Analysis of Change in Nutritional Value of Raw Papaya and Nano Emulsion Coated Papaya

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Abstract: Clove oil-based Nano-emulsions (NE) were prepared ultrasonically using Tween 80, The developed NEs were characterized for various parameters (particle size, polydispersity index, zeta potential, morphology, viscosity, colour, turbidity and pH) and the comparative effect of both the surfactants at variable levels. It was found that the type of surfactant and oil to surfactant ratio significantly affected particle size and stability of NEs. NEs prepared using tween 80 were found to be more viscous than those prepared with soy lecithin. The prepared clove oil NEs has important implication to be used as a natural delivery system to increase the shelf life of food products. Access to a healthy diet plays a more fundamental role for several reasons, such as environmental changes and oxidative stress factors. As a result, researchers focus on developing the functionality and beneficial effect of foods by natural components within a large health benefits scale. In particular, plant-derived compounds have rising importance in food processing for the reason of functional properties.

Key Words: —*Raw Papaya, Nano Emulsion, Nutritional Assessment, fat estimation.*

I. INTRODUCTION

Food components are an example of soft matter; they have a highly complicated biological structure, but their function can be determined. It is accomplished by the contribution of functionality provided by the major component. Carbohydrate, proteins, and fat are naturally occurring nano-substances that make up the macro composition of food. There should be definite advantages to ordering any new technology in any sector. Every change has a cost that must be offset by a benefit in order for it to be accepted. This is especially true in the case of micro and nanotechnologies. The present applications of nanotechnology in the food business are nano-emulsions based on nanotechnology.

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Nano-emulsions are colloidal particulate systems with submicron size particles that act as medication carriers. Their diameter ranges from 10 to 1,000 nanometers. These carriers are solid spheres with an amorphous, lipophilic, negative-charged surface. To improve site specificity, magnetic nano particles can be utilized. As a medication delivery system, they improve the drug's therapeutic efficacy while reducing side effects and toxic reactions. Infections of the reticulo endothelial system (RES), enzyme replacement therapy in the liver, cancer treatment, and vaccination are all examples of major applications. An emulsion is a biphasic system in which one phase is dispersed in the other phase as minute droplets with diameters ranging from 0.1 to 100 micro meters.

It's a thermodynamically unstable system that can only be stabilized by adding an emulsifying agent (emulgent or emulsifier). The dispersed phase is also known as the internal phase or the discontinuous phase, whereas the dispersion medium, external phase, or continuous phase is the outer phase.

A mini-emulsion is a fine oil/water or water/oil dispersion stabilized by an interfacial coating of surfactant molecules with droplet sizes ranging from 20 to 600 nanometers. Nano-

emulsions are transparent due to their small size. There are three types of nano-emulsions that can be created: (a) oil in water nano-emulsions in which oil is dispersed in a continuous aqueous phase, (b) water in oil nano-emulsions in which water droplets are dispersed in a continuous oil phase, and (c) bi-continuous nano-emulsions in which water droplets are dispersed in a continuous oil phase nano-emulsion.

Organic, nonorganic, and hybrid nano materials are all types of nano materials. Organic nano materials are more biodegradable in nature than inorganic nano materials, which is why bio-nano composites are formed when they are mixed with a biodegradable polymer. Inorganic nano materials, on the other hand, are commonly used in food packaging systems as antibacterial agents. Depending on the type of inorganic nano particle, preparation methods include the sol gel method, mechanochemical processing, physical vapor synthesis, and others. One of the most fascinating delivery techniques in the food sector is nano-emulsions. The bioavailability of encapsulated bioactive components is improved by nano-emulsion-based delivery technologies, which also improve food stability.

Food-grade nano-emulsions are rapidly being employed in the food industry to improve digestibility, encapsulation efficiency, bioavailability, and targeted delivery.

Nano-emulsions' applicability in the food business has grown as a result of the aforementioned benefits over conventional emulsions. Stabilizers such emulsifiers, ripening retarders, weighing agents, and texture modifiers can improve the kinetic stability of nano-emulsions. Emulsifiers used in the food business include small molecule surfactants (Tweens or Spans), amphiphilic polysaccharides (gum Arabic or modified starch), phospholipids (soy, egg, or dairy lecithin), and amphiphilic proteins (caseinate or whey protein isolate).

Texture modifiers, substances that increase the viscosity such as proteins (whey protein isolate, gelatin or soy protein isolate), sugars (high-fructose corn syrup or sucrose), polysaccharides (Carrageenan, xanthan, pectin, alginate) and polyols (sorbitol or glycerol) can be also used as stabilizers. Dense lipophilic materials such as brominated vegetable oil, sucrose acetate isobutyrate, ester gums can be used as a weighting agent to balance the densities of the liquid's nano-emulsions.

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II. Material and Method

The present study was an experimental research design. It was conducted in nutritional laboratory of Department of Food and Nutrition, School of Home Science, Department of Physics and laboratory of Department of Microbiology, School of Environmental Science, Babasaheb Bhimrao Ambedkar University (BBAU), Lucknow, Uttar Pradesh.

2.1 Material required:

Sodium alginate powder, tween 80, distilled water, clove essential oil, hydrophilic powder (sugar) and glycerol.

2.2 Preparation of Product:

2.2.1 for the preparation of the nano-emulsion

Distilled water (50ml), clove essential oil 8% (1.5ml) and tween80 7% (3.5ml) is mixed in a beaker, stirring on magnetic stirrer, ultrasonication which reduce it to droplet size.

2.2.2 for the preparation of edible coating

Sodium alginate 3% (15ml), sugar powder (4g), glycerol 0.6% (0.5 ml), distilled water (500ml), mixing using a magnetic stirrer.

2.2.3 Mixing of nano-emulsion with edible coating

Cooling of edible coating leads to mixing it with nano-emulsion and then final coating solution is obtained.

2.2.4 Equipment

Ultrasonicator, particle size analyzer, magnetic stirrer, laminar air flow, autoclave, weighing balance, micro pipette, scradder, spirit lamp.

III. Method

Distilled water (50ml), clove essential oil 8% (1.5ml) and tween80 7% (3.5ml) was mixed in preparation of Nano emulsion, which was then placed on magnetic stirrer on temp 50-55C for 15 minutes and then it was forwarded for ultrasonication >20khz on Ultrasonicator to reduce it to droplet size. Particle size of Nano emulsion was analyzed by

using particle size analyzer.

For the preparation of edible coating, sodium alginate15ml mixed with hydrophilic powder(sugar) then it was mixed with glycerol .5ml in distilled water 500ml. it was collectively mixed with using stirrer and mixed with Nano emulsion then final coating solution was obtained. Collected raw papaya with standardize cuts is dipped in final coated solution. Place the dipped fresh cut papaya into the plate, Nano emulsified papaya plate was wrapped with plastic paper.

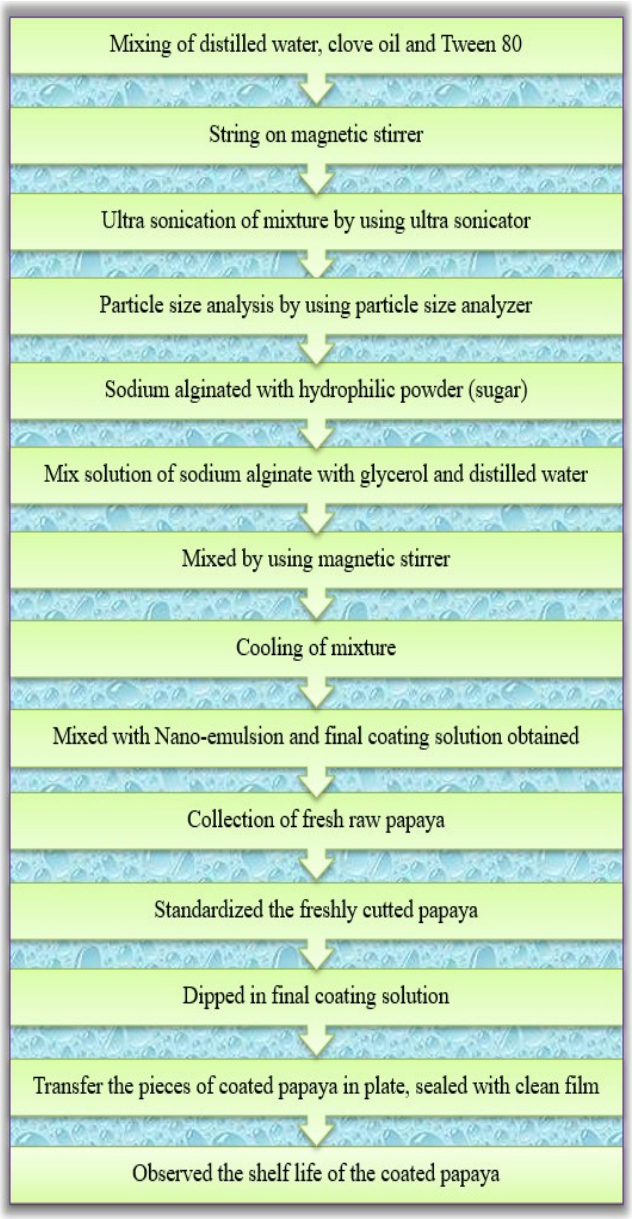

Fig.1. Flow diagram of processing

Fig.2. Figures related to processing

3.1 Nutritional assessment of the prepared product

3.1.1 Moisture content

The moisture content of the samples was evaluated using the oven drying method (Nielsen, 2010), in which 5gm of dried samples were placed in a hot air oven at 105 ˚C for 24 hours before being cooled to room temperature in a desiccator. Weigh the sample both before and after it has been dried in the oven. The formula was as follows:

$$\boldsymbol{Moisture}\% = \frac{(\boldsymbol{Blank\ weight + sample\ weight}) - \boldsymbol{Dry\ weight}}{\boldsymbol{Sample\ weight}} \times 100$$

3.1.2 Ash content determination

Weigh roughly 10 gm of the sample material properly in a silica crucible to estimate the ash content. The crucible was heated at 5500C for around 3-5 hours in a muffle furnace. It was chilled in a desiccator and weighed at the end of the ashing process. To ensure that the ashing was completed, it was heated in the furnace for another half hour, cooled, and weighed. As a result, this was done until the weight remained constant (ash become white or greyish white). The following formula was used to compute the weight of the ash content:

Formula: -

$$Ash\ \% = \frac{Dry\ weight - Blank\ weight}{Sample\ weight} \times 100$$

3.1.3 Determination of fat:

Apparatus required- conical flask, water bath and Soxhlet apparatus.

Reagent- HCL (8N), Ethanol 95% (v/v), Petroleum Ether, Glass beads.

Procedure: In separate conical flasks, 10 gm of each sample was obtained. To begin, 2 ml ethanol was added as a mordant, followed by 10 ml 8N HCL for digestion. They were kept in a water bath for half an hour to allow the sample to digest. The sample was taken out and filtered with Wattman filter paper no. 1 using a tiny amount of hot water. After that, it was rinsed in hot water until the neutral pH was reached. The filtered materials were placed in an oven for roughly half an hour after cleaning the filter paper. The black cup was then weighed, and the filter paper was placed in a thimble for 2 hours of distillation. Cups were dried in the oven after distillation. The dry weight was measured and the calculation was completed.

Calculation- $\text{Fat\%} = \frac{(W_2 - W_1)100}{W_1 - W_2}$

W_2= dry weight of thimble

W_1= blank weight of thimble

W= weight of sample taken

3.1.4 Determination of Protein:

Estimating the nitrogen content of a substance and multiplying the nitrogen value by 6.25 yields the protein content of a food. The crude protein content nitrogen (CPCN) can be calculated by subtracting NPN from total nitrogen. A dry Kjeldahl flask was used to weigh the material (0.5-2 gm). In some samples, 5 gm of digestion mixture and 20 ml of pure conc. H2SO4 were added, and the mixture was heated for 4 to 5 hours to digest. To avoid bumping, glass beads were added. The digestion is continued for at least 1 hour after the contents of the flask have turned clear. The contents of the Kjeldahl flask were chilled, diluted with distilled water, and made alkaline by adding an excess of 40% NaOH to the liquid (about 75 ml). To reduce bumping during distillation, a small amount of pumice powder was added. The ammonia was collected and distilled into a receiver with 25 ml of N/10 H2SO4. Using 3 drops of methyl red indicator, the surplus acid in the receiver was back titrated against N/10 NaOH. A reagent black is digested and distilled in the same way. The genuine titer value 'b' is derived by subtracting this titre value from the value obtained for the sample.

$$Protein\ \% = \frac{(c - b) \times 14d \times 6.25}{a \times 1000} \times 100$$

If 'a' gm of the sample is taken and if 'b' and 'c' ml of alkali of normality 'd' are required for back-titration and to neutralize 25 ml of N/10 H_2SO_4, respectively.

The estimation of nitrogen is done by Kjeldhal method.

3.1.5 Determination of pH

The pH of the sample was determined using a pH meter. The pH of the food sample was determined by dissolving it in 10 ml distilled water. When the solution was ready, the pH meter's probe was dipped in it until the reading was obtained.

3.1.6 Determination of TSS

Refractometer was used to carry out the procedure. The sample solution was dropped on the detector and the measurement was taken. Based on the ratio of the speed of light in vacuum to the speed of light through the sample, the TSS value was expressed in percent Brix and the result was shown.

3.1.7 Determination of Calcium

A 15 ml centrifuge tube was filled with 2 ml of sample. 2 ml distilled water and 1 ml ammonium oxalate solution were added and carefully mixed before being left overnight. The materials were combined once more and centrifuged for 5 minutes at 1500 rpm. The supernatant liquid was emptied away, and the centrifuge tube was drained by inverting it and wiping it with filter paper. The precipitate was agitated, and the slides of tubes were cleaned with 3 ml dilute ammonia. It was centrifuged and emptied one more as previously. To guarantee full elimination of ammonium oxalate, the precipitate was washed once more with diluted ammonia. 2 ml 1 N H_2SO_4 was used to dissolve the precipitate. The tube was heated in a boiling water bath for 1 minute before being titrated against a 0.01 N $KMnO_4$ solution to a distinct pink colour that lasted at least 1 minute.

1 ml of 0.01 N $KMnO_4$ is equivalent to 0.2004 ml of Ca.

mg of Ca/100 ml serum = (x-b) x 0.200 x 100/2

Where, x = volume in ml of 0.01 N $KMnO_4$ required to titrate the sample

b = volume in ml of 0.01 N $KMnO_4$ required to titrate 2 ml of

H_2SO_4 (black). If the normality of $KMnO_4$ is "a", the value obtained in the above formula should be multiple by the fat/0.01.

IV. Result and Discussion

All the nutrient values of product are presented in table no1. And table no2. And the result and discussion are as fellow-

4.1 Moisture Content Estimation

The moisture content of the sample 1 (Raw Papaya) obtained 15.5% and the moisture content of sample 2 (Nano emulsified papaya) obtained 13.22%. The moisture content was obtained which is recommended for safe storage of dried vegetables for more than 9 months.

4.2 Ash Content Estimation

The ash content of the sample 1 (Raw Papaya) was obtained 0.6% and the ash content of the sample 2 (Nano Emulsified Papaya) was obtained 1%. Generally, ash content of Raw Papaya is 0.4% which is higher than the fruits.

4.3 pH Estimation

The pH value of both samples was obtained almost similar. The pH value of sample 1 obtained was 6.21 at 30.80C which is acidic in nature which indicate that the shelf life of the prepared product was good. The pH value of the sample 2 was obtained 5.07 at 30.80C which is also acidic in nature which indicated good stability of the product. The standard pH value of the raw Papaya is 8.5.

4.4 TSS Estimation

The TSS of each sample was obtained almost same. The TSS of the sample 1 obtained 8.4 at 35.00C. The TSS of sample 2 was obtained 7.5 at 33.10C. The standard TSS value of vegetable is 7 to 9. Total soluble solid means, amount of total soluble solid present in the unit volume of the solution. The obtained value was almost as similar as standard value is means the formulated product was good for health and having right properties.

4.5 Fat Estimation

The fat estimated in sample 1 was 0.4 gm in sample 2 obtained 0.7gm. The obtained fat content of the products is good for health. Fat content needed to help the body to absorb the vitamin content like Vitamin A, vitamin E and vitamin D.

4.6 Protein Estimation

The protein content in sample 1 was obtained 0.7g.and in sample 2 obtained 0.7g. There are no changes found in both samples.

4.7 Carbohydrate Estimation

The carbohydrate content was calculated in sample 1 was 16 g and in sample 2 estimated value of carbohydrate was 21g. The amount of carbohydrate obtained was excellent as expected.

4.8 Calcium Estimation

The calcium estimated in sample 1 was 30mg and in sample 2 estimated values was 33mg. The standard value of calcium found in Raw Papaya is 29 mg. The recommended upper limit for calcium is 2,500 mg a day for adults 19 to 50. For those 51 and older, the limit is 2,000 mg a day. Our body needs calcium to build and maintain strong bones. Human heart, muscles and nerves also need calcium to function properly (Daily R.D.A Calcium and calcium supplements: Achieving the right balance).

Table .1. Nutrients of the products (100 g) Raw Papaya S_1

Protein(g)	0.7
Fat(g)	0.4
Calcium(mg)	29
Energy(kcal)	19.26
Carbohydrate(g)	16

Table.2. Nutrients of the products (100 g) Raw Papaya S_2

Protein(g)	0.7
Fat(g)	0.7
Calcium(mg)	33
Energy (Kcal)	24
Carbohydrate(g)	21

V. Conclusion

Clove essential oil present in nano-emulsion provides anti-microbial property to food as well as it enhanced the nutritive value, aroma of the food product. Fresh raw papaya is containing various digestive enzyme like pepsin and also enriched in calcium and other micro nutrient with very low amount of fat and protein. Raw papaya when treated with

nano-emulsion gets additional nutrient like sugar, align, oil etc. it forms an outer layer covering over the fresh raw papaya which is directly the combination of edible coating and nano-emulsion. Estimation of fat, pH, moisture, ash, calcium and protein is done with specific method to check the nutritive value of raw papaya. Nano-emulsified raw papaya contains increased value of fat and sugar as compared with uncoated sample. Nano-emulsion provides scope for food additives in food industry to add emulsifiers, enzyme, active chemical, bioactive molecules, nutritive supplement, drugs, sweetening agents etc.

REFERENCES

[1]. Kjeldahl, J. (1883) "Neue Methode zur Bestimmung des Stickstoffs in organischen Körpern" (New method for the determination of nitrogen in organic substances), Zeitschrift für analytics Chemie, 22 (1): 366-383.
[2]. "International Starch: ISI 24 Determination of Protein by Kjeldahl". www.starch.dk. Retrieved 2019-03-21.
[3]. Dr. D. Julian McClements. "Analysis of Proteins". University of Massachusetts Amherst.
[4]. Harwood, Laurence M.; Moody, Christopher J. (13 Jun 1989). Experimental organic chemistry: Principles and Practice (Illustrated ed.). Wiley-Blackwell. pp. 122–125.
[5]. Soxhlet, F. (1879). "Die gewichtsanalytische Best immung des Milchfettes". Dingler's Polytechnisches Journal (in German). 232: 461–465.
[6]. Jensen, William B. (December 2007). "The Origin of the Soxhlet Extractor". Journal of Chemical Education. 84 (12): 1913-1914.
[7]. McLean FC, Hastings AB. The state of calcium in the fluids of the body. 1. The conditions affecting the ionization of calcium. J Biol Chem. 1935; 108:285–322.
[8]. Robertson WG, Marshall RW. Calcium measurements in serum and plasma total and ionized. CRC Crit Rev Clin Lab Sci. 1979; 11:271–305.
[9]. Covington, A. K.; Bates, R. G.; Durst, R. A. (1985). "Definitions of pH scales, standard reference values, measurement of pH, and related terminology". Pure Appl. Chem. 57 (3): 531–542.
[10]. International Union of Pure and Applied Chemistry (1993). Quantities, Units and Symbols in Physical Chemistry (2nd ed.) Oxford: Blackwell Science.