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Characterization pH, stability of emulsion, and viscosity canola oil (*Brassicca napus* L.) emulsion (O/W)

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Abstract. The aimed of this research was to determine the best oil in water emulsion as the main ingredient in the gel matrix. The experimental design of this study used a factorial completely randomized design with two factors. The factors were factor canola oil concentration using 30%(CO1), 40%(CO2), and factor xanthan gum concentration using 0.3%(XG1), 0.5%(XG2). The best emulsion formulation was selected based on functional properties such as pH, emulsion stability and viscosity. The result of research showed that the using of 40%(CO2) canola oil concentration and 0.5%(XG2) xanthan gum had the best oil in water (O/W) emulsion. This was indicated by the results of pH 6,5, the highest emulsion measurements (99.4%) and viscosity (22226 cP). canola oil concentration affects the pH value of the emulsion, the stability of the emulsion and viscosity are influenced by the concentration of xanthan gum and the concentration of canola oil. the higher the concentration of xanthan gum, the higher the stability of the emulsion and viscosity.

1. Introduction

Emulsions play a major role in chemical and agrochemical, pharmaceutical and in many food products. Because of requests for reduced energy foods, emulsions with an inner aqueous phase that partly replaces the fat are increasingly used in, for example, fillings, dressings, sauces and desserts. The resulting structural changes often lead to altered sensory and technological properties which, to keep up with the original products characteristics, have to be compensated by additional ingredients (e.g. thickener and antioxidant) or by adapted processing steps [1,2]. Emulsions are composed of two immiscible fluids, with one being finely dispersed within the other. Emulsions can be stabilised by applying emulsifiers, thickeners or weighting agents [3]. The choice of type and concentration emulsifiers will determine the stability of the emulsion formed [4]. Xanthan gum (XG) is an extracellular polysaccharide produced by the bacteria *Xanthomonas campestris* [5]. It is a non-toxic and biodegradable polymer of natural origin that is widely used in the food [6]. Xanthan gum (XG) is used as a thickening and suspending agent and as an emulsion stabilizer [7]. Based on research described the concentration of xanthan gum affects the physical stability of the emulsion produced [8].

Canola oil is extracted from rapeseed and consumed all over the world due to its valuable ingredients [9]. It has a low amount of saturated and a substantial amount of monounsaturated fats with roughly 2:1 mono to polyunsaturated fatty acids [10]. In general, it contains 61% oleic acid which is classified as a monounsaturated omega-9 fatty acid, 11% α -linolenic acid and 21% linoleic acid which are omega-3 and omega-6 polyunsaturated fatty acids, and 7% saturated fatty acids [11,12].



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Canola oil is second to olive oil in oleic acid content and intermediate among other vegetable oils in polyunsaturated fatty acid (PUFA). It contains high level of PUFA comparing to olive and palm oil but lower level than corn, soybean, and sunflower oils [11]. In addition, it contains phytosterols, tocopherols, which are biologically active isomers of vitamin E [11,13], beta-carotenes and chlorophylls [11]. Research on the manufacture of canola oil emulsion in water (O / W) with the addition of xhantan gum has not been carried out, it is hoped that from this study the characteristics of canola oil emulsion in water will be the basis for further research, namely research on the combination of spatial distribution of fat and thin layer biopolymers. as a strategy to improve fat perception from low-fat gel foods.

2. Material and Methods

2.1. Preparation of oil-in-water (O / W) emulsions

Twelve emulsions, varying in canola oil and xhantan gum concentration, were produced in the present study according to a full factorial design based on two factors; canola oil concentration level (CO1 = 30%, CO2 = 40%) and xhantan gum concentration level (XG1 =0,1% XG2 = 0,5%). The concentration of xhantan gum levels had been selected according to their stability in a preliminary test (data not shown). The ingredients used for the emulsion can be seen in table 1

Table 1. Experimental design of oil-in-water (O / W) emulsions with canola oil and xhantan gum

	canola oil (% w/w)	xhantan gum (% w/w)
CO1XG1	30	0.1
CO1XG2	30	0.5
CO2XG1	40	0.1
CO2XG2	40	0.5

To produce the emulsion, the water phase containing canola oil were prehomogenized with an ultraturax (Ultra Turrax IKA-T25 Basic) at 800 rpm for 2 min. Xhantan gum were added to the mix, which was then homogenized with ultraturax (Ultra Turrax IKA-T25 Basic) at 8000 rpm for 2 min. The obtained emulsion o/w were stored at 18°C until used for analyzed.

2.2. Analysis of samples

This stage was chosen the best emulsion formulation based on functional properties such as emulsion stability and viscosity.

2.2.1. Emulsion stability. We transferred 15 g (F0) of each sample to test tubes (internal diameter 15mm, height 125mm), the emulsions were placed in centrifuge tubes and processed for 10 min at 3000 rpm (High Speed Refrigerated Micro Centrifuge, TOMY, MX-305, US) to remove the top oil layer. The weight of the precipitated fraction (F1) was measured, and the emulsion stability was characterized as (%) = (F1/F0)× 100 [14].

2.2.2. Viscosity. Viscosity samples of 100 ml were measured using a viscometer (Viscotech Hispania S.L, Spain) with a speed of 200 rpm using spindle number 1 for CO2XG1, CO1XG1 and number 3 for CO2XG2, CO1XG2. Determination of viscosity is done by observing the numbers on the viscometer scale.

2.2.3. pH. The pH value of sample was determined using a pH meter (Jenway 3010; Jenway Ltd, Essex, UK) equipped with an electrode (J95,924001, Jenway Ltd., Essex, UK).

2.3. Data analysis

Analysis of the data of this study was analyzed using SPSS software version 26 with 3 replications and a Duncan Multiple Range Test (DMRT).

3. Results and discussion

Table 2. Summaries of the functional properties of canola oil emulsions

Research Treatment	pH	Emulsion stability (%)	Viscosity (cP)
CO1XG1	7,1 ^a	90 ^a	1150,3 ^a
CO1XG2	7,3 ^b	99,3 ^b	32091,3 ^b
CO2XG1	6,4 ^c	95,7 ^c	618 ^c
CO2XG2	6,5 ^d	99,4 ^d	22226 ^d

Means : A1B1 (A1% canola oil 30% + B1 xhantan gum 0.1%), A1B2 (A1% canola oil 30% + B2 xhantan gum 0.5%), A2B1 (A2 40% canola oil + B1 xhantan gum 0.1%), A2B2 (A2 40% canola oil + B2 xhantan gum 0.5%).

Note : ^{a, b, c, d} Different superscripts in the same column show differences (P <0.05).

3.1. pH

The pH value of each emulsion shows different results. CO1XG1, CO1XG2 showed emulsions at neutral pH, whereas CO2XG1, CO2XG2 showed acidic pH. The pH of the canola oil emulsion acid is influenced by the concentration of canola oil which is 40% (CO2). Generally, canola oil contains 61% of oleic acid which is classified as monounsaturated omega-9 fatty acids, 11% α -linolenic acid and 21% linoleic acid which is omega-3 and omega-6 polyunsaturated fatty acids. % saturated fatty acids [11,12].

3.2. Stability

Emulsion stability measurements were carried out to see the characteristics of O / W canola oil (oil in water) emulsions. One of the components that has an influence on the physical stability of the emulsion is the stabilizer. Xanthan gum is a hydrocolloid emulsifier that can form to form oil-in-water emulsions. Xanthan gum is non-toxic, can mix with many ingredients, and has good stability and viscosity over a wide range of pH and temperature [15]. It is used as a functionalising, thickening and suspending agent and as an emulsion stabilizer [7]. Based on statistical analysis conducted canola oil concentration (CO) significantly affected the stability of the emulsion for produce of emulsions ($\alpha < 0.05$). The concentration of xhantan gum (XG) also significantly affected the stability of the emulsion for produce of emulsions ($\alpha < 0.05$). Because the canola oil concentration (CO) & xanthan gum concentration (XG) significantly affect the stability of the emulsion, a further DMRT test is performed to see which treatment is significantly different, the results of DMRT emulsion stability can be seen in table 02. The effect of addition concentration of Xhantan Gum and Canola Oil on Canola Oil Emulsion can be seen in Figure 1 and Figure 2.

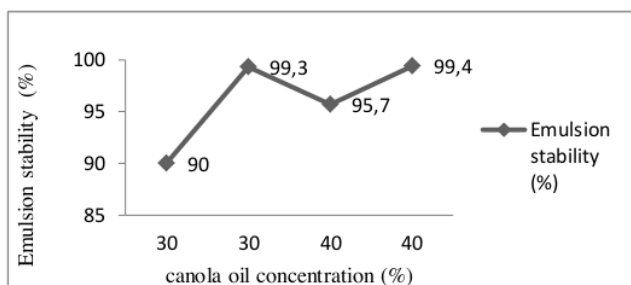


Figure 1. Effect of canola oil concentration on emulsion stability

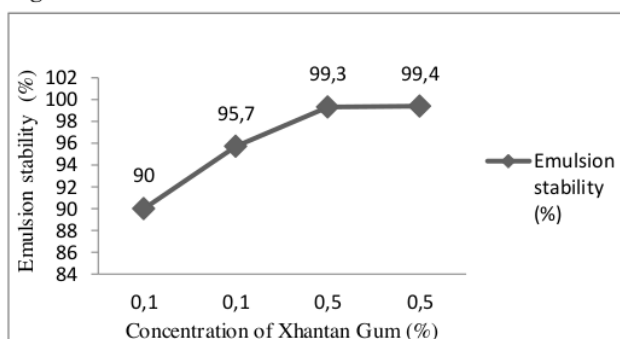


Figure 2. Effect of Xanthan Gum concentration on emulsion stability

Based on figure 1 and figure 2 shows that the higher the concentration of canola oil and xanthan gum is used, the level of emulsion stability increases. The stability emulsion is influenced by several factors, such as particle size, two-phase density differences, storage conditions, including the high and low temperatures, the number and effectiveness of emulsifying emulsions [16]. The addition of low xanthan gum levels (0.2%) causes large decrease in stability, whereas at higher xanthan gum concentrations, stability improves [8].

3.3. Viscosity

Viscosity testing is performed to determine the consistency of the emulsion. Viscosity is an important parameter in the emulsion because the stability of the emulsion is influenced by the viscosity of the emulsion. The higher the viscosity, the smaller the rate of separation of the dispersed phase and the dispersing phase, this causes the product to be more stable [17]. Viscosity measurement results can be seen in Table 2. Based on statistical analysis conducted canola oil concentration (CO) significantly affected the viscosity of the emulsion for produce of emulsions ($\alpha < 0.05$). The concentration of xanthan gum (XG) also significantly affected the viscosity of the emulsion for produce of emulsions ($\alpha < 0.05$). Because the canola oil concentration (CO) & xanthan gum concentration (XG) significantly affect the viscosity, a further DMRT test is performed to see which treatment is significantly different, the results of DMRT emulsion viscosity can be seen in table 2. The effect of addition concentration of Xanthan Gum can be seen in Figure 3.

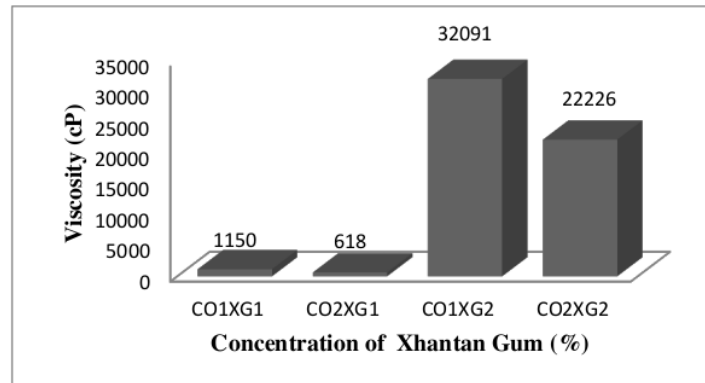


Figure 3. Effect of Xanthan Gum concentration on viscosity

Figure 3 shows a trend towards an increase in the viscosity of canola oil emulsions with increasing xanthan gum concentration. This increase in viscosity is due to the nature of xanthan gum which is completely dispersed in water so that at increasing concentrations of xanthan gum, the emulsion will be thicker [15].

The addition of Xanthan Gum concentration has a correlation to the increase in the value of the stability of the emulsion and the viscosity of the canola oil emulsion. Correlation of addition of Xanthan Gum to the stability of the emulsion and the viscosity of canola oil emulsions can be seen in Figure 4.

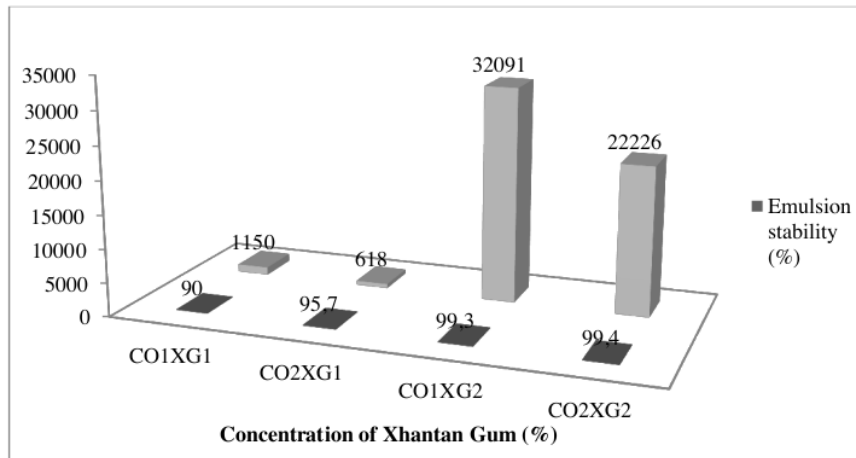


Figure 4. Correlation of the addition of Xanthan Gum to the emulsion and viscosity of canola oil

The correlation between increased concentration of xanthan gum with an increase in the stability value of the emulsion and viscosity, because xanthan gum has properties not only as an emulsifier but also as a thickener of a material [15]. therefore if the concentration of xanthan gum is increased in an emulsion, the stability value of the emulsion and the viscosity of an emulsion will increase. The addition of xanthan gum is generally used not only to create the desirable textural attributes but also to stabilize the emulsion against gravitational separation [18].

4. Conclusion

Canola oil concentration affects the pH value of the emulsion, the stability of the emulsion and viscosity are influenced by the concentration of xanthan gum and the concentration of canola oil. the higher the concentration of xanthan gum, the higher the stability of the emulsion and viscosity.

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