

Development of Chocolate Using Nanosized Soy Protein Isolate, Jaggery and Casein Protein

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Abstract: Soy protein Isolate is a kind of protein with high nutritional value and have average particle size of Untreated Soy protein Isolate (SPI) is 263.7 nm, and which is used to loose weight and boost energy. The objective of making chocolate with the help of soy protein is develop protein packed source for vegetarian diet and to develop energy boosting chocolate. The concentration of Soy protein Isolate (SPI) was taken as 5%, 7.5% and 10%. the cocoa powder was used in combination with Soy protein Isolate (SPI) to give a chocolatey flavor and to add sweetness factor in the chocolate another nanosized Jaggery was mixed and the size of jaggery particle ranges from 7.5 to 20.3 nm. Milk was added which contain casein protein which is a naturally present nanoparticle which size ranges from ~ 30 nm to ~ 500 nm, and this was used to bind all the raw material together. Emulsion was made using edible coconut oil and soy lecithin to decrease chocolate viscosity and slow down the autooxidation of fat. 7.5% concentration of Soy protein isolate with other raw material was much accepted for sensory evaluation and this finalize product was analyzed for physicochemical properties for its nutritional content, and storage effect was recorded for 2 weeks which showed slightly increased in hardness and turned darker in color. The total plate count (TPC) of the control and Soy protein Isolate chocolate was less than 10 colonies/g.

Keywords: Nanosize, Soy Protein Isolate, Jaggery, Casein Protein, Lecithin

I. INTRODUCTION

Chocolate is a nutrient made of roast and ground flowering tree pods, that's accessible as a liquid, solid or paste, on its own or as a flavouring agent in different foods.. flowering tree has been consumed in some type since a minimum of the Olmec civilization (19th-11th century BC), and also the majority of Mesoamerican folks - as well as the Maya and Aztecs - created chocolate beverages. Chocolate is one in all the foremost in style food varieties and flavors within the world, and lots of foodstuffs involving chocolate exist, notably desserts, as well as cakes, pudding, mousse, chocolate brownies, and chocolate chip cookies. several candies area unit full of or coated with sweet chocolate. Chocolate bars, either manufactured from solid chocolate or different ingredients coated in chocolate, area unit devoured as snacks. a lot of of the chocolate consumed nowadays is within the type of sweet chocolate, a mixture of cocoa solids, cocoa butter or accessorial vegetable oils, and sugar. Several styles of chocolate will be distinguished. Pure, sugarless chocolate typically referred to as "baking chocolate", contains primarily cocoa solids and cocoa butter in variable proportions.

Nanotechnology in Food Science:

Nanotechnology is outlined because the creation, utilization, and manipulation of materials, devices, or systems at the

micromillimetre scale. Nanomaterials area unit typically outlined as materials smaller than 100 nm and have distinctive properties when put next with their macroscale counterparts, because of the high surface to volume magnitude relation and novel chemistry properties like color, solubility, and physics. These novel properties give opportunities to boost the sensory qualities of food like style, texture, and color. additionally, nanomaterials is used to improve protection mechanisms for food. Utilizing nanosensors and nanopackaging materials allows fast, sensitive, and reliable detection of microbial contamination, harmful chemicals, and pesticides. Nanoencapsulation systems have the potential to boost food process by sanctioning the delivery of bioactive compounds for enhancing bioavailability in foods. (Baranwal et al., 2018)

Soy Protein Isolate and its health benefit:

Soy protein isolate is a protein that comes from soybeans. It's cheaper than some protein options and easy to add to your diet. Soy protein isolate may additionally manage your secretion balance and lower your risk of carcinoma, cardiopathy, and pathology. Protein is very important for your overall health and boosts development. Soy macromolecule is ninetieth macromolecule. alternative plant proteins haven't got the entire organic process price that soy will.

SPI is one in all the vital soy macromolecule product, typically containing 85%–90% macromolecule (dry basis). thanks to the complexity of production, the structure and useful properties of SPI significantly vary with the beginning materials, process variables and even the producer (Moure, Sineiro, Domínguez, & Parajo, 2006). Among all the variables, pH seems to be the foremost one touching the structure of soy proteins; the pH-related modifications of structure typically occur at quaternary and/or tertiary levels (Tang, 2017). SG is a lot of vulnerable to pH changes than SC; once the SG was denaturised, its solubility would lose (Petrucci & Anón, 1996; Wagner, Sorgentini, & Anón, 1996). therefore industrial SPI is typically poorly soluble in water (Lee, Ryu, & Rhee, 2003). Due to their insoluble nature, the particle size of SPI, in several cases, is hard to determine. To date, solely some works evaluated the dimensions of macromolecules or protein aggregates within the SPI dispersions, and also the determined size (e.g., z-average diameter) of the aggregates in SPI ranges from fifty nm to (writer, 2013; Keerati U-Rai & Corredig, 2009; Liu & Tang, 2013; Tang & Ma, 2009). The insoluble aggregates in SPI may be remodeled into soluble aggregates, for instance, with the assistance of combined homogenisation and inaudible treatments (Tang, Wang, Yang, & Li, 2009), or microfluidization (Shen & Tang, 2012)

Jaggery (The natural sweetener) and its health benefit:

Jaggery purifies the blood, various diseases like jaundice, breathlessness and kidney. prevents the rheumatic afflictions and disorders of bile. rheumatic afflictions and disorders of

bile .Jaggery is an energy food that is said to purify blood, regulate liver function and keep the body healthy.

bile .

Casein Protein (Naturally present nanoparticle in Milk)

Casein protein is a protein found in milk that gives milk its white color. Cow's milk consists of around 80% casein protein. Casein protein provides the body with all of the amino acids necessary to help build muscle. Casein protein is digested more slowly than other proteins, so it might be better at reducing appetite and increasing feelings of fullness. In milk the caseins are present in the form of large, roughly spherical colloidal associations, or micelles, ranging in size from ~30 to 500nm.

II. MATERIALS AND METHODS

Table 1: List of glassware , instruments , ingredients and chemicals

Glassware	Instruments	Ingredients	Chemical
Glassbowl	Refrigerator	Soy protein isolate	Soy lecithin
Stainless Steel Bowl	Analytical balance	Milk	Plate count Agar
Stainless Steel Spatula	Infrared Moisture Meter	Vegetable oil	
Whisk	Incubator	Cocoa powder	
Chocolate Mold	Autoclave	Vanilla	
Conical Flask	Muffle Furnance	Jaggery	

Soy Protein Isolate: Soy protein isolate is the protein having many health benefits such as it maintains secretion balance and has many applications in candy and confectionary products . (Decloedt , 1982) reported the utilization of soy protein isolates (SPI) in chocolate , confectionery and bakery . Inclusion of soy protein isolate can increase the protein content of chocolate. (Weber, 1985)

Table 2: Nutritional composition of Soy protein isolate (SPI)

Amount Per serving	Per 30 g
Total fat	< 1 g
Protein	27 g
Calcium	258 mg

Cocoa powder: Cocoa powder contain healthy components which has chemical that induce euphoria and cause cravings , and contain vital antioxidants that contribute to several areas of overall health. Several cardiometabolic parameters in type 2 diabetics were not affected by cocoa powder .Sabine Ellinger (2020).

Table 3: Nutritional composition of cocoa powder

Nutrients	Per 100 g
Carbohydrates	35 g
Protein	23 g
Fats	11 g

Jaggery: Jaggery is one of the most important sweeteners. Jaggery has great nutritive and medicinal value. Jaggery purifies the blood, various diseases like jaundice, breathlessness and kidney . prevents the rheumatic afflictions and disorders of

Table 4: Nutritional composition of jiggery

Nutrients	Per 100 g
Carbohydrates	84.3 g
Protein	4.98 g
Fat	0.26 g

Casein Protein: Casein protein is a protein found in milk that gives milk its white color. Cow's milk consists of around 80% casein protein. Casein protein provides the body with all of the amino acids necessary to help build muscle.

Table 5: Nutritional Composition of Casein Protein

Nutrients	Per 30 g
Calories	111
Protein	24 g
Total carbohydrates	3.75 g

III. METHOD

Soy protein isolate (SPI) (unflavored) and soy lecithin was ordered from amazon . Milk, cocoa butter , cocoa powder , vanilla , jaggery and edible coconut oil was collected from local shop . Firstly the cocoa power and cocoa butter was blended properly until it get in the paste form. Transfer the chocolate mixture into bowl and then place the chocolate mixture on top of the double boiler and bring the water on the lower part to just simmering over low heat and put it back in the blender and blend until it get smooth , after this add some amount of milk and then stir the paste and add milk gradually , mix it well until the paste get smooth and creamy , now different ratio of soy protein isolate was taken such as 5 % , 7.5 % and 10 % . jaggery and cocoa paste were maintained according to the composition .then mixture is poured into chocolate mold and air bubbles were removed by tapping . And chocolate mold is then kept in the refrigerator to set the chocolate at 4 degree celcius for 10 hr. After this emulsion is prepared with the help of coconut oil and soy lecithin and chocolate is dipped in this emulsion for texture maintainance .

Table 5: Formulation for chocolate with different levels of soy protein isolate (SPI) , milk , jaggery and cocoa butter

INGREDIENTS %	Control	SAMPLES 5 % SPI	7.5 % SPI	10 % SPI
Jaggery	30.68	30.68	30.68	30.68
Soy protein isolate	0.00	5.00	7.50	10.00
Milk	26.50	19.87	16.56	13.25
Cocoa butter	14.34	15.97	16.78	17.59
Cocoa powder	28.16	28.16	28.16	28.16
Vanilla essence	0.16	0.16	0.16	0.16
Salt	0.16	0.16	0.16	0.16

SENSORY EVALUATION:

The sensory properties of different concentration of chocolates is usually evaluated and ranked on the basis of scores given by panel of the judjes of the product . Chocolate quality could defined by consumer tasting that evaluates the feeding quality

in terms of characteristics like appearance, taste, mouthfeel, flavor, and after sensation. The developed product were evaluated by fifteen panelists for its sensory characteristics like mouthfeel, aftertaste, flavor, taste, appearance, and overall satisfactoriness on nine point hedonic scale, where the panelists were asked to permit a moment interval between tasting of samples then score for the attributes of every sample supported the united numbers on the nine-point hedonistic scale, with one = dislike extremely; two = dislike terribly much; three = dislike moderately; four = dislike slightly; five = neither like nor dislike; half dozen = like slightly; seven = like moderately; eight = like terribly much; 9 = liked extremely. The result of the analysis of variance revealed that sensory result assigned by judges on taste were found statistically significant.

PHYSICOCHEMICAL ANALYSIS:

1. Moisture Content:

Moisture content of chocolate was determined by the infrared moisture meter which has the capacity of 5gms. Sample was placed on the plate and fixed on to the meter. After putting the sample into the meter, needle was set to the zero as the moisture will reduce the needle will change its reading.

2. Ash Content:

Ash content represents the overall mineral contents in foods. Ash content of chocolate was determined by muffle furnace, where 10 g sample was taken and weighed and then dried crucible was weighed and then it burns away the chemical compound in an air at temperature above 500 degree Celsius for 8 to 10 hrs., and then it is cooled in the desiccator and again burn sample is weighed.

3. Determination of Texture:

Chocolate sample were analyzed with a TA-XT2 texture analyzer. In that sample is placed and then it is moved either up or down to compress or stretch the sample, the travelling arm which is present is fitted with a load cell and the record was taken of the force response of the chocolate sample to the deformation that is imposed on it.

4. Determination of color:

The tempered chocolate samples were molded in petri dish, stored at 21°C for 24 hr using color difference meter and difference was recorded.

5. Protein Content:

Protein was determined by Kjeldahl method as per AOAC (1995), which mainly involves the three steps such as digestion, distillation, and titration.

6. Microbiological Test:

All steps were carried out aseptically. A 90 mL of peptone water (1.5%) was taken and mixed with 2.5 g of yeast extract, 1 g glucose and 15 g of agar. The mixture was mixed and then all media instrumentation were sterilized by use of steam sterilization at 15 psi for 20 minutes at 121 degree Celsius in autoclave. Chocolate dilution ranging from 10⁻¹ to 10⁻⁶ were prepared and 0.1 mL were spread onto PCA plates using sterile glass spreader. The plates were incubated at 37°C and the colonies were counted according to the method of Messer zykwet zykwal. (1984) at 24 and 48 hr incubation.

IV. RESULT AND DISCUSSION

Sensory evaluation analysis:

When sensory evaluation of soy protein chocolate was done, composition with 7.5 % soy protein isolate (SPI) was much accepted sample and much liked and thus final sample was decided according to 9 point hedonic scale and was taken further for physicochemical and microbial analysis.

Texture analysis:

Hardness of chocolate has been shown to be considerably tormented by SPI content. The high quantity of SPI have caused a rise within the hardness of the resultant chocolates. SPI produces swollen insoluble protein, and increases the volume of chocolates throughout conching method (Norma et al. 1996). Cocoa butter (35-36%), that was used to maintain the entire fat of chocolates, could even have contributed to the rise within the hardness of the chocolate samples. It conjointly shows that every one chocolates tend to be slightly hardened once stored at 21°C for two weeks as per Hutton and mythologist (1981), SPI has the ability to soak up oil or macromolecule within the vary of eighty to a hundred and fiftieth so, throughout conching, SPI was possible to soak up the melting cocoa butter and cut back chocolate viscosity; upon molding, chocolate hardness has then multiplied.

Color analysis:

The addition of various levels of SPI has modified the colour values of the chocolates for every treatment, the chocolate with SPI minimized its achromatic colour, compared to control chocolate. Thus there was lightness of color in chocolate during 2 weeks.

Other physicochemical analysis:

Table 6: Result of physicochemical analysis Microbial analysis

Parameters	Results
Moisture content	2.63 ± 0.27 %
Ash content	5.92 ± 0.43 %
Protein content	54 ± 2 %

The chocolate samples had TPC of 10 colonies/g at week zero and one. At week 2, the TPC slowly hyperbolic to quite 10 colonies/g at 24 hr for control and 5% SPI and at 48 hour for management, 5% and 7.5% of SPI, severally. Those with 10% SPI still had but ten colonies/g in 48 hr at 2 week.

Table 7: Total plate count of chocolate during storage at 21 °C at 24 hours

Week	Control	5 % SPI	7.5 % SPI	10 % SPI
0	< 10	< 10	< 10	< 10
1	< 10	< 10	< 10	< 10
2	100	50	< 10	< 10

Table 8: Total plate count of chocolate during storage at 21 °C at 48 hours

Week	Control	5 % SPI	7.5 % SPI	10 % SPI
0	< 10	< 10	< 10	< 10
1	< 10	< 10	< 10	< 10
2	100	350	50	< 10

CONCLUSION

Chocolate is one of the most popular food and common confectionary material in the world, that's why healthy

chocolate was made with the help of soy protein isolate which is nanosized having average size of 263.7 nm and has many health benefits such as it helps in maintaining secretion balance in the body . This soy protein isolate has been combined with other raw material such as jaggery , cocoa powder and milk , which was used to bind all the raw materials together and milk contain the casein protein which is a natural nanomaterial . The soy protein concentration was taken as 5 % , 7.5 % and 10 % . the most accepted composition was 7.5 % according to 9 point hedonic scale in sensory evaluation and finalize product was gone through several physicochemical analysis for its nutrient content and microbial for total plate count (TPC) . thus , chocolate was developed in order to provide protein packed source for vegetarian diet and to develop energy boosting chocolate .

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