

# Spirulina Incorporated Pineapple and Banana Smoothie

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**Abstract :** Smoothie was prepared using pineapple, banana, toned milk and spirulina. Pineapple and banana are rich sources of various nutrients including dietary fiber, vitamins and minerals. Spirulina is a micro algae consumed for its nutritive value and various health benefits. It is a rich source of proteins, vitamins and minerals. The smoothie prepared was evaluated for its sensory characteristics and analyzed for pH, total solids, sugar and protein contents. Spirulina was incorporated at levels of 0.5, 1.0 and 2.0 per cent in the formulation. Sample prepared using 0.5 % spirulina was found to be more acceptable. A marginal increase in the protein content was observed in the spirulina incorporated sample compared to the control. The intense flavor of spirulina resulted in the product being less acceptable when incorporated at higher levels.

**Index Terms - Smoothie, spirulina.**

## I. INTRODUCTION

A smoothie is a thick, cold beverage made from fruit puree and blended with ingredients such as water, sweeteners, dairy products and other nutritional supplements. Since smoothies are prepared using fresh fruits, vegetables and other sources of nutrients, they are a rich source of vitamins and energy. They are popular as they pack as much nutrition as possible in a single drink.

Spirulina is a blue-green microalgae which grows in water and has been used as food for centuries by different populations. Among the various microorganisms used as sources of single cell protein, spirulina is considered as the best source. The composition of the biomass, including the high protein content, low content in nucleic acids, occurrence of high concentrations of vitamins and other growth factors and the presence of cell wall that is more easily digestible than that of other microbes make spirulina a promising source of food. In powder form, spirulina can be used in a number of food products such as soups, sauces, pasta, snack foods, instant drinks, fermented foods such as cheese, yogurt and tofu and other recipes.

Spirulina has gained considerable popularity in the health food industry and increasingly as a protein and vitamin supplement. It is a very good source of various macro and micro nutrients. It contains unusually high amounts of protein, between 55 and 70 percent by dry weight. It is a complete protein, containing all essential amino acids, and is considered to be superior to all standard plant proteins such as that from legumes. Spirulina has 5–6 percent total lipid with a high amount of polyunsaturated fatty acids, particularly  $\gamma$ -linolenic acid. It contains vitamin B1 (thiamine), B2 (riboflavin), B3 (nicotinamide), B6 (pyridoxine), B9 (folic acid), B12 (cyanocobalamin), vitamin C, vitamin D and vitamin E. It is also a rich source of potassium, and contains calcium, chromium, copper, iron, magnesium, manganese, phosphorus, selenium, sodium and zinc in significant amounts [1].

Several health benefits of the consumption of spirulina have been established through various clinical trials. It has been shown to be effective in lowering blood lipid level and in decreasing white blood corpuscles after radiotherapy and chemotherapy, as well as combating fatigue and increasing the level of immunoglobulin A (IgA) and immunoglobulin M (IgM). Spirulina also lowers serum cholesterol, triglyceride and low-density lipoprotein particles (LDL).

Pineapple is a tropical fruit that is rich in antioxidants and vitamins, especially vitamin C and thiamine. It is known to boost the immune system and build strong bones. It contains high amount of dietary fiber which helps in overcoming problems of indigestion. Bromelain present in pineapple helps to reduce severe inflammation. It contains nearly 75% of the daily requirement of manganese which is essential in developing strong bones and connective tissue.

Banana is one of the most widely consumed fruits. It is a rich source of fiber, minerals such as potassium, calcium, manganese, magnesium and iron as well as vitamins like niacin and riboflavin. Potassium helps in maintaining the fluid levels in the body and regulates heart beat, blood pressure and the movement of nutrients in and out of the cells.

Considering the rich nutritive value and the several health benefits provided by spirulina, pineapple and banana, the present study was carried out to prepare a pineapple and banana smoothie incorporating spirulina. Acceptability of the product and its physico-chemical properties were also evaluated.

## II. MATERIALS AND METHODS

### 2.1. Materials used

Pineapple, banana, toned milk, sugar, spirulina powder and pineapple flavor used in the preparation of smoothie were sourced from the local market.

## 2.2. Preparation of spirulina incorporated pineapple and banana smoothie

The control and test samples of smoothie were prepared as per the formulations shown in Table 1. Ripe pineapple was washed in clean, running water, peeled and the core removed. It was then cut into pieces and ground. Similarly, ripe fruits of banana were peeled, cut into pieces and ground. Pulp obtained by grinding of pineapple and banana were mixed together at different proportions as shown in the Table together with the specified quantities of toned milk, sugar, spirulina powder and pineapple essence. The materials were blended to a smooth consistency using a mixer and stored at refrigeration temperature. Samples T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were prepared with 0.5, 1.0 and 2.0 per cent of spirulina powder and 19.5, 19.0 and 18.0 percent pineapple respectively. Proportions of other ingredients used are shown in the Table. Control sample (T<sub>0</sub>) was prepared without the addition of spirulina powder.

Table 1. Formulations used for preparation of spirulina incorporated pineapple and banana smoothie (percentage).

Ingredient	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Pineapple	20.0	19.5	19.0	18.0
Banana	20.0	20.0	20.0	20.0
Toned milk	39.5	39.5	39.5	39.5
Sugar	20.0	20.0	20.0	20.0
Spirulina powder	0.00	0.5	1.00	2.00
Pineapple flavoring	0.5	0.5	0.5	0.5
Total	100	100	100	100

## 2.3. Sensory Evaluation

The control sample and samples of smoothie prepared with addition of different levels of pineapple and spirulina powder were evaluated by five panelists for the sensory qualities of color, aroma, taste, texture and overall acceptability using a 5-Point Hedonic Scale. Sample with highest acceptability was awarded a score of 5 and 1 for the least acceptable. The mean value of the scores from five panelists was then calculated.

## 2.4. Chemical analysis

The control and sample prepared with spirulina powder incorporation having the highest sensory acceptance (sample T<sub>2</sub>) were analyzed for the Total Solids, pH, Titratable Acidity, Total Carbohydrate and Protein contents as per the AOAC methods [2].

# III. RESULTS AND DISCUSSION

## 3.1. Sensory Evaluation

Table 2. Mean scores for sensory evaluation of pineapple and banana smoothie samples.

Parameter	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Color/appearance	5.0	3.8	4.2	2.6
Consistency	4.0	4.0	4.8	4.0
Taste	4.6	3.2	4.2	3.0
Flavor	4.6	3.8	4.6	3.2
Overall Acceptance	4.5	3.5	4.4	3.1

The mean scores for sensory evaluation of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> samples are shown in Table 2. Of the three samples containing added spirulina, sample T<sub>2</sub> with 1.0 % spirulina and 19.0 % pineapple was most acceptable. The score for color and appearance was less than the control as the dark green color imparted by spirulina was not liked much by the members of the sensory panel. The scores for other parameters were similar to the scores for the control sample. The results show that spirulina can be successfully incorporated into pineapple and banana smoothie to increase the protein content of the product.

## 3.2. Chemical analysis

The most acceptable sample with added spirulina, sample T<sub>2</sub>, and the control sample were analyzed for various chemical parameters and the results are shown in Table 3. Incorporation of spirulina resulted in decrease in the acidity of the product from 0.64 % to 0.43 % citric acid. The protein content of T<sub>2</sub> was higher (14.3 %) than that of the control (13.2 %) which was due to the addition of spirulina powder. No difference was observed in the carbohydrate contents of the two samples.

Table 3. Chemical analysis of T<sub>0</sub> and T<sub>2</sub> samples.

Parameter	T <sub>0</sub>	T <sub>2</sub>
Total solids (%)	33.1	34.1
pH	4.83	4.96
Titrateable acidity (% citric acid)	0.64	0.43
Total carbohydrate (%)	40.0	40.0
Protein (%)	13.2	14.3

Spirulina has a very strong algal odour which makes it highly unacceptable to consume as such in the powder form. Efforts were therefore made to incorporate spirulina powder in to smoothie which is a highly nutritious product. During the initial trials, when smoothie was prepared using water, the product obtained had a very unpleasant dark green colour. In order to improve the acceptability of the product, water was replaced with toned milk. Addition of milk resulted in a lighter colour in the product making it more acceptable. Pineapple flavour was used in order to mask the algal odour and taste of spirulina. Flavour of smoothie was much more acceptable after the addition of pineapple essence. Spirulina incorporated smoothie is therefore a protein enriched product that could be manufactured with acceptable sensory qualities to meet the nutritional requirements of the consumers.

#### IV. CONCLUSION

Smoothie is a product commonly consumed for its high nutritive quality. Incorporation of spirulina into smoothie further improves the nutritive value of the product which can help in overcoming problems arising out of malnutrition. Banana and pineapple smoothie of acceptable sensory quality and improved nutritive value was prepared. Manufacture of the product can be an effective means of utilizing spirulina to meet the increasing demand for therapeutic foods by the consumers.

#### REFERENCES

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