Development of orange flavour emulsion

M. Saifullah and M. G. Aziz

Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh -2202, Bangladesh, Email: saif.emon04@gmail.com

Abstract

The study was concerned with development of orange flavor emulsion by homogenizing method. Different gum concentration and number of passes were used during emulsion formation. Three different concentration of Gum Arabic (10%, 15% and 20%) and 4, 6 and 8 numbers of passes were used in the experiment. For each concentration of gum 4, 6 and 8 numbers of passes were applied and graphically observed their stability kinetics' and microscopic view of particle distribution in emulsion system was observed for each sample through microscope. It was found that at 15% gum concentration and 6 passes was best one and showed most stability than others.

Keywords: Gum concentration, Homogenization, Emulsion development, Emulsion stability

Introduction

Many natural and processed foods consist either partly or wholly as emulsions or have been in an emulsified state at some time during their production; such foods include milk, cream, butter, margarine, fruit beverages, soups, cake batters, sauces, desserts, salad cream, ice cream, and coffee whitener (Dickinson, 1992; Swaisgood, 1996). Emulsion usually consists of at least two immiscible liquid phases one of which is dispersed as globules in the other liquid phase stabilized by a third substance called emulsifying agent. The common liquid phases are aqueous phase and oil phase. Aqueous phase consists of water and different gums as hydrocolloids, and oil phase consists of usually citrus oil based with weighting agent, brominated vegetable-oil, ester gum, sucrose acetate iso-butyrate, bees-wax etc (McClements, 2005). Another important ingredient of emulsion is emulsifier, which stabilizes an emulsion by increasing its kinetic stability. Research revealed that one of the essential molecular features of hydrocolloids was the ability to act as emulsifying agents and emulsion stabilizing agents. Though most hydrocolloids can act as stabilizers (stabilizing agents) of oil-in-water emulsions, only few can act as emulsifiers (emulsifying agents) (Dickinson, 1993; Friberg, 2004). Now-a-days the food industry relies more and more on ready to use food ingredients. This is done to simplify the production and reduce the production cost as much as possible. In Bangladesh there are many soft drinks, cookie, ice cream and bread industries, which use large amount of food grade emulsion for their production. But most of the industries have to depend on imported emulsion to fulfill their requirement due to unavailability of locally developed emulsion. Keeping the above views in mind attempt has been taken to develop a formulation of orange emulsion applying gum arabic as emulsifying agents. The objectives of the study were i) To assess the effect of hydrocolloids as emulsifying agents; ii) To assess the effect of homogenization on emulsion stability.

Materials and Methods

Orange oil, orange flavor, citric acid, sodium benzoate, gum arabic were collected from market and high pressure homogenizer, microscope, balance were used for this experiment.

Sample preparation

The standard formulation for the preparation of orange emulsion is given below:

Ingredient	Amount
Orange oil	10%
Gum arabic	10 - 20%
Citric acid	0.3
Flavour	1%
Colour	1%
Sodium benzoate	0.1%
Distilled water	67.6 – 77.6

* http://www.apv.com

Before going to carry out each trial oil, water, gum, flavor, color, citric acid, sodium benzoate were mixed properly according to the formulation. After mixing, the solution was kept at room temperature at undisturbed condition for half an hour. Then it was ready for homogenization.

Gum concentration of emulsion

Gum Arabic, which has dual functions as stabilizer and emulsifier, was used as different concentration of 10%, 15% and 20%. For each concentration, specific amount of gum Arabic was weighed and taken in a pot then water was added to the pot and kept for 1.5 – 2 hr for wetting of gum. Then the gum solution was filtered through filtering cloth to remove undesirable impurities. Then this solution was ready for mixing with other ingredients and homogenization.

Homogenization of droplet size

The pre-mixed samples were homogenized for 2, 4, 6, and 8 passes at 1000 psi. At first, hopper of homogenizer was filled with sample then the machine was run. The automation of machine was done by using pipe to the out late. It was calculated that to complete one pass it is necessary 26 sec for 0.5L samples. For maintaining pass accurately stop watch was used from starting to stop the machine.

Analysis

To assess gum effect and homogenization effect stability kinetics' and particle size distribution were used. Particle distribution in emulsion system was observed for each sample through microscope.

Stability study

For stability studies, homogenized emulsion was stored in plastic tube at room temperature (25°C-27^{0}C). The total height of homogenized emulsion was measured with a measuring scale. During storage the loss of height was observed and reading was taken on specific storage interval. Percent stability of the samples was calculated as follows:

$$\%\text{Stability} = \frac{\text{Original height of sample} - \text{Separation height}}{\text{Original height of sample}} \times 100$$

Results and Discussion

Effect of gum (emulsifier) concentration on the stability of emulsion

A good quality emulsion is kinetically stable for a reasonable period of time. A good quality emulsion could be made by preventing the droplets from the merging of droplets together formed during homogenization. This is achieved by having a sufficiently high concentration of emulsifiers present during the homogenization process.

To assess the effect of emulsifier on the stability of emulsion, three gum concentrations were used and the stability kinetics of emulsion was measured and plotted in Fig. 1.

As shown in Fig. 1, 15% gum concentration showed better stability than that of emulsion containing 10% and 20% gum concentration. Just after 1st day instability exhibited both in the emulsion containing 10% and 20% gum. Between them, 20% showed extreme instability than that of 10% concentration. However, emulsion developed from 15% gum concentration also lost stability slightly.

Practically, emulsifier adsorbs to the surface of the droplets during homogenization, by forming a protective membrane which prevent them from coming close enough together to coalesce (Walstra 1983, 1996a). Droplets formed during 6 passes might better protected at 15% gum concentration than that of at 10% and 20%. The 10% gum concentration might be too low to form a protective membrane to prevent the droplets to come close. On the other hand 20% concentration might too high concentration to accommodate the droplets in emulsion system.
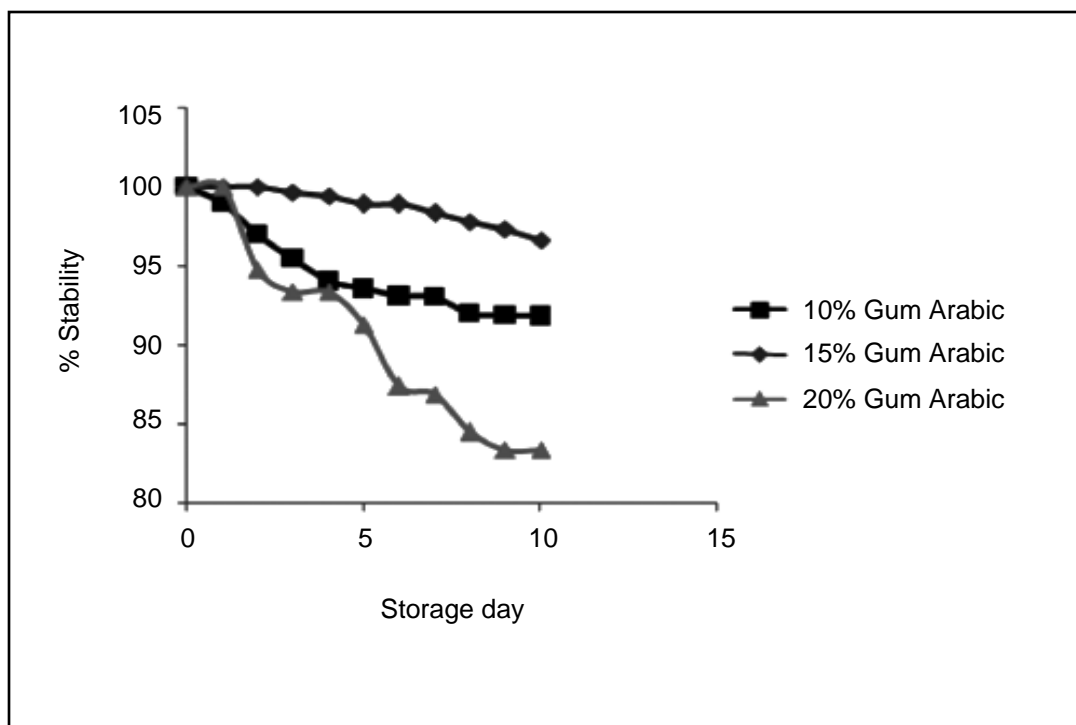

Fig. 1. % Stability kinetics' of emulsion for 6 passes

As shown in Fig. 2, stability of emulsion containing 10% gum Arabic exhibited better stability than 15% and 20% gum concentration at 8 passes. Instability started just after 1st day of formulation of emulsion in case of 15% gum. On the other hand, in case of 20% gum concentration instability started from 2nd day of formulation.

Here in case of 10% gum due to increase of pass no particle size become uniform and particles are evenly distributed. But in case 15% and 20% gum concentrations with increasing gum percentage increase solute content, during homogenization produced temperature relatively higher in 20% gum containing emulsion than 15% and 10% gum containing emulsion. In case of 15% gum concentration produced temperature is higher than 10% gum concentration.

Homogenization effect on the stability of emulsion

Fig. 3 shows that stability of emulsion system containing 10% gum at 4, 6 and 8 passes. Emulsion produced by applying 8 passes is relatively stable than emulsion produced by applying 4 and 6 passes. In case of 8 passes there might uniform particle size and particle distribution even in emulsion system than 6 and 4 passes. In case of 4 passes, instability occur rapidly after 1st day. On the other hand, in case of 6 passes emulsion is more stable than emulsion of 4 passes.
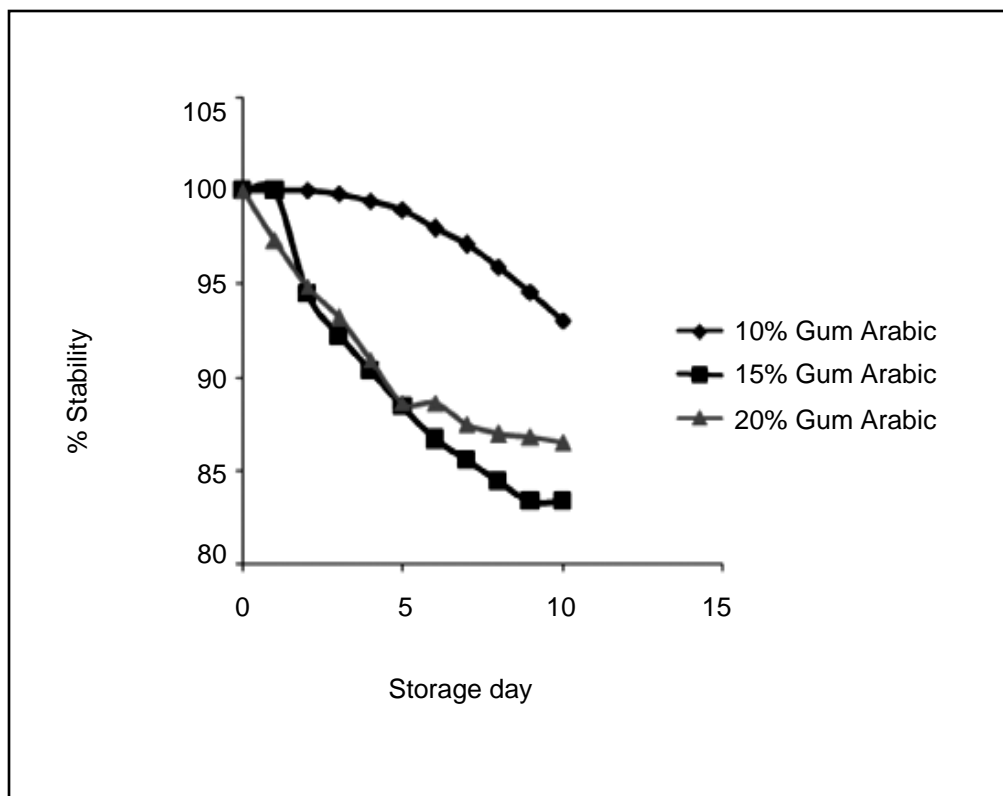
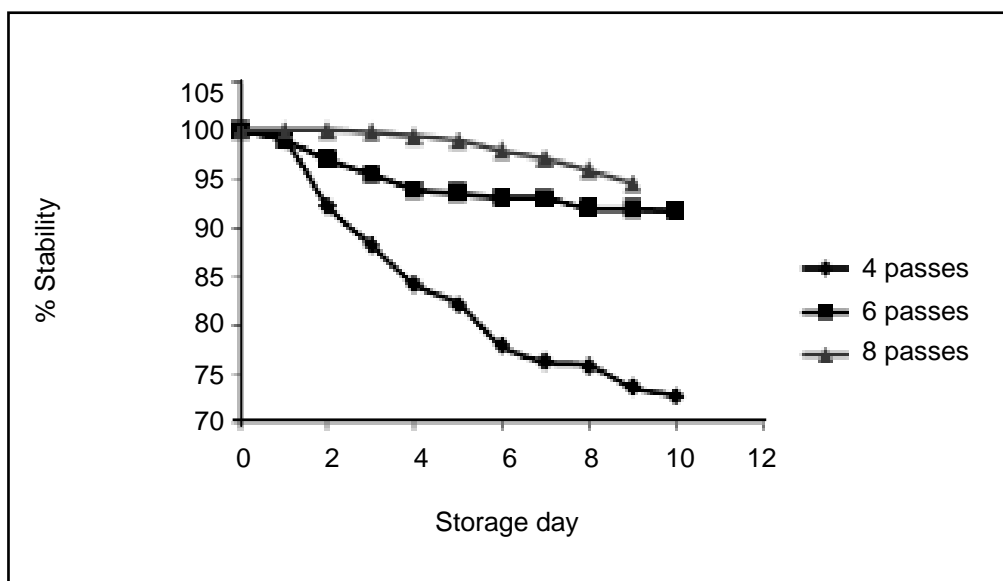Fig. 2. % Stability kinetics' of emulsion for 8 passes

Fig. 3. % Stability kinetics' of emulsion for 10 % Gum Arabic at different passes

Fig. 4 shows the stability of emulsion containing 15%gum and at applying 6 and 8 passes. It is found that the emulsion produce by applying 6 passes is more stable than that of emulsion produce by applying 8 passes. In case of 8 passes, instability started after 1st day and it occur rapidly. This might occur due to adverse storage condition.

Fig. 5 shows that stability of emulsion of 20% gum concentration and for 6 and 8 passes. Emulsion produced by applying 6 passes is more stable than emulsion produced by applying 8 passes. Instability started just after 1st day of formulation in case of 6 passes and in case of 8 passes instability exhibit from 2nd day. For both cases, 20% gum concentration is found relatively high gum concentration than 10% and 15% gum. Incase case of 8 passes, instability might exhibit due to high solute content and since temperature of product increase with increasing homogenization effect (passes).
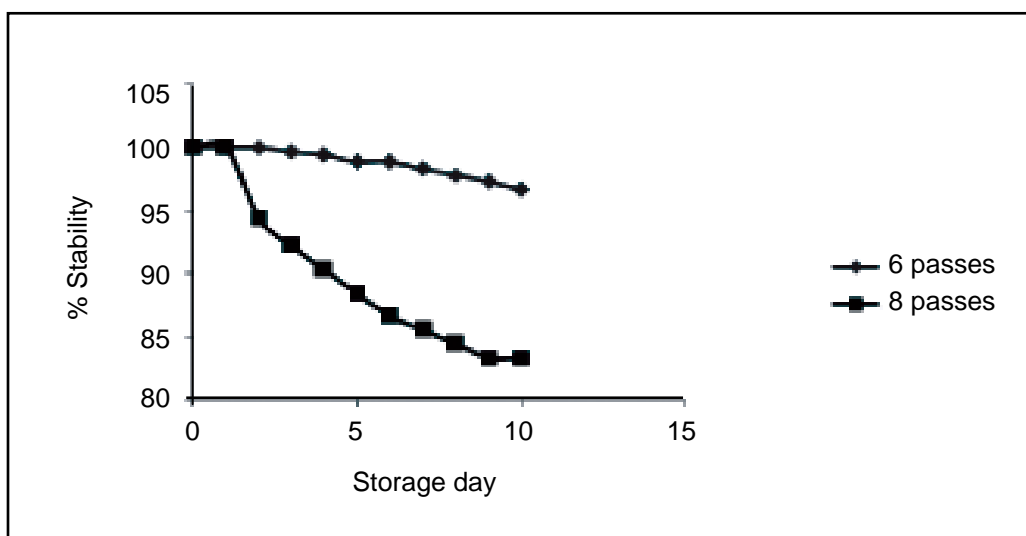

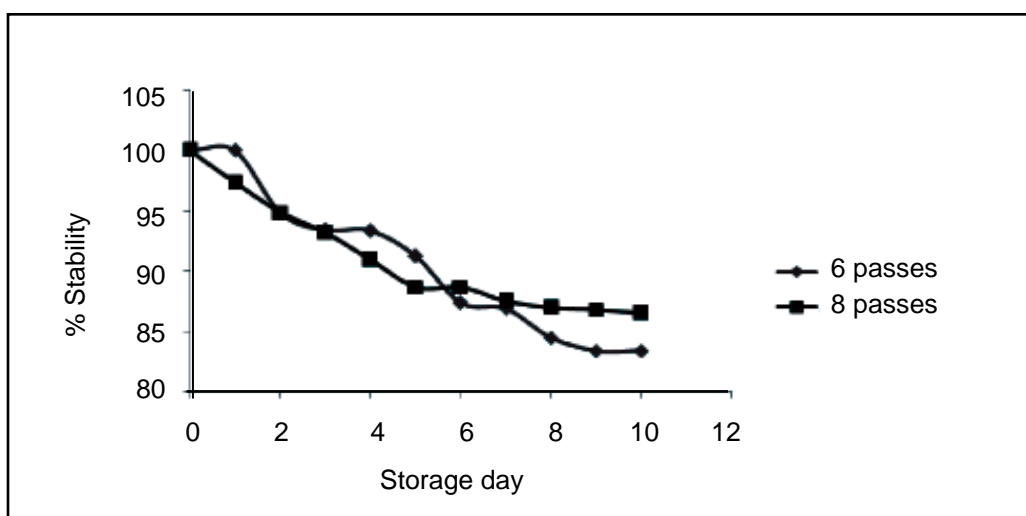Fig. 4. % Stability kinetics' of emulsion for 15 % Gum Arabic at different passes

Fig. 5. % Stability kinetics' of emulsion for20 % Gum Arabic at different passes

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