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Rheological properties of maltodextrin based fat - reduced confectionery spread systems

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Abstract

Vegetable fat for confectionery spreads was partially replaced with two different types of maltodextrin gels (potato and specialty waxy maize maltodextrin gel) used as fat replacers at 20% gel concentration. The fat replacement levels were 15%, 30% and 50%. Fullfat confectionery spread was used as a control sample. Steady shear (hysteresis loop, apparent viscosity and yield stress determination), oscillatory and firmness measurements were performed. Also, melting profile of a confectionery vegetable fat was determined in order to confirm the working temperatures of all tests. Reduced fat systems with fat replacement level above 15% resulted in the formation of a product with inverted phases, so called ′ganache′ no matter of the used maltodextrin gel type. Therefore, only systems with 15% replacement level were observed. The incorporation of both types of maltodextrin gel as fat replacers in reduced fat system resulted in significant increase in degree of thixotropy, yield stress value, apparent viscosity, elastic moduli and firmness value. Also, reduced fat systems prepared with potato maltodextrin gel expressed more significant increase in all tested rheological parameters in comparison to waxy maize maltodextrin gel containing systems. This study showed that incorporation of maltodextrin gels used as fat replacers can be performed up to 15%. However, negative influence on system rheology was observed. Therefore, further studies should focus on changing preparation techniques as well as the addition of different emulsifier.

Keywords: vegetable fat; maltodextrin; reduced fat; rheology

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Chocolate and chocolate type products represent semi-solid suspensions of sugar, cocoa, milk powder, hazelnut and other ingredients particles in a continuous fat phase [1]. Chocolate type products,

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confectionery spreads may contain other vegetable fats than cocoa butter, e.g. palm oil, soybean oil etc. [2]. Due to high fat content, these products have high caloric value. However, one of the demands in modern nutrition regarding the increasing human obesity is to decrease fat consumption. Also, it is well known that fat plays one of the major roles in product rheology, texture and sensory properties. It was estimated [3] that large group of functional properties of fat-containing products e.g. spreadability, gloss, graininess or smoothness are governed by the characteristics of the crystal network formed by its constituent lipid species. Also, properties of fat crystal network are influenced by chemical composition, solid fat content, fat polymorphism etc. [4]. According to Hadnađev et al. [5] rheological behaviour of blends in which the part of the vegetable fat is replaced with maltodextrin gel is mainly governed by the properties of maltodextrin phase. It was observed that in a solid state (20°C), waxy maize maltodextrin allowed fat replacement up to a level of 50 %, expressing only a minor decrease in firmness value. In contrast, the potato maltodextrin was found to cause significant decreases in firmness value.

The aim of this work was to investigate the possibility of replacing certain amount of vegetable fat with two different types of maltodextrin gels in chocolate type confectionery spread product. Rheological and textural measurements were performed in order to determine the changes in handling and storage properties in reduced fat systems.

2. Materials & Methods

2.1. Materials

Confectionery vegetable fat, melting range temperature 30-32°C, was donated by oil industry Dijamant Zrenjanin, Serbia.

Two types of maltodextrin were used:

potato maltodextrin characterized by DE = 3.5 and moisture w = 4.7% and

maltodextrin obtained from waxy maize starch by special enzyme hydrolysis (isoamylase) characterized by DE = 2 and moisture w = 5.5%.

Reduced fat chocolate spread was prepared in the laboratory Ballmill Refiner CAO-B5 (Caotech, Wormerveer, The Netherlands).

2.2. Preparation conditions

Twenty percent of maltodextrin solutions were prepared and left for 24h at room temperature in order to obtain gels. Consequently, the obtained gels were gently mixed with vegetable fat and incorporated in reduced fat chocolate spreads in modified 50g Farinograph mixing bowl. The mixing was kept for 15 minutes at 30°C. The extent of fat reduction was 15%, 30% and 50%.

2.3. Steady shear measurements

Hysteresis loop method was used to establish the extent of system thixotropy. Shear rate was increased from 0-100 1/s, it was kept at 100 and finally decreased from 100-0 1/s at 30°C using Z20 cylinder geometry. Duration of each step was 240s. All rheological measurements were performed in triplicates by HAAKE MARS, ThermoScientific, Germany. Obtained hysteresis loop areas which refer to system thixotropy were calculated using Origin 6.1 Scientific Graphing and Data Analysis Software (OriginLab Corporation, USA). Moreover, the apparent viscosity at 100 1/s were recorded.