The Effects of Various Food Stabilizers on Quality Evaluation of Low Fat Mayonnaise

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Abstract

This research work aims to prove the use of food stabilizers for the storage stability of low fat mayonnaise served as creamy dressing condiment. Different processing methods were used to get best quality product. The mayonnaise based condiment consists primarily of egg yolk and incorporation of vegetable oil, vinegar and other food additives. Storage stability and quality properties of dessert mayonnaise was prepared by using two stabilizers viz., sodium carboxymethylcellulose (SCMC), xanthan gum, mixed two stabilizers and a control (without stabilizer) as a substitute for oil and egg yolk. Effort was taken to optimize the quality product, such as the effect of food additives on flavour and texture of product was investigated. Low fat mayonnaise was prepared by using sunflower oil in which the composition varied from 35-55% (%w/w) and egg yolk from 10-30% (%w/w) as low as possible. Mayonnaise made from 25% (%w/w) egg yolk and 45 % (%w/w) oil was found to be the best. Evaluation of varying processing formulae demonstrated that mayonnaise substituted with 0.1 (%w/w) xanthan gum only was the best. The chemical compositions of the product such as pH, acidity, moisture content, ash content, fatty acid composition, peroxide value, soluble solid content and viscosity were also analyzed. The formation of yeast and mold and other microorganisms such as E.*coli*, S-*aureus* and *Salmonella* were not detected in microbial analysis. Sensory studies for its storage stability confirmed that without using chemical preservatives, the product could stay fresh for a month when stored under refrigeration temperature whereas it could stay fresh at room temperature for seven days. Benefits of this project work would be providence for a safe and feasible condiment product.

Keywords: storage stability, egg –yolk, stabilizers, condiment

Introduction

Mayonnaise is a thick, creamy dressing used as a condiment and stable emulsion of oil and egg yolk base with other special food additives. Several new fat replacements are being developed to meet demands associated with the current low-fat foods trend. Egg yolk is the mainly protein species and phospholipids composed of large amounts of surface active components. These surface active components can act as an interfacial film between an oil phase and a water phase, thereby stabilize an emulsion of food produced. Egg yolk is therefore used as natural emulsifier in many food emulsions, such as mayonnaise and dressings.

Mayonnaise is one of the most consumed special dessert and oil in water emulsion which contains vegetable oil, pasteurized egg yolk, acidulants and other food additives. The aim of this study was to characterize the low fat mayonnaise prepared by different food stabilizers of sodium carboxymethylcellulose and xanthan gum. These stabilizers were used as oil substitute to develop the product low fat mayonnaise. Emulsion of low fat mayonnaise were prepared using sunflower oil, egg yolk, food stabilizers, warm water, vinegar, salt, sugar, white pepper and mustard.

In mayonnaise preparation, the oil in water emulsion is formed by slowly blending vegetable oil to a premix that consists of egg yolk, vinegar and mustard, resulting in closely packed foam of oil droplets or coarse emulsion. Due to the use of vinegar as one of the ingredients, the product mayonnaise has low pH and high fat acid value that causes relatively resistant to microbial spoilage. The colour of mayonnaise varies, ranging from white, cream to

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pale yellow. Its texture may range from light cream to a thick gel. Traditional mayonnaise is a mixture of egg, vinegar, oil and spices especially mustard.

Oil may account for 75% or more of the total volume of mayonnaise. This means that the oil droplets become distorted from their normal, spherical shape (http://www.google.com./ patent/ EP0055577A2). Oil-in-water emulsion mayonnaise is stable at room temperature because it reaches phase equilibrium.

On the other hand, the whole eggs store significant amounts of protein and choline. The color of an egg yolk is directly influenced by the makeup of the chicken feed. Egg yolk color is generally improved with a feed containing a large component of yellow, fat-soluble pigments, such as the carotenes in dark green plant material.

Vinegar is the liquid condiment or food flavouring used to give a sharp or sour taste to foods and also used as a natural preservative in pickling. Mustard can act as an emulsifier that stabilizes a mixture of two or more immiscible liquids, such as oil and water. The essential vitamins and nutrients found in mustard seeds are selenium and omega-3 fatty acid.

The stabilizer, xanthan gum as well as sodium carboxymethylcellulose has its ability to produce a large increase in the viscosity of a liquid by adding a very small quantity and also can be used in many preparations as a viscosity modifier or thickener, and to stabilize emulsions. Especially, the viscosity of xanthan gum solutions decreases with higher shear rates or pseudoplasticity.

Mayonnaise is a microbe-stable foodstuff due to its acidic conditions and may be kept at room temperature. Nevertheless, the loss of quality during storage always exists due to the auto-oxidation of unsaturated fatty acids. Mayonnaise sauce is a relatively microbial safe product because of its high fat content and presence of acidic ingredients which reduce the pH of product to a lower value. Most pathogenic bacteria such as *Escherichia coli*, *L. monocytogenes*, *Salmonella*, *Yersinia enterocolitica*, and *Staphylococcus aureus* are destroyed when inoculating into mayonnaise (Zanjani, 2019).

Low-fat mayonnaise is usually associated with deficiencies in texture, taste, appearance, stability and sensation in the mouth. To produce low-fat mayonnaise, this component of the base formulation must be substituted with functional fat substituents in order to obtain a product with the same sensory attribute of the fat product (Fernandes et.al , 2017). In this context, a potential source for fat substitution is xanthan gum and sodium carboxymethylcellulose which have strong functional characteristics.

Materials and Methods

Materials

The essential ingredients such as xanthan gum and sodium carboxymethylcellulose (commercial grade) used as stabilizer were purchased from Supershell Chemical Shop, Pebaedan Township, Yangon, Myanmar. Other ingredients such as sugar, salt, vinegar, vegetable oil (sunflower oil), spices (mustard) and chicken egg yolk were obtained from local markets.

Methods of Preparation

The natural emulsifying agent egg yolk after the separation of white was pasteurized, placed in a bowl and blended thoroughly for a few minutes to obtain a uniform paste. The blended egg yolk was mixed with vinegar and dispersed into water by adding warm deionised water (about 70ºC). During the addition of warm water, the egg yolk proteins do not denature and coagulate because of the dilution of acid and water. Flavouring agents such as salt and sugar were then added into this continuous phase and then beat with spoon until to get the paste dispersed uniformly. Sunflower oil was poured drop by drop during stirring to eliminate

splitting and then spices (mustard) was added to the resulting mass. Stirring was done continuously in only longitudinal direction to mix all the ingredients thoroughly.

Xanthan gum [0.1% (%w/w)] dissolved in boiling water was added and blended at high speed for about 5 minutes to stabilize the emulsion. Then, the prepared mayonnaise was filled in a sterilized glass bottle and pasteurized in water-bath at 70º C for 15 minutes.

Alternatively, mayonnaise was also prepared by using another food stabilizer sodium carboxymethylcellulose only and the two mixed stabilizers of xanthan gum plus sodium carboxymethylcellulose.

Determination and Optimization Parameters of Mayonnaise

Optimization of Oil and Egg Yolk amount in Mayonnaise

Five samples were prepared by making variation in the proportion of egg yolk 10%, 15%, 20%, 25% and 30% (% w/w) and coded as E_1, E_2, E_3, E_4 and E_5 respectively, other ingredients as presented in Table (1) was kept constant. Thus the prepared mayonnaise was drawn for sensory analysis to get optimum level of egg yolk.

Similarly, another five samples were prepared by using different proportion of sunflower oil 35%, 40%, 45% , 50 %and 55% (% w/w) and coded as S_1, S_2, S_3, S_4 and S_5 respectively, other ingredients as presented in Table (2) was kept constant. Thus the prepared mayonnaise was drawn for sensory analysis to get the suitable amount of oil for low fat product.

Optimization of amount of Stabilizers on Mayonnaise

Four samples of mayonnaise were prepared by using the suitable amount of 25% (%w/w) egg yolk, 45% (%w/w) oil and stabilizers 0.1% (%w/w) like sodium carboxymethylcellulose samples coded as Type I, xanthan gum as Type II and mixed these two stabilizers (0.05% sodium carboxymethylcellulose and 0.05% xanthan gum) as Type III and a control (without stabilizers) samples coded as Type IV [Table 3]. These samples were subjected to sensory evaluation in terms of appearance/ color, flavor, texture and its storage stability were also analyzed [Table 4].

Determination of Organoleptic Properties

The organoleptic properties namely color, flavor and texture and taste were determined on the basis of 9 point Hedonic scale. 10 g of each sample was placed in a small dish. So there were 5 different dishes and the samples were coded with symbols. Then the samples were presented randomly and the tasted test was carried out. Similarly, the color and aroma tests were carried out and the results are recorded as in Tables (1) (2) and (4).

Determination of Physico-chemical Properties of Mayonnaise

The physico-chemical characteristics showing the quality of mayonnaise such as moisture content, ash content, acid value, fat content, protein content, viscosity and peroxide value were determined by AOAC official and tentative methods, soluble solids content was measured with a refractometer (WYT-4,°Brix 0-80) and pH was measured by pH meter (Mi 150,pH/Temperature Bench Meter). The results are shown in Table (5). Microorganisms such as yeast and mold, E.*coli*, S-*aureus* and *Salmonella* were measured at Food Industry Supporting Laboratory, UMFCCI Tower, Yangon, Myanmar [Table 6].

Results and Discussion

This present work mainly sorts out the possible composition employed for the preparation of low fat mayonnaise to reflect best possible taste and aroma. To get the safe and

whole nutritious product, the composition of mayonnaise was evaluated by using different food additives. The functional evaluation was performed by using varying concentration of essential ingredients and thus allowed to obtain a product with good physical and organoleptic qualities, as well as better textural properties. The product have accepted and qualified well, as sensorial features like color, fragrance and taste.

To get the good quality product, the composition of mayonnaise was evaluated by optimizing the composition of basic raw material egg yolk. According to the results of Table (1), the proportions of egg yolk varied according to the amount of 10%, 15%, 20%, 25% and 30% (% w/w). As the indicated results, 25% (%w/w) composition of egg yolk had the natural good flavor and texture of the product mayonnaise. Similarly, different composition of sunflower oil 35%, 40%, 45%, 50 %and 55% (% w/w) were used. From the presented data shown in Table (2), 45% (%w/w) sunflower oil was found to be the least possible amount with well texture and good emulsification formation.

Food stabilizers, which stabilize the emulsion and prevent the oil layer separation from storage condition, were used to modify the composition of mayonnaise. According to the use of variations of stabilizers such as SCMC only (Type I), xanthan gum only (Type II), both xanthan gum and SCMC (Type III), and a control (without stabilizers) as Type VI, however other constituents were kept constant [Table 3]. Xanthan gum serves as a binder for many food preparations, to keep the whole product with smooth and uniform textural properties. In the same way, SCMC was used in many food preparations as a viscosity modifier or thickener and to stabilize emulsions. From the results shown in Table (4), it can be seen that the colour, flavour and textural properties of Type II mayonnaise have acceptable values from the sensory evaluated point of view. Xanthan gum has better stabilization activity than SCMC. Blending with xanthan gum improves the stability of prepared product with smooth texture, good aroma and prevents the separation of oily layer during storage condition.

The quality of prepared finish product was evaluated by determination of its physio-chemical characteristics. In Table (5), the physico-chemical characteristics such as pH, moisture content, ash content, acid value, fat content, protein content, viscosity, peroxide value and soluble solid content of prepared mayonnaise were tabulated. The results also obviously indicate that type II gave the highest soluble solid content. In type II, xanthan gum not only helps to thicken commercial egg substitutes but to replace the fat and emulsifiers found in yolks. Egg yolk is a major source of vitamins and minerals. The oil and egg's fat constituents from the mayonnaise could be replaced with the food stabilizer, xanthan gum to produce low fat product with smooth consistency.

The moisture content of the prepared product has ranging from 16-18% (%w/w) and that of pH value was around 4. This pH value was for prepared food product owing to the use of vinegar in mayonnaise formulation. Fat content of prepared mayonnaise ranged from 50 to 60% (% w/w) [type II has 49.2%] and lower than literature value of 70.6% due to the use of fat substitutable food stabilizers. Protein content and peroxide value of the prepared product has approximately the same results as literature value.

After processing, pH and acidity values of prepared product were evaluated under different storage conditions of room temperature and refrigeration temperature of -10ºC. It was observed that there were no remarkable changes in pH and acidity value within a week when stored under refrigeration temperature of -10ºC. The colour, flavour and texture of whole product keep to maintain up to 30 days. But there was slight increase in acidity and unpleasant texture of product after 14 days when stored under room temperature [Table 7].

The microorganisms contained in the prepared product were evaluated after one month and the results are shown in Table (6). It can be seen that S-*aureus*, E. *coli* and *Salmonella* were not detected in all samples due to pasteurization of egg yolk prior to use. Yeast and mold was in the range of lower than 100 cfu/g and found to be acceptable.

From reliable data as presented above, it can be seen that the composition and characteristics of mayonnaise have acceptable values serves as feasible condiment dessert for the consumers. Prepared mayonnaise has a shelf life of excess one month when it was well packed and stored under refrigeration temperature.

Figure (1) Prepared Mayonnaise

Table (1) Composition of Mayonnaise with Different amount of Egg Yolk

Sample No.	Composition						Organoleptic Properties (after one week)
	Egg Yolk (%w/w)	Brown Sugar (%w/w)	Salt (%w/w)	Vinegar (%w/w)	Mustard (%w/w)	Sunflower Oil (%w/w)	
E 1	10	8	1.5	12	7	45	Slightly brown
E 2	15	8	1.5	12	7	45	Slightly sour taste
E 3	20	8	1.5	12	7	45	Sour taste
E 4*	25	8	1.5	12	7	45	Good flavor and texture
E 5	30	8	1.5	12	7	45	Formation of oily droplets

*The most suitable condition

Table (2) Composition of Mayonnaise with Different amount of Sunflower Oil

Sample No.	Composition						Organoleptic Properties (after one week)
	Egg Yolk (%w/w)	Brown Sugar (%w/w)	Salt (%w/w)	Vinegar (%w/w)	Mustard (%w/w)	Sunflower Oil (%w/w)	
E 1	25	8	1.5	13.5	7	35	Slightly brown
E 2	25	8	1.5	13.5	7	40	Slightly brown and sour taste
E 3*	25	8	1.5	13.5	7	45	Good flavor and texture
E 4	25	8	1.5	13.5	7	50	Emulsion breaks down and formation of oily layer
E 5	25	8	1.5	13.5	7	55	Emulsion breaks down and formation of oily layer

*The most suitable condition

Table (3) Composition of Mayonnaise with Different amount of Stabilizers

Sample	Egg yolk (% w/w)	Sunflower Oil (% w/w)	Stabilizers (% wt/wt)		Brown Sugar (% w/w)	Salt (% w/w)	Vinegar (% w/w)	Mustard (% w/w)
			SCMC	XG				
Type I	25	45	0.1	-	8	1.5	13.5	7
Type II*	25	45	-	0.1	8	1.5	13.5	7
Type III	25	45	0.05	0.05	8	1.5	13.5	7
Type IV	25	45	-	-	8	1.5	13.5	7

*The most suitable condition

XG= xanthan gum, SCMC=sodium carboxymethylcellulose

Table (4) Organoleptic Properties of Prepared Mayonnaise Using different Stabilizers

Sr. No.	Samples	Organoleptic Properties			Observation
		Colour	Flavour	Texture	
1.	Type I	white	natural flavor	soft and sticky	Unacceptable
2.	Type II*	creamy	good flavor	Smooth texture	Good
3.	Type III	creamy	natural flavor	Formation of oily droplets	Unacceptable
4.	Type IV	White	natural flavor	Formation of oily droplets	Unacceptable

* The most suitable condition
Type I = Using sodium carboxymethylcellulose
Type II = Using Xanthan Gum
Type III = Using two stabilizers with 1: 1 ratio
Type IV = Without using stabilizer

Table (5) Physico-chemical Properties of Processed Mayonnaise

Sr. No.	Properties	Type I	Type II	Type III	Type VI	Literature Value*
1.	pH	3.90	4.50	4.0	4.10	3.96
2.	Acidity (%w/w)	0.65	0.54	0.61	0.58	0.5
3.	Moisture Content(%w/w)	18.2	14.3	17.2	17.8	15.6
4.	Ash Content (%w/w)	0.15	0.13	0.18	0.18	0.2
5.	Soluble Solid Content (°Brix)	20	23	21	20	-
6.	Protein(%w/w)	5.4	5.2	5.65	4.7	4.6
7.	Fat Content(%w/w)	53.5	49.2	51.4	69.3	70.6
8.	Peroxide value (meqv/kg oil)	1.56	1.23	1.95	2.12	1.12
9.	Viscosity (cP)	14.4	15.6	13.9	13.2	-

*M. Pradhananga1 and B. Adhikari (2015)

Table (6) Microbiological Characteristics of Processed Mayonnaise Prepared after one Month Storage Temperature = -10ºC

Sr. No	Microbiological Characteristics	Result			
		Type I	Type II	Type III	Type VI
1.	S-*aureus*	ND	ND	ND	ND
2.	*Escherichia coli* (E. *coli*)	ND	ND	ND	ND
3.	*Salmonella*	ND	ND	ND	ND
4.	Yeast and mold Count(cfu/g)	<100	<100	<100	<100

ND = Not Detectable

Table (7) Properties of Prepared Mayonnaise under Different Storage Conditions

Sample Name = Type II (xanthan gum only)

No.	Samples	Freshly Prepared		Prepared After One Week			
				Stored at room temperature		Stored under refrigeration (-10 º C)	
		pH	Acidity (%w/ w)	pH	Acidity (%w /w)	pH	Acidity (%w /w)
1.	Type I	3.9	0.65	3.1	0.92	3.9	0.68
2.	Type II*	4.5	0.54	3.7	0.63	4.5	0.55
3.	Type III	4.0	0.61	3.2	0.89	3.94	0.65
4.	Type VI	4.1	0.58	3.1	0.86	4.0	0.64

Conclusion

The process for making the low fat mayonnaise involves the purpose of diversifying the use of food stabilizing agents. The product is acceptable as when it was determined by quality as well as sensorial features like colour, flavor, texture and taste.

In this present work, the food stabilizers such as xanthan gum and sodium carboxymethylcellulose were used for stabilization of oil-in water emulsion and reduce the fat content of product. This present work also relates to the mayonnaise-like food sauce frequently used in the food industry. The pasteurization temperature at 70ºC within 15 minutes gives the good appearance of the product and prevents the growth of microorganisms. During storage condition, the low pH value mayonnaise is relatively resistant to microbial spoilage. For the preparation of mayonnaise, the additives such as salt and sugar tend to give the desirable light, fluffy flavor and texture. There was no change in flavour, colour and texture of the product when stored under refrigerated conditions for period excess of one month.

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