

Soybean, mango and ginger beverage: nutritional information, sensory evaluation and consumption intent

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Abstract

The consumption of soybean has been associated with beneficial effects on the state of human health. By associating mango and ginger with the water soluble soybean extract, a beverage endowed with good sensory qualities and good nutritional value is obtained. The objective of this work was to promote soybean as a healthy food among adolescent and adult patients of an university hospital by inviting them to sensory trials of a drink formulated with water soluble soybean extract, mango pulp and ginger extract. Other objectives were to establish the nutritional facts concerning this drink and survey the consumption intention of subjects. Two groups, each with 125 individuals, one consisting of adolescents and one consisting of adults, took part in this study by filling in a questionnaire. The results revealed that the beverage showed higher nutritional value than pure water soluble soybean extract, that it was more appreciated by adolescents than adults, and that its future consumption intention was higher among teenagers.

Keywords: Juices; Soybeans; Fruit; Mangifera; Ginger.

Resumo

Avaliação sensorial de bebida de soja, manga e gengibre como uma maneira de divulgar preparações saudáveis para adolescentes e adultos num hospital universitário

O consumo da soja tem sido associado a efeitos benéficos ao estado de saúde humano. A manga e o gengibre, ao serem associados ao extrato hidrossolúvel de soja, contribuem para a obtenção de bebida de boa qualidade sensorial e bom valor nutricional. O objetivo deste trabalho foi divulgar a soja como alimento saudável para pacientes, adolescentes e adultos de um hospital universitário, por meio de realização de provas sensoriais de uma bebida formulada com extrato hidrossolúvel de soja, polpa de manga e extrato de gengibre. Outros objetivos foram estabelecer a informação nutricional desta bebida e pesquisar a intenção de consumo pelos participantes. Dois grupos com 125 indivíduos cada, um de adolescentes e outro de adultos, participaram deste trabalho respondendo a um questionário. Os resultados mostraram que esta bebida apresentou valor nutricional superior ao do extrato hidrossolúvel de soja puro, agradou mais aos adolescentes que aos adultos e obteve maior intenção de consumo futuro entre os integrantes do primeiro grupo que entre os do segundo.

Descritores: Sucos; Feijão de soja; Frutas; Mangifera; Gengibre.

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Resumen

Evaluación sensorial de la bebida de soja, mango y jengibre: una forma de promover prestacionar saludables para adolescentes y adultos en un hospital universitario

El consumo de soja se ha asociado con efectos beneficiosos sobre la salud humana. El mango y el jengibre al ser asociados con el extracto hidrosoluble de soja, contribuyen a obtener unabebida de buena calidad sensorial y buen valor nutritivo. El objetivo de este estudio fue promover la soja como alimento saludable para pacientes, adolescentes y adultos de un hospital universitario, mediante la realización de pruebas sensoriales de una bebida formulada con extracto hidrosoluble de soja, pulpa de mango y extracto de jengibre.Otros objetivos fueron establecer la información nutricional de esta bebidae investigar cuál es la intención de consumode los participantes. Dos grupos de 125 individuos cada uno, uno de adolescentes y el otro de adultos, participaron en este estudio, respondiendo a un cuestionario. Los resultados mostraron que esta bebida tenía valor nutritivo superior al del extracto hidrosoluble de soja puro, agradó más a los adolescentes que a los adultos y obtuvo una mayor intención de consumo futuro entre los integrantes del primer grupo que entre los del segundo

Palabras clave: Zumos; Soja; Frutas; Mangifera; Jengibre.

Introduction

In China soybean was considered one of five sacred seeds, and the survival of this nation has been attributed to the use of soybean as a staple protein source.¹

An increase in the consumption of sugar-rich and fat-rich industrialized foods with little complex carbohydrate and fiber has been observed in the standard diet of the Brazilian population.² According to the Family Budget Survey carried out in Brazil in 2008 and 2009,³ the Ministry of Health recommended daily ingestion of 400g of fruits and vegetables was not reached by more than 90% of the population. On the other hand, beverages with added sugar, such as juices, refreshers, and soft drinks were consumed with greater frequency, especially among teenagers, who ingested twice as much as adults and the elderly.

Healthy eating habits should be included into the everyday routine, as they prevent nutritional deficiencies and improve immune functions, protecting the individual from diseases.²

Public health intervention should promote healthy habits from the earliest age, preferably from childhood,⁴ since eating habits acquired in childhood and adolescence don't tend to change during adult life.

The worldwide consumption of soybean has been gradually increasing in recent years. This consumption is associated with the growth of the world population and an increase in purchasing power, especially in developing countries such as China, India, and Brazil.⁵ According to a review carried out by Brazil's National Supply Company,⁶ in 2012/13, the Brazilian soybean harvest was estimated at a record 82.6 million tons, making Brazil the world's largest producer, overtaking the USA, with an estimated production of 73.27 million tons.

The soybean (*Glycine max* L Merrill) contains isoflavones, which are phenolic phytoestrogen compounds found in vegetables, widely studied with respect to their benefits to human health, such as their estrogenic, anti-estrogenic, hypocholesterolemic, and anti-carcinogenic effects;⁷ and it also has a high protein content and significant mineral and fiber contents.⁸

However, it should be mentioned that the soybean also contains anti-nutritional factors, such as protease inhibitors, lectins, oligosaccharides such as stachyose, verbascose, and raffinose, phytates, saponins, polyphenols, and phenolic acids.⁹ The presence of protease inhibitors contributes to a reduction in digestibility of soybean proteins.¹⁰ The presence of these inhibitors decreases the amount of protein hydrolyzed by digestive enzymes and effectively absorbed¹¹ and also prevents the absorption of haem iron, consequently reducing iron bioavailability.¹²

Soybeans require heat treatment before consumption, but this treatment must be controlled so as to avoid the destruction of important amino acids and a decrease in the bioavailability of other nutrients.¹³

The mixture of fruit juices with water soluble soybean extract results in beverages with better nutritional characteristics than either the pure fruit juice or pure water soluble soybean extract.¹⁴

A soybean, banana and orange beverage carried out a sensory evaluation with adolescents. The beverage was highly appreciated with a prevalence of the responses "excellent" and "good" for the sensory attributes of color, aroma, flavor, sweet taste and viscosity.¹⁵

Mango (*Mangifera indica* L.), which belongs to the *Anacardiaceae* family, is originated in India. It stands out for its pleasant flavor and aroma allied to a high nutritional value.¹⁶ It's a source of carotenoids, which are vitamin A precursors, and also contains vitamin C and small amounts of B vitamins components.¹⁷

Ginger (*Zingiber officinale* Roscoe) originated in Southeast Asia, and is used in traditional Chinese and Indian cuisines and widely appreciated in the modern world. It's included in diet for its anti-inflammatory, anti-emetic, anti-nausea, anti-mutagenic, detoxifying, antiulcerative, hypoglycemic, and bactericidal effects.¹⁸

The objective of this work was to evaluate the soybean as a healthy food for teenage and adult patients of an university hospital by carrying out sensory trials of a soybean, mango and ginger drink. Other objectives were to establish nutritional information concerning this beverage and survey the future consumption intention by the participants.

Methods

This was a casuistic study with two groups, each with 125 individuals: one group of adolescents, and one group of adults. There were no inclusion nor exclusion criteria in this study. The adolescents, from 11 to 19 years old, of both sexes, were patients at the Núcleo de Estudo da Saúde do Adolescente (NESA) (Nucleus for the Study of Adolescent Health) of the Hospital Universitário Pedro Ernesto (HUPE), in Rio de Janeiro, and the adults, from 20 to 60 years old, of both sexes, were undergraduates, lecturers and employees, patients of



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the Departamento de Saúde no Trabalho (DESSAUDE) (Department of Health at Work), both belonging to Universidade do Estado do Rio de Janeiro (UERJ) (Rio de Janeiro State University).

For the sensory evaluation, each participant was offered a sample of the soybean, mango and ginger beverage. In both NESA and DESSAUDE, the trials were carried out at a table provided with two chairs, one for the person applying the test and another for the participant.

The following domestic utensils were used to prepare the beverage: cups, spoons, knives, measuring cups, stainless steel pans, balance with a precision of 1 gram, blender, 30 cm long piece of white longcloth, domestic centrifuge, fine mesh plastic sieve, cooker and refrigerator. The beverage was transported using 1 liter vacuum flasks and served in 50 mL disposable white plastic cups together with drinking water served in 100 mL disposable white plastic cups and white paper napkins, all placed on a white tray. The beverage was prepared according to the diagram presented in Figure 1.

Periodically the beverage was microbiologically analyzed for the presence of *Salmonella sp*, heat tolerant coliforms and *Bacillus cereus*.¹⁹

The aproximate composition, macro and micromineral contents, water soluble vitamins and carotenoid contents of the beverage were calculated based on the data presented in the Brazilian Food Composition Tables²⁰ and, for ginger, using the "Nutrient Database for Standard Reference" tables.²¹

The participants were informed that the objectives of the study were to investigate food habits regarding soybean and fruit beverages, soybean, mango and ginger, and to collect responses on the sensory quality of the soybean, mango and ginger beverage and on the intentions of the participants with respect to consumption of this beverage.

Before applying the sensory test with the soybean, mango and ginger beverage, they were invited to answer a few questions about sex, age, educational level, state of health and food habits with respect to soybean and fruit beverages, mango and ginger.

The sensory evaluation of the drink was based on a nominal scale of five categories for color, aroma, flavor, sweet taste and viscosity: dreadful, bad, regular, good, and excellent. It followed the protocol of experiments carried out in 'Healthy Food and Sensory Evaluation of Soybean Preparations by Healthy and Non-Healthy communities', a program endorsed by the Brazilian Ministry of Education. The present study



Refrigeration

Figure 1. Preparation of the soybean, mango and ginger beverage.

represents one of the actions developed in the Project "Preparations containing soybeans for patients in the university hospital (HUPE/UERJ): sensory evaluation and culinary workshops", approved by the University Ethics Committee with a Presentation Certificate for Ethical Appreciation, CAAE n° 05423112.8.0000.5259.

The attitude test to measure the consumption intention was also applied, with a nominal scale with the following categories: "would never drink it", "would drink it very rarely", "would drink it rarely", "would drink it very occasionally", "would drink it frequently", "would drink it very frequently" and "would drink it all the time".²²

Results

Table 1 presents the compositions of the soybean, mango and ginger drink and of the water soluble soybean extract (WSE), showing that the former presented an improved nutritional value in carbohydrate, fiber and energy contents. Protein content was higher in the pure WSE, with 2.4%, whereas the soybean, mango and ginger drink contained 1.84%.

Comparing macro and micro-mineral content in the pure WSE with the values presented by the drink (Table 1), the soybean, mango and ginger beverage presented higher amounts of potassium and manganese than the WSE.

The soybean, mango and ginger drink also presented higher contents of the water soluble vitamins riboflavin, piridoxin, niacin, and vitamin C than the WSE (Table 1). Table 1 shows the absence of retinol in the WSE and the presence of this important component in the soybean, mango and ginger drink.

Table 2 shows Colony Former Unit (CFU) levels in soybean, mango and ginger beverage offered to the participants.

Of the adolescents, 57% were men, and among the adults, 42% were men. 87% of the were 15 to 18 years old, and 13% were 11 to 14 years old. 54% of the adults were 20 to 40 years old, and 46% were 41 to 60 years old.

Of the adolescents, 82% were in High School and 18% were in Primary School. Just 1% had concluded High School. Of the adults, 56% were college graduates, 30% were undergraduates, and 14% had only completed High School.

With respect to their state of health, 21% of the adolescents and 36% of the adults were suffering from some type of disease. Of the adolescents, 8% suffered from dyslipidemia, 6% from asthma, 5% from anemia, and 2% from hypothyroidism. Among the adults, 9% suffered from asthma, 6% from dyslipidemia, 6% from allergies, 5% from high blood pressure, 2% from anemia, 2% from chronic gastritis, 2% from hypothyroidism, 2% were convalescing post-operative, 1% suffered from Diabetes mellitus, and 1% from osteoporosis.

Table 3 shows industrialized soybean and fruit beverages classification by adolescents and adults.

Table 4 shows consumption frequency of industrialized soybean and fruit beverages by adolescents and adults.

With respect to mango, all the adults and 97% of the adolescents liked this fruit, and the adolescents consumed mango with a greater frequency than the adults. Among the adolescents, 54% consumed the fruit from 1 to 3 times a week, 28% from 1 to 3 times a month, 15% every day, and 3% never. Of the adults, 51% consumed the fruit from 1 to 3 times a month, 37% from 1 to 3 times a week, 7% every day, and 6% never.

Concerning ginger, 70% of the adolescents did not know this root whereas 86% of the adults did. Of the 30% of adolescents who knew ginger, only 25% liked it, and of the 86% of adults that knew ginger, only 67% liked it. The majority of both groups didn't consume ginger. Of the adolescents, 75% never consumed the root, 17% consumed it from 1 to 3 times a month, and 7% consumed it once a week. Of the adults, 54% never consumed it, 35% consumed it from 1 to 3 times a month, and 11% consumed it from 1 to 3 times a week.

The soybean, mango and ginger drink was evaluated for the following attributes: color, aroma, flavor, sweet taste, and viscosity (Figure 2). The results showed a prevalence of the answers "excellent" and "good" for both adolescents and adults for the five sensory attributes. All the adolescents and adults answered "excellent" or "good" for the attributes of color and aroma. For the attribute of flavor, 99% of the adolescents and 96% of the adults evaluated the beverage as "excellent" or "good", and all adolescents and 98% of the adults answered "excellent" or "good" for the attribute of sweet taste. All of the adolescents and 98% of the adults answered "excellent" or "good" for the attribute of viscosity.

The adolescent group showed a greater consumption intention of the beverage than the adult group. 33% of the adolescents affirmed they would always drink the beverage, 22% would do it frequently, and 18% very frequently. On the other hand, for the adults, 33% affirmed they would drink it occasionally, 31% would do it frequently, and 27% very frequently (Figure 3).

Discussion

According to statistics of the National Supply Company,⁶ Brazil leads the production of soybeans and is considered its largest exporter. Nevertheless, between 2012 and 2013, it was estimated that only 20% of the Brazilian soybean production was destined for the production of industrialized food for human consumption in the form of beans and their derivatives, since 38% is exported and 42% is converted into oil and bran.⁵

One kilogram of soybean has the same energetic value as 3.5 kg of bovine meat or 6.5 liters of integral



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Table 1. Compositions, mineral and water soluble vitamin and retinol equivalents contents of the pure water soluble soybean extract (WSE) and the soybean, mango and ginger beverage.

	Water soluble soybean extract (WSE)	Soybean, mango and ginger beverage
Energy (kcal)	39,0	62,56
Carbohydrate (g.100g-1)	4,30	12,34
Protein (g.100g-1)	2,40	1,84
Fat (g.100g-1)	1,60	1,08
Fiber (g.100g-1)	0,40	0,95
Potassium (mg.100g-1)	121,00	138,52
Sodium (mg.100g-1)	57,00	36,06
Phosphorus (mg.100g-1)	53,00	38,25
Calcium (mg.100g-1)	17,00	13,77
Magnesium (mg.100g-1)	15,00	13,84
Iron (mg.100g-1)	0,40	0,31
Zinc (mg.100g-1)	0,30	0,23
Manganese (mg.100g-1)	0,15	0,19
Copper (mg.100g-1)	0,08	0,07
Vitamin C – ascorbic acid (mg.100g-1)	Tr*	2,52
Vitamin B3 – niacin (mg.100g-1)	Tr*	0,05
Vitamin B6 – pyridoxine (mg.100g-1)	Tr*	0,02
Vitamin B2 – riboflavin (mg.100g-1)	Tr*	0,01
Vitamin B1 – thiamin (mg.100g-1)	Tr*	0
Retinol Equivalents (µg. 100g-1)	-	32,86
Retinol Activity Equivalents (µg. 100g-1)	-	16,43

*Tr = Trace.

Table 2. Microbial counts of the soybean, mango and ginger beverage.

Microorganism	Count	Reference ²²
Bacillus cereus	< 10 ² CFU/mL	5x10 ² CFU/mL
Heat tolerant coliforms	< 10 CFU/mL	10 CFU/mL
Salmonella sp	Absence/25 mL	Absence/25 mL

CFU: Colony Former Unit.

milk. Among all kinds of legumes used in human diet, soybean has 35 to 36% of nitrogen compounds whereas the others have 22 to 23%.¹ These facts make soybean an important food which should be consumed more frequently in Brazil.

Regarding Table 1, a similar result was obtained by Abreu *et al.*,¹⁴ evaluating the chemical and physicochemical compositions of different brands of soybean based beverages with pineapple, guava, mango, passion fruit, and mixtures with coconut milk, sold in Brazil. Protein contents were higher in the beverage containing pure soybean extract, varying from 0.06 to 0.37%.

The results of Table 1 corroborate those of authors who found that food products containing soybean and fruits resulted in an excellent combination, aggregating further nutritive value to that of the soybean and in addition improving the sensory characteristics of this bioactive compound rich legume.²³

In a study carried out by Silva *et al.* with consumers in the city of Rio de Janeiro, it was shown that 81% of the interviewees consumed soybean products. It is also worth mentioning that, regarding consumption frequency, 25% answered they consumed soybean products frequently.²⁴

Nowadays, fiber, vitamins, and energy contents are important selling points of beverages marketed as healthy.

Concerning Table 2, the soybean, mango and gin-

ger drink was fit for consumption according to the health standards established by the Brazilian legislation.¹⁹

In this work, among adolescents and adults dyslipidemia, a no transmissible chronic disease, was prevalent. In the last decade, heart disease mortality has decreased in developed countries whereas in developing countries, including Brazil, it has increased at a growing pace. To prevent and treat dyslipidemias, the food plan must consider cultural, regional, social, and economic issues, including pleasing and attractive preparations.²⁵

A consumption intention test with a beverage based on the water soluble extract of the CD 206 soybean cultivar with pineapple, passion fruit, and strawberry pulps showed that the sample with passion fruit was the most appreciated.²²

In this work, of the industrialized soybean and fruit beverages, mango was the most preferred flavor by the adolescents, while orange pleasing the adults.

Regarding industrialized soybean and fruit beverages, Table 3 shows that 96% of the adults classified them as excellent, good, or regular, whereas 74% of the adolescents didn't.

Data in Table 4 confirmed that of Table 3, where before trying soybean, mango and ginger drink, 74% of the adolescents had not tried any type of soybean plus fruit beverage.

Brazil should adopt public policies aimed at

	Adolescents (%)		Adults (%)			
	Excellent	Good	Regular	Excellent	Good	Regular
Industrialized soybean and fruit beverages	6	14	6	22	66	8

Table 3. Classification of industrialized soybean and fruit beverages by adolescents and adults.

Table 4. Consumption frequency of industrialized soybean and fruit beverages by adolescents and adults.

	Never (%)	1 to 3 Times a week (%)	1 to 3 Times a month (%)	Every day (%)
Consumption fre- quency of industri- alized soybean and fruit beverages	Adolescents			
	74	16	7	3
	Adults			
	9	49	28	14





adolescents adults

The consumption of soybean based foods should



Adolescents Adults

Figure 3. Distribution of the replies of the adolescents & adults about their consumption intention of the soybean, mango and ginger beverage.

be stimulated, with attention not only to the nutritional and functional characteristics of the raw material, but also to the sensory appreciation, easily obtained as shown in the present work: the association of soybean with mango and ginger made it possible to obtain a beverage with sensory characteristics considered pleasant by both adolescents and adults.

The soybean, mango and ginger beverage showed higher carbohydrate, fiber, manganese, potassium, riboflavin, piridoxin, niacin, vitamin C, and retinol contents than the pure water soluble soybean extract, indicating that the incorporation of fruit juice in the pure water soluble soybean extract was an important nutritional complement.

Conclusion

Brazil is the world's largest producer of soybean, a high-protein legume. However, this study showed that 74% of the adolescent patients who took part in the sensory trial of the soybean, mango and ginger drink had never tried any type of soybean plus fruit beverage before. This beverage was found to have a healthy chemical composition; it also received a secure hygienic grade. The drink was classified as excellent or good regarding five sensory attributes by all adolescent and adult participants of this research. The consumption intention of this beverage was higher than 73% for both adolescents and adults.

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