RHEOLOGY, TECHNOLOGICAL AND SENSORY CHARACTERISTICS OF FORTIFIED DRINK PRODUCTS WITH FIBERS

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Abstract

Fruits, vegetables and grain all produce a complex carbohydrate known as fiber that plays an important role in overall health. As fiber passes through gastrointestinal system, it isn't absorbed or digested like protein or fat. Instead, it stays in intestines to produce soft, formed stools that pass easily through body. Fiber also combines with fluid to create a gel-like substance that helps lower the level of cholesterol and glucose in blood. To make yoghurt even more beneficial to health and to replace conventional stabilizers with newer, healthier ones a research has been carried out, during which conventional processing aids used to improve the consistence of yoghurt, were replaced with orange pulp, pectin, bamboo and cane fibers. This study evaluated the effect of the supplementation of the same dietary fiber on the syneresis, stability, pH, acidity, dry matter content, viscosity and sensory evaluation of yogurt, juices and juice drinks. Dry matter content evaluation results showed that all the fibers were able to increase the dry matter content of yoghurt, juices and juice drinks. Viscosity measurements confirmed that fiber improved the consistence of yogurt. Results indicate that the Citri-Fi fiber is an almost applicable ingredient for the design of new high value-added yoghurt, juices and juice drinks.

Keywords: dietary fiber, yoghurt, juice drinks, texture.

Introduction

Fruits, vegetables and grain all produce a complex carbohydrate known as fiber that plays an important role in overall health. As fiber passes through gastrointestinal system, it isn't absorbed or digested like protein or fat. Instead, it stays in intestines to produce soft, formed stools that pass easily through body. Fiber also combines with fluid to create a gel-like substance that helps lower the level of cholesterol and glucose in blood and dietary fiber intake on a daily basis to prevent obesity, atherosclerosis, heart diseases, gut cancer and diabetes (Granato et al., 2010, Ramage et al., 2014).

High quantities of new minimally processed foods have appeared on the market in response to a growing demand for natural products that are perceived by consumers as healthier. Among them are beverages based on a mixture of fruit juices and milk fortified with vitamins, minerals and fiber (Renuka, 2009). These beverages are the most widely consumed functional foods. Today's consumers who being more health conscious are seeking products with greater health benefits and there is a great demand for “health foods”.

A major concern of the yoghurt industry is the production and maintenance of a product with optimum consistency and stability. Tamime and Robinson (2007) mentioned that factors known to improve consistency are increasing total solids, manipulation of processing variables and characteristics of starter culture. The addition of stabilizers (such as polysaccharides) improves body and texture, appearance and mouth feel and retards syneresis of yoghurts (Hussein et al., 2011). The addition of polysaccharides as a stabilizer in the manufacture of yoghurt is a common practice. Stabilizers are sometimes referred to as hydrocolloids and have two basic functions in yoghurt: the binding of water and improvements in texture.

For the development of new fermented milks, the influence of modifications in the milk base on texture, rheology and sensorial properties of products has been studied, concerning mainly the lipid content of milk (Santo et al., 2012a, 2012b), the total dietary fiber (DF) contents (Santo et al., 2013), and the addition of proteins to increase total solids (Marafon et al., 2011). Formulation of new food products with ingredients from fruit by-products rich in total DF has increased in recent years. Dietary fiber can be fractioned into two major groups of components, the water-insoluble and the water-soluble fraction. While the insoluble fraction stimulates the intestinal peristalsis, the soluble one promotes the selective growth of the indigenous microbiota, acting as a prebiotic. Therefore it is healthier to consume the total dietetic fiber, instead of just its prebiotic fraction. One of the promising fruit by-products is orange pulp fiber, which, in addition to its functional properties such as the reduction of cholesterol and glucose in blood serum. Moreover, orange pulp fiber enhanced the texture parameters of ice-cream (Crizel et al., 2013). Based on this background, the present study aimed to evaluate some important aspects of the rheology, spontaneous whey separation, acidity of fruit juice beverages (apple juice) and yoghurts enriched with different kinds of fiber.

Materials and Methods

Preparation of apple juice

Fibers were mixed with the apple juice after pasteurization 85 °C, in 200 mlL pasteurized apple juice added 3 g fibers. By analogy, all tests have been carried out with different types of fiber: Potatoes fiber (Campus fiber 110), Orange pulp fiber (Citri-Fi 100). When fibers were placed in the juice, the mixtures were homogenized at 10000 rpm and left in the fridge for 24 hour at 4 °C.

Preparation of yoghurt

Four types of yoghurts were prepared. The fibers used for yoghurt preparation were used: sugar cane fiber (JustFiber SC 200), bamboo fiber (JustFiber BFC 40), Orange pulp fiber (Citri-Fi 100). For the analysis, each yoghurt type was prepared in duplicate in two independent batch fermentations (N=4) 0.5% and 1% (in the final yoghurt) concentrations of fibers (Table 1) were dissolved individually in the 500 mL amount of milk, homogenized, and heated to 85 °C for 5 min. The flasks containing 500 mL of the heat treated skim milk base were inoculated with yoghurt starter cultures (YO-MIX LYO DUC, Danisco, Germany). Afterwards, the flasks with the samples were transferred to a water bath at 42 °C. At pH 4.5, fermentation was stopped and the flasks were cooled to 6 °C in an ice bath and stored in refrigerator at 4 °C.

Table 1

Specification of fiber

Fibre	Appearance	Total dietary fiber, %	Ash, %	pH (10% suspension)
Sugar cane fiber	Fine cream white fiber	99.0	0.5	5.0–7.5
Bamboo fiber	Fibrous white powder	99.0	0.3	4.0–7.0
Orange pulp fiber	Light yellow powder	68.2	2.65	5.0-7.0
Potatoes fiber	White powder	72.0	3.0	5.0–7.0

Methods of analyses

Titratable acidity (using 0.1 N NaOH for titration and phenolphthalein as an indicator) according ISO/TS 11869:2013. Total solids were measured by electronic moisture analyser (KERN MLS 50-3). The viscosity measurements were performed in triplicate at 18 °C in a rotational viscometer (Fungilab, Spain) with spindles R3 (juice) and R2 (yoghurt). Water holding capacity (WHC) was performed as described (Wu et al., 2013). 10 g of samples were centrifuged at 1800 g for 20 min at 25 °C. The sedimentable fraction was calculated by the ratio of the weight of sediment to the weight of the sample. All measurements were performed in triplicate. Arithmetic mean standard deviation was calculated for each sample.

Results and Discussion

Analyses of apple juice beverages

At first step apple juice was fortified with different kinds of fiber, as Sugar cane fiber, Bamboo fiber, Orange pulp fiber and Potatoes fiber. Sensory analysis indicated that only juice with Orange pulp fiber (Citri-Fi) and Potatoes fiber (Campus) was acceptable taste.

Quantitative solids evaluation of juice beverages samples (Table 2) indicated that apple juice with Citri-Fi fiber had highest amount of dry matter. The potato pulp fiber (Campus, 0.5%) reduced the dry matter in samples.

Table 2

Total solids of juice

Samples	Dry matter, %
Citri-Fi M 40 0.5%	11.92
Citri-Fi 200 FG, 0.5%	12.27
Campus, 0.5%	11.02

The apple juice acidity is expressed in the presence of malic acid. It is thought that Citri-Fi 200 FG fiber acids adsorbed more than another fiber used because this kind of fiber is natural mixture of citrus fiber and guar gum (Fig. 1).

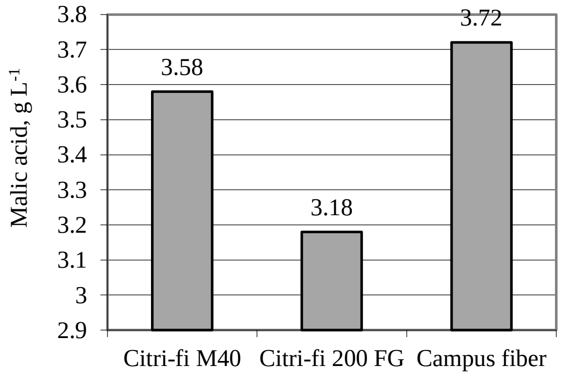

Figure 1. Acidity of apple juice with different fiber

Sedimentation results are presented in Figure 2. The results showed that juice with potato fiber sedimentation was bigger than with citrus fibers.

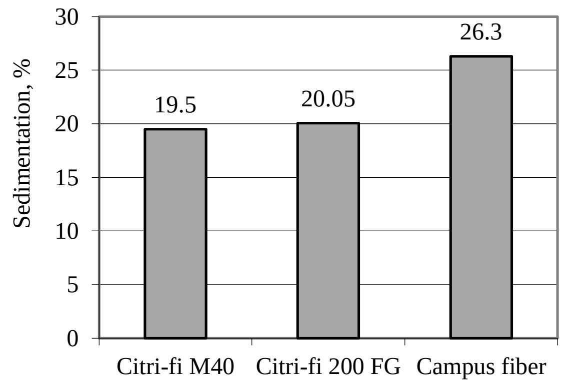

Figure 2. Sedimentation of apple juice with different fiber

Viscosity flow dependency of used kind of fiber is showed on Fig. 3.

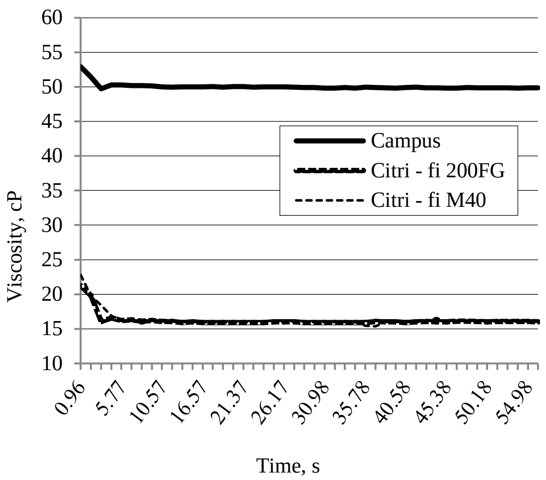

Figure 3. Viscosity flow of apple juice with different fiber

Analyses of yoghurt

Quantitative evaluation of solids of yoghurt samples (Table 3) indicated that yoghurt with sugar cane fiber had highest amount of dry matter. The orange pulp fiber 1% increased significantly the dry matter of samples compare to 0.5%.

Table 3

Total solids of yoghurt

Samples	Dry matter, %
Sugar cane 0,5%	13.47
Sugar cane 1%	13.5
Bamboo 0,5%	12.07
Bamboo 1%	12.75
CitriFi 0.5%	12.31
CitriFi 1%	13.24

The results of titratable acidity at the end of 3 weeks (21 days) exhibited the increasing in Figure 4. The highest influence on acidity was observed in yoghurts supplemented with sugar cane 0.5% and bamboo 0.5% fibers. The addition of fiber to 1% decreased variation of acidity.

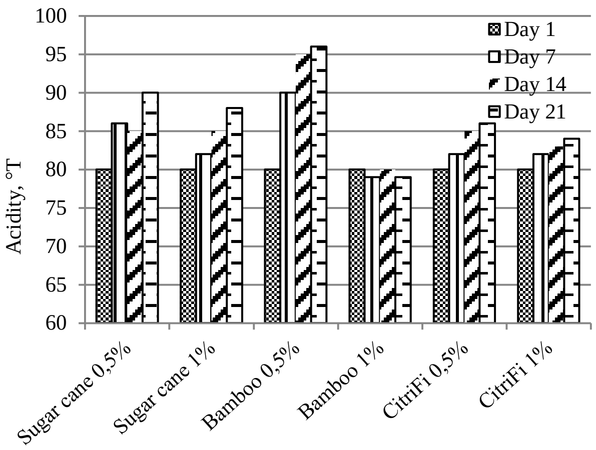

Figure 4. Titratable acidity of yoghurts with different fiber

The stability of yoghurt samples with fiber were characterized by sedimentation measurements as shown in Figure 5. The 1 day results showed that kind of fiber had no influence to sedimentable fraction. Otherwise, after 3 weeks the content of sedimentable fraction decreased. The experimental results were in agreement with increasing acidity when stability of yoghurt decreased. Therefore, the stability of samples with 1% of bamboo and Citri-Fi was constant.

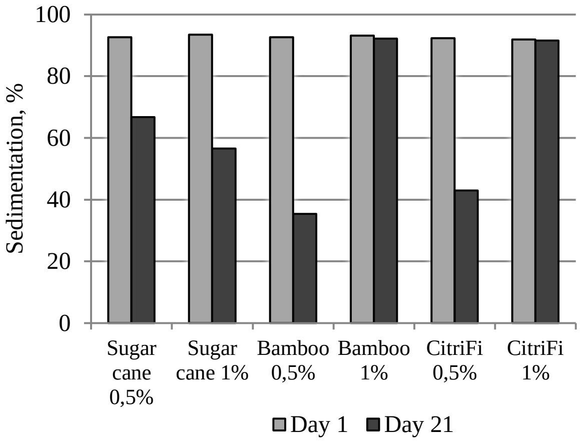

Figure 5. Sedimentation of yoghurts with different fiber

As can be seen from Figures 6, 7, 8, the viscosity of yoghurt with different fiber exhibited shear-thinning flow behaviour. The viscosity of yoghurts with sugar cane (Figure 6) decreased during time. During cold storage the behaviour of viscosity didn`t changed.

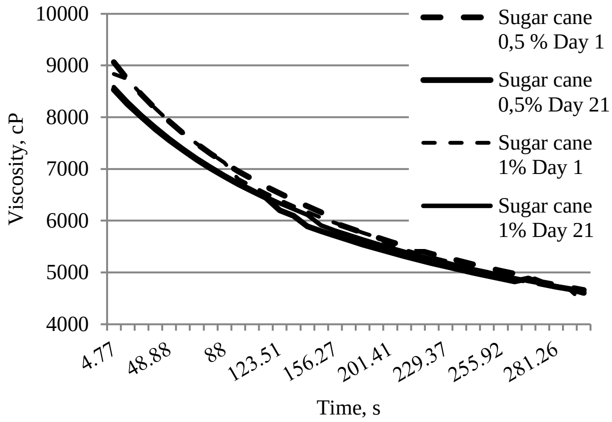

Figure 6. Viscosity flow of yoghurts with sugar cane fiber

The same viscosity decreasing during storage was observed with Citri-Fi fiber (Figure 7). Results indicated that concentration of fiber had no influence.
The viscosity results with bamboo fiber didn`t showed the significant differences (Figure 8). Moreover, yoghurts with sugar cane and bamboo fiber were less viscous at the end of storage. The Citri-Fi fiber helped yoghurt to keep structure more constant.

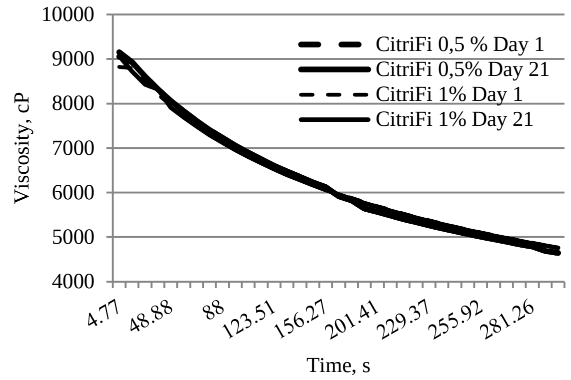

Figure 7. Viscosity flow of yoghurts with orange pulp fiber

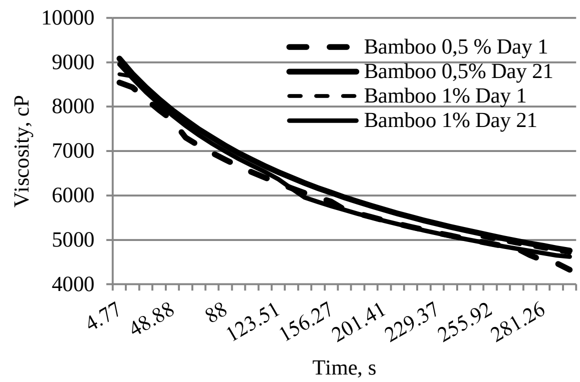

Figure 8. Viscosity flow of yoghurts with bamboo fiber

Conclusions

Results showed that apple juice could be produced by using citrus and potatoes fiber. The essential physicochemical parameters of apple juice depending on fiber kinds remained essentially unchanged, but juice with Citri-Fi 200 FG fiber which guar gum adsorbed more malic acid.

Enriching yoghurt with bamboo and orange pulp fiber offered a scaffold that strengthened the yoghurt's structure, and increased stability during storage. The experimental results have demonstrated that as a potential stabilizer, the orange pulp fiber – Citri-Fi 100 has shown promise for the stabilising yoghurt system.

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