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Rheological behavior of sesame paste/honey blend with different concentration of honey

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ABSTRACT

Sesame paste is oil-in-water emulsion that is one of the traditional foods stuff in Iran and usually mixed with sweetener agent and consumption. In this research sesame paste was mixed with 3 different concentrations (36, 39 and 42 %) of honey. The experiments performed to characterize the time dependency of prepared samples. Result of this study revealed that all of the samples were shown time independency and shear thinning behavior.

Keywords: Sesame paste, Rheological properties, Honey.

INTRODUCTION

Ardeh is a local food product in Iran breakfast that produced from sesame seed (*Sesamum indicum* L.), which is milled, dehulled and roasted. This product is very popular in Eastern Asian and Middle East countries and is known by different names for examples Tahineh and Tahin in Arabic and Turkey countries respectively. Due to its high energy, it has a wide consumption especially in winter. This product has valuable nutrition component. It is rich in proteins (17-27%), carbohydrates (6.4-21%) lipids (54-65%), and dietary fiber (9.3%), in addition it contains vitamins and minerals in cloud niacin (4.5-5.5 mg/100g), calcium (429mg/100g), iron (9g/100g), phosphorous (732-840mg/100g), and thiamin (1.1 mg/100g) [1]. Also it has antioxidant activity and due to its high content of polyunsaturated fatty acid can reduce level of blood cholesterol [2]. Consumer prefer sweet taste for Ardeh, so this product usually consumption with sweating agent such as honey or concentrated grape juice. In the Iranian market, Ardeh is sold separately so the blends with other ingredient usually sweetener agent is prepared at home by the consumers. For blend preparation, the ratio of Ardeh to other component is measured by consumers according to their preference and taste. Consumer acceptance of honey/Ardeh blend is dependent on its flow behavior to spread on bread. This has a direct relationship with rheological properties. In addition, preparing and maintenance of the quality of product while providing suitable textured and stability during storage period in different condition are the most important concerns and require true rheological information [1]. Knowledge on rheological behavior is important for sensory assessment, quality control, consumer acceptance of a final product, design, different process such as, direction of feed, evaporator and heat transfer rate [3]. The 2 immiscible liquids; Ardeh and honey form a two-phase system. So this blends can be define as an oil-in-water emulsion. The stability of an emulsion system is

related on the water -oil interface. Between the different surfactants, proteins are the suitable classes of emulsifiers that stabilize the food emulsion by surrounding the droplets and stabilizing for aggregation and coalescence. In the case of Ardeh/honey blend, protein of sesame interacts with lipids to form stable food stuff. Ardeh has a high dietary fiber and protein content, so when enriched with high vitamin and mineral containing honey, it offers a valuable and nutritious food to consumers [4]. There is a number of different studies about rheological properties of Ardeh. Habibi-Najafi, and Alaei (2006) demonstrated time dependent rheological properties of tahin [5]. The organoleptic and rheological properties of pekmez/ tahin blends were studied by Alparslan & Hayta, (2002) [4], But rheological data about Ardeh/honey blends with a suitable ratio of the ingredient is limiting in the articles. Therefore, the aim of this study was to determine the time dependent rheological properties of Ardeh/honey blends at different honey concentrations (36-39-42%) in constant temperatures (20 °C) by using a rotational viscometer.

MATERIALS AND METHODS

Materials

Ardeh was obtained from a local company and mixed with 3 different concentrations (36, 39, and 42%) of honey. In all the samples the weight of Ardeh was 450 gram.

Methods

Flow properties of samples were determined with a Haake-VT 500 viscometer (bob diameter 20.2 mm, bob length 61.4 mm). Samples were allowed to rest for about ten minutes before to measuring their rheological properties. The experiments performed to characterize the time of the viscosity of samples. The result of this test was the changes of apparent viscosity versus time in three different rotational speeds (60, 500 and 1000 1/s). Sample with different concentration of honeys were loaded into the gap of the cylinder viscometer and then left to reach the suitable temperature (20 °C). Also, the change of shear stress versus shear rate was measured, by continuously increasing and decreasing of the shear rate (Forward and backward measurements). The shear rate was varied from about 0 to 150 1/s [6].

RESULTS AND DISCUSSION

In some food system, in constant shear rate, the apparent viscosity can be constant (time independent behavior) either decrease or increase with time of shearing (time dependent behavior), these changes of viscosity can be reversible or irreversible. Time independent fluids can be categorized into three classes: Pseudoplastic, Bingham and Plastic, and time dependent fluids divided in to two group Rheopectic and Thixotropic fluids [7]. The change of viscosity versus time was shown in figures 1- 3. Samples of Ardeh with different concentration of honey (36 – 39 and 42 %) were sheared at different values of constant shear rate (60 -500 and 1000 rpm) and at constant temperatures (20 °C). At a constant shear rate, the apparent viscosity was constant within the time of shearing (10 min). It means structure of prepared samples didn't significant change during test condition. For examples in the samples with 39% honey viscosity was about 1800, 1500 and 1500 mpas when applied spindle speed was 60, 500 and 1000 rpm and after 10 min remained similar with its level at the initial time of experiment (Fig. 2). Just during the two first min of experiment, a low decreased of viscosity was observed in samples with 42 % honey, when 500 rpm was applied (Fig.3). The level of viscosity depended on the applied shear rate. In all the samples viscosity decreased with shear rate, this behavior known as pseudoplastic flow behavior. Previous work has shown that Ardeh with different concentration of honey showed shear thinning behavior [8]. In this regard, viscosity of samples with 42 % honey was about 2700, 2200 and 1800 mpas when applied spindle speed with 60, 500 and 1000 rpm (Fig. 3). Also at the end of shearing time viscosity of honey with 36% honey was about 1800 and 1400 by applying the 60 and 500 rpm respectively (Fig. 2). Addition of the honey with Ardeh increased viscosity. It means viscosity was 1800, 1900 and 2700 mpas in sample with 36, 39 and 42% honey (at first second of test and spindle speed: 60 rpm). Here, the presence of sugar of honey appears to be responsible for the increase in the viscosity of samples.

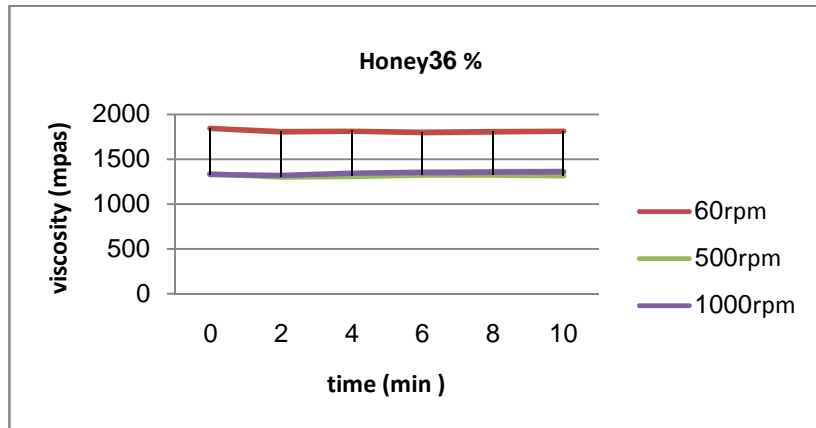


Fig. 1: Effect of different speed of spindle and time on the apparent viscosity of Ardeh with 36% of honey

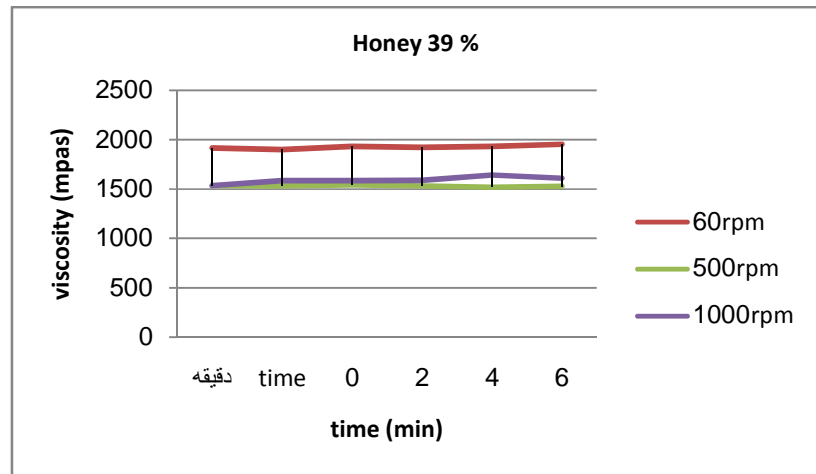


Fig. 2: Effect of different speed of spindle and time on the apparent viscosity of Ardeh with 39% of honey

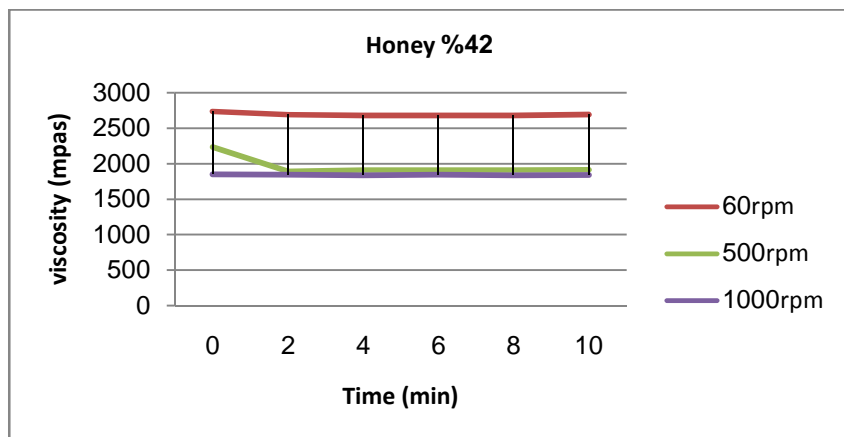


Fig. 3: Effect of different speed of spindle and time on the apparent viscosity of Ardeh with 42% of honey

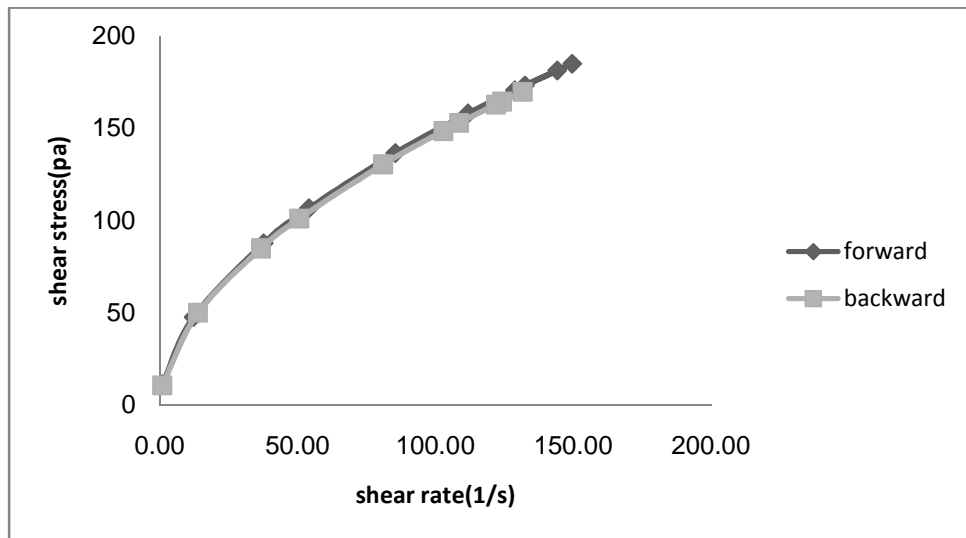


Fig. 4: forward and backward curve for Ardeh with 36% of honey

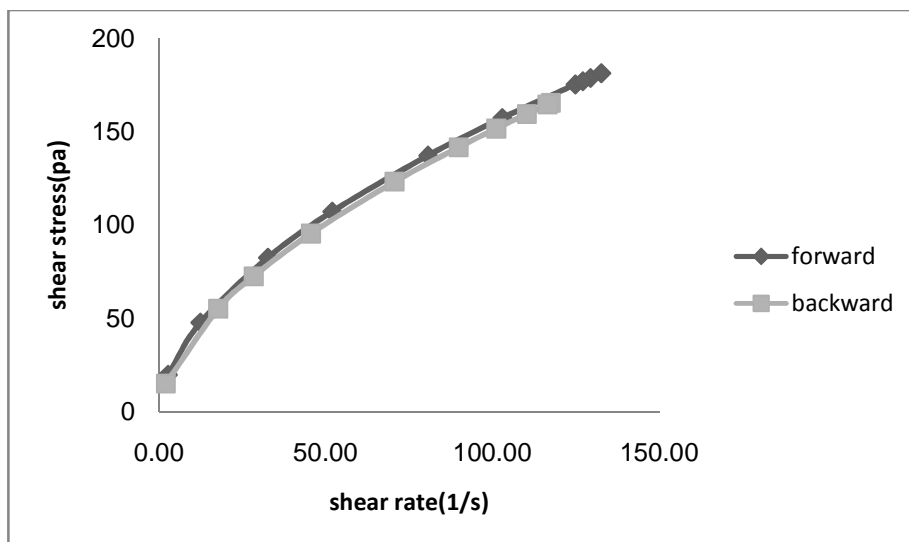


Fig. 5: forward and backward curve for Ardeh with 39% of honey

As mentioned above, the shear stress of Ardeh /honey blend was measured by decreasing (backward measurement) and increasing (forward measurement) the shear rate in order to test for the presence of time-dependent properties. The results show that relationship between the shear stress-shear rate is non-linear, indicating that Ardeh/honey blends behave as non - Newtonian system and known as pseudoplastic fluid. This phenomenon is explained as the shearing of fats globuls causes disruption of structure through the breaking of primary and secondary bond [5]. These flow curves of forward and backward of different samples at constant temperatures are shown in Fig. 4-6. There wasn't any hysteresis loop between the backward and forward curves, indicating time independent rheological properties. But with increasing the honey concentration (42%) very low hysteresis loop was appear (Fig 6), maybe in higher level of honey thytrophic behavior was appear it means hysteresis loop will be wider. It should be pointed out that the time dependent properties have commercial and industrial importance. For instance, since the viscosity decreases with shearing time or shear rate during the mixing operation, this will lead to lower power of mixing machine. Moreover, sedimentation of suspended particles, which in this case would conversely affect the consumer acceptance of the final product. In addition, the time independent and pseudoplastic behaviors of this product have significant effect on its ability to spread on bread, where the Ardeh/honey blend can break down for

suitable spreading. Newtonian fluid couldn't show this behavior, because when spread on bread they squeezing very rapidly, and so reducing the thickness of the desirable film [1]. The results of these curves (Fig 4, 5 and 6) accepted the results of Fig 1, 2 and 3, that both of them showed time independent behavior. Studies regarding the rheological properties of sesame paste blends are found in the some different literatures Habibi-Najafi and Alaei in (2006) [5]; Akbulut et al, (2012) [6] and Abu-Jdayil (2004) [1]. All of these studies were approved that sesame pastes alone or with sweating agent to be shear thinning at all temperatures measured, it means apparent viscosity decreased with the increasing the shear rate, but time dependent behavior and hysteresis loop was observed in some study, Abu-Jdayil, (2004) [1]; Akbulut et al (2012) [6], this observed difference in result may be due to the low level of honey in formulation or different experimental condition.

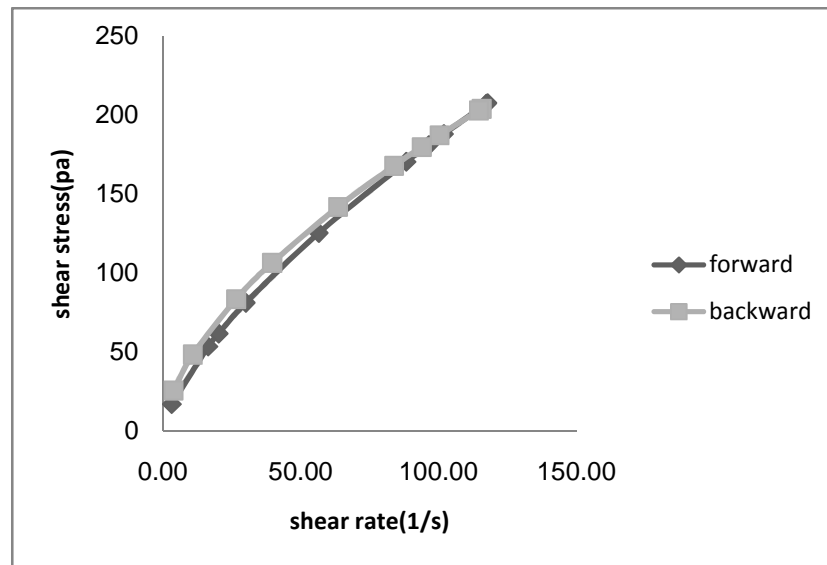


Fig. 6: forward and backward curve for Ardeh with 42% of honey

CONCLUSION

Consumer prefers sesame paste with sweet taste, therefore, usually this product consumed with sweetener agent. Concentration of sweetener agent and rate of shear rate are variables that highly affect the rheological behavior of this blend. The ratio of Ardeh to honey in the blends is a very important determinant for consumer acceptance of final product.

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