processing for physico-chemical and physiological properties of dietary fiber, *Proc. Nutr. Soc*. **2003**, 62:187–92.
15. Nyman, E.M.G.L.; Svanberg, S.J.M.; Asp, N.G.L., Molecular weight distribution and viscosity of water-soluble dietary fiber isolated from green beans, Brussels sprouts, and green peas following different types of processing, *J. Sci. Food Agri*., **1994**, *66*, 83–91.
16. Svanberg. S.J.M.; Gustafsson, K.B.H.; Suortti, T.; Nyman, E.M.G.L., Molecular weight distribution, measured by HPSEC, and viscosity of water-soluble dietary fiber, in carrots following different types of processing, *J. Agric. Food Chem*. **1995**, *43*, 2692–7.
17. Căpriţă, R.; Căpriţă A., The Variation of Relative and Reduced Viscosity with Concentration in Wheat and Barley Aqueous Extracts, *Scientific Papers: Animal Science and Biotechnologies* **2012**, *45*(2), 117-120.