

Research Article

Preparation of soybean protein isolate (SPI) drinks using ginger essential oil and oleoresin as flavouring agents

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Abstract: Ginger essential oil and oleoresin were extracted using steam distillation and solvent extraction respectively. Soybean protein isolate drink (SPID) using ginger oil and oleoresin was made and the functional properties and sensory evaluation were studied. Comparatively the bulk density, dispersibility and water absorption capacity increased in the SPI drink, whereas solubility increased in powdered drink from commercial grade soy milk powder (CSMD). The colour parameters L*, 'a' and 'b' increased in SPID and decreased in CSMD. All drink samples differed, sometimes significantly ($p \leq 0.05$) in their functional properties. To improve the soy protein isolate drink flavour and taste, the powdered drinks were formulated through the addition of ginger oil and oleoresin at different concentrations, salt and sucrose. Sensory properties were then evaluated using a 10 member panel to determine the most preferred sample. C powdered drink with ginger flavour was selected as being the best tasting.

Keywords: beverages, additives, flavours, functional properties, sensory evaluation

Introduction

Ginger is widely used as a flavouring agent in beverages and many food preparations. It can be made into a powder or drink to facilitate its use as an ingredient in infusions, beverages, spice mixtures and nutrition products. The main use of most ginger oils is to give their own characteristic flavour to an end-product. The flavour may be simple or part

of a blend with other essential oils. In some cases the character may be enhanced by the addition of natural identical raw materials.

Ginger flavouring agents used in beverage preparation include essential oils or oleoresin, which are generally water-insoluble. However, flavours that are used in commercial beverages must be water-soluble or dispersible. Accordingly, carbohydrate gums are commonly employed to form flavour emulsions and these are used to flavour a beverage. Oleoresins are similar to essential oils but contain much more of the characteristic flavour of an herb. For example, most of the characteristic flavour, but none of the pungency of ginger is present in the essential oil. An oleoresin must be used to obtain a full ginger flavour. Popular oleoresins include, but are not limited to, ginger, black pepper and capsicum.

The purpose of this study was to prepare soy protein isolate drink using ginger essential oils and oleoresin as flavouring agents using a spray drying process and to study the functional properties and sensory evaluation.

Materials and Methods

Materials

Ginger oil was obtained from a super market in Wuxi, China. Soy Protein Isolate was kindly supplied by Shanghai Honghao Chemicals Co., Ltd (food grade). Sucrose was purchased from a supermarket, citric acid, gum arabic, maltodextrin (food grade) and solvents were obtained from the chemical store of Jiangnan University.

Extraction of Oleoresin

The preparation of ginger oleoresin involves alcohol extraction of ginger residue (solids) after oil extraction by steam distillation as proscribed by AOAC [1], followed by removal of the alcohol by distillation in a vacuum. The oleoresin remaining after alcohol evaporation is a dark brown viscous liquid.

Extraction is carried out in a sealed vessel in which the ginger residues are continuously soaked in aqueous ethanol/water (80:20) and then heated at 78°C using a water bath. This process provides oleoresins with optimal flavour properties and solubility in aqueous ethanol. After decanting and filtering, total evaporation of alcohol is undertaken under a given temperature through vacuum concentration. This extraction process enables the processor to extract the heavy constituents of ginger such as resins, as well as their volatile and aromatic components.

Formulation and Processing of SPID

The SPI is hydrated with water in a high-shear mixer, and then all other ingredients are added and mixed thoroughly. The mixture is heated to 65-70°C. The flavouring agents (essential oil and oleoresin) are added. The mixture is homogenized, cooled and spray dried as shown in Figure 1.

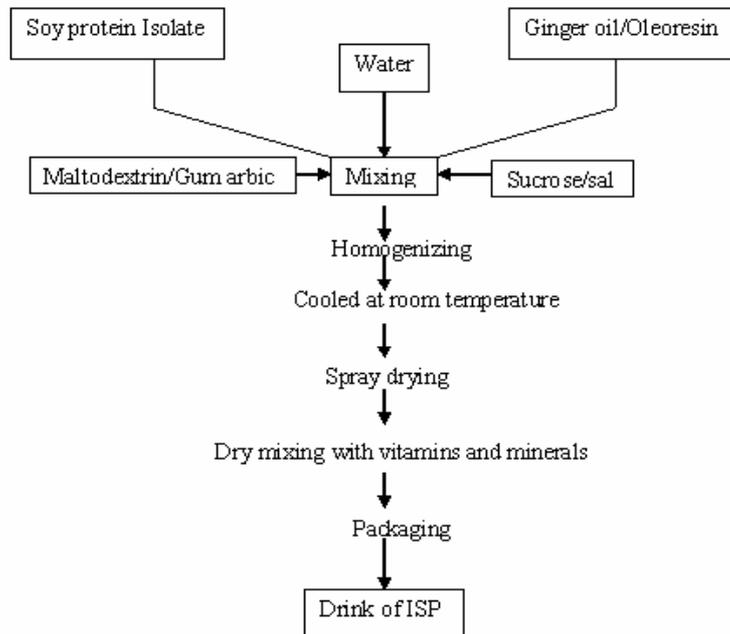


Figure 1. Soy protein isolate drink processing flow diagram.

Functional Properties and Sensory Evaluation

Bulk Density

Bulk density was determined by the method of Narayana and Narasinga [2]. An empty calibrated centrifuge was weighed. The tube was then filled with a 5 ml sample by constant tapping until there was no further change in volume. The weight of the tube and its contents was taken and recorded. The weight of the sample alone was then determined by difference. Bulk density was calculated from the values obtained as follows:

$$\text{Bulk density (g/ml)} = \text{Weight of sample} / \text{Volume occupied} \quad (1)$$

Dispersibility

Dispersibility in water, which indicates the ability to reconstitute, was determined by the method of Kulkani *et al.* [3]. 10 g of powder sample were weighed into a 100 ml measuring cylinder. Distilled water was added up to 100 ml volume. The sample was vigorously stirred and allowed to settle for 3 hours. The volume of the solution was recorded and subtracted from 100 to give a difference that is taken as percentage dispersibility.

Water Absorption Capacity

Absorption capacity, which gives an indication of the amount of water available for gelatinization, was determined according to Solsulski [4]. 2 g of the sample were added to 30 ml distilled water in a weighed 50 ml centrifuge tube. The tube was agitated by

vortex for about 5 min before being centrifuged at 4,000×g for 20 min. The mixture was decanted and the clear supernatant discarded. Adhering drops of water were carefully siphoned as much as quantitatively possible and the tube was reweighed. Water absorption capacity was expressed as the weight of water bound by 100 g dry powder.

Solubility

The reconstituted sample (5g powder in 35ml water at 25 ~30°C) was centrifuged in a weighed tube at about 2,000×g rpm for 10 minutes. The sediment was washed once. After the second or the third centrifugation, the wash water was decanted and the tube with the sediment was dried. The solubility index was calculated according to Equation 2 [5]:

$$\text{Solubility} = \left(1 - \frac{G}{W \times (1 - H\%)} \right) \times 100\% \quad (2)$$

Where **G** is the insoluble matter in the sample weight and **H** is the moisture content of the sample.

Colour

The sample colour was determined by using a colour meter (Model WSC-S, Shanghai). The instrument was calibrated with a standard tile ($L^* = 91.32$, $a^* = 0.03$, $b^* = -0.01$). The sample was placed in a dish and the surface smoothed. The sensor of the colour meter was then placed on the surface of the sample and the colour-reading read on the meter. This was carried out on three randomly selected points on the surface of the sample and average value was determined. The colour meter yielded L^* , a^* and b^* for the sample, which were converted to lightness index value according to the expression:

$WI = 100 - [(100 - L^*)^2 + (a^*)^2 + (b^*)^2]^{0.5}$, hue angle (h°) was calculated from $h^\circ = \arctan(b^*/a^*)$ and chroma(c^*) from $c^* = [(a^*)^2 + (b^*)^2]^{0.5}$.

Formulation

The SPI drink was formulated into 4 samples with the aim of improving its taste, flavour and rendering the drink more acceptable to consumers by adjusting the ginger oil to oleoresin and sucrose to acid ratio.

The four samples were formulated as follows; sample **A**: oleoresin 0.6%, ginger oil 0.1%, sucrose 3%, salt 0.05%, sample **B**: oleoresin 0.2%, ginger oil 0.2%, sucrose 4%, salt 0.05%, sample **C**: oleoresin 0.2%, ginger oil 0.1%, sucrose 5%, salt 0.2% and sample **D**: oleoresin 0.3%, ginger oil 0.2%, sucrose 3%, salt 0.1%. After formulation of the samples, sensory evaluation of the samples was done.

Table 1. Formula for drink of soy protein isolate.

| | |
|---------------------------|--------|
| Soy Protein Isolate (SPI) | 6.00 % |
| Maldodextrin (MD) | 2.00 % |
| Ginger oil | 0.10 % |
| Oleoresin | 0.60 % |
| Gum Arabic | 0.25 % |
| Salt | 0.05 % |
| Sucrose | 3.00 % |
| Water | 88 % |

Sensory Evaluation

The test was carried out in a well-lit laboratory room under daylight. A trained panel consisting of 10 members was used in the evaluation of sweetness, acidity, flavour, aftertaste and overall acceptability of the SPI drink. Evaluation was carried out in a descriptive way using a 9-point hedonic scale for each attribute, ranging from 1 for lowest intensity to 9 for highest intensity. Panelists were made familiar with the test format, the meaning of the scale and the main attributes of interest prior to the sensory evaluation implementation so as to avoid bias and uniformed choices about the attributes under investigation, as proscribed by Price and Morris [6].

Statistical Analysis

The data were analyzed as factorials by the analysis of variance using the Statistical Analysis System (SAS system for Windows V8.2) by the SAS Institute, Inc. Cary, NC, USA. Means of the variables were separated by the Duncan option of the SAS.

Results and Discussion

The functional properties of soy protein isolate drink (SPID) and the commercial soy milk powder drink (CSMD) were studied. SPID was used in this work basically for comparative purposes with CSMD. In addition, bulk density, dispersibility, water absorption capacity, solubility was studied and the results shown in Table 2.

Table 2. Some functional properties of the drink samples.

| Property | SPID | CSMD |
|------------------------|-------------------------|-------------------------|
| Bulk density (g/ml) | 0.76±0.3 ^a | 0.63±0.2 ^b |
| Dispersibility (%) | 87.50±0.4 ^c | 87.0±0.1 ^b |
| Water abs capacity (%) | 35.80±0.3 ^a | 30.4±0.6 ^b |
| Solubility (%) | 89.5±0.1 ^b | 90.0±0.4 ^a |
| Colour | | |
| L | 96.07±0.03 ^a | 98.74±0.22 ^a |
| a | 2.67±0.04 ^a | 1.24±0.02 ^b |
| b | 18.74±0.01 ^a | 6.51±0.21 ^b |

SPID: soy protein isolate powdered drink

CSMD: powdered drink from commercially available soy milk powder

Values followed by different subscripts are significantly different by Duncan's Multiple Range Test across columns ($p \leq 0.05$).

Comparatively, the bulk density value of SPID was higher than the CSMD and was significantly different ($p \leq 0.05$) to CSMD. Dispersibility was almost similar in SPID in comparison to CSMD and there was no significant difference between them.

Water absorption capacity (WAC) is the ability of powder to associate with water, particularly when hydration is required to enhance handling characteristics. It was found to be lower in CSMD and higher in SPID. Bulk density values obtained were generally higher (between 0.76 for SPID and 0.63 for CSMD) than those obtained by Nzigamasabo and Hui [7] for cassava flours (0.54 to 0.55). Also, water absorption capacity values were higher than those observed by Nzigamasabo and Hui [7]. Dispersibility values obtained were higher (between 87.50 for SPID and 87 for CSMD) than those reported by Edema *et al.* [8] for maize-soybean flour blends (33.10 to 32.93).

Solubility was a little higher in CSMD than SPID and they were not significantly different.

Sensory Evaluation

The results from the sensory evaluation are shown in Table 3. From these results it was determined that aftertaste, flavour and acidity showed no significant difference for the formulated SPI drink samples A, B, C and D. Significant differences ($p \leq 0.05$) were recorded for sweetness between samples A and D in comparison with sample C, while there was no significant difference for sweetness between A and D.

The overall acceptability test found that sample C was most preferred, followed by sample B, the two insignificantly different for preference ($p \leq 0.05$) while sample A was least preferred and was insignificantly different from C.

Table3. Mean sensory score for the samples of SPID with different formulations.

| Sensory attributes | Samples | | | |
|--------------------|------------------------|-------------------------|-----------------------|-----------------------|
| | A | B | C | D |
| Sweetness | 3.7 ±0.2 ^a | 4.80±0.36 ^{ab} | 6±0.22 ^b | 4±0.27 ^a |
| Acidity | 5.4±0.32 ^a | 3.9±0.24 ^a | 3.9±0.07 ^a | 4.6±0.31 ^a |
| Aftertaste | 6±0.18 ^a | 4.8±0.19 ^a | 4.5±0.12 ^a | 4.7±0.16 ^a |
| Flavour | 6.6±0.54 ^a | 4.5±0.2 ^a | 4.7±0.21 ^a | 4.6±0.32 ^a |
| Acceptability | 4.6±0.25 ^{ab} | 6.3±0.40 ^{ab} | 7.5±0.1 ^a | 5.9±0.12 ^b |

*Average of duplicate determinations with 10 panelists (1-9 point scale):

Means with the different superscript letters in the same row are significantly different by Duncan's Multiple Range Test across columns ($p \leq 0.05$).

The flavour attributes strongly correlated negatively when the flavours ginger oil and oleoresin were used at high concentration in A and also led to an increase in aftertaste. The results showed that flavour is accepted to a certain degree whereby if exceeded unacceptability will occur. Conclusively, the SPI drink sample with only oleoresin and oil addition at a concentration of 0.2 and 0.1%, respectively (sample C) was acceptable to the sensory evaluation panel.

With regard to colour preference of samples, lightness factors are expressed in terms of 'L' values which indicate lightness or darkness on a scale of 100 to 0. The chromati-break coordinates, which represent hue and chroma, are expressed by 'a' and 'b', respectively. In general, the drink from commercial soy milk powder sample showed higher scores for lightness than the soy protein isolate drink samples (Table 2). The high values of 'a' and 'b' for both samples indicates the dominance of yellow colouration in the samples, with the products from soy protein isolate drink being significantly more yellow than commercial soy milk powder samples. This high yellow colour resulted from the SPI and oleoresin brown colour. The soy protein isolate drink, using the stated parameters, resulted in lighter products with more yellow colour.

Conclusion

Soy protein isolate drink using ginger oil and oleoresin were made and the functional properties and sensory evaluation were studied and compared with the commercial product. Comparatively, only the solubility increased in commercial soy milk powder (CSMD) whereas the dispersibility, water absorption capacity, bulk density increased in the SPI drink, however the difference was not regarded as significant.

There was an increase of colour parameters, 'a' and 'b' in SPID and L* was highest in the CSMD. This high yellow colour resulted in SPI and oleoresin brown colour.

The sensory evaluation results for SPID samples A, B, C and D that were formulated to determine the acceptability of the samples in powdered drink displayed that sample C was most preferred, followed by sample B which indicated that the addition of 0.2% oleoresin and 0.1% oil to the SPI drink results in a drink with acceptable taste.

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