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# Development and Quality Evaluation of Beetroot Powder Incorporated Yogurt

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**Abstract**

Beetroot (*Beta vulgaris* L.) was pulped and dehydrated to get the powder. Yoghurt was formulated and flavored with prepared beetroot (*Beta vulgaris* L.) powder at different concentration levels (0, 6, 8 and 10%). Milk is a rich source of proteins, vitamins, minerals as well as many short and medium chain fatty acids. Milk has better digestibility, lower allergenicity and suitable for those who suffer from lactose intolerance. Considering those health benefits, current study was carried out to produce a buffalo milk yogurt and identify the plausibility use of beetroot powder. Yogurt samples were stored at 4°C and physicochemical evaluation was conducted for 7 days at the interval of one days. To evaluate the effect of above powder addition, chemical evaluation such as moisture content, fat content, ash content, protein content, carbohydrate content, acidity and pH were carried out. Shelf life study was done by microbiological analysis. Sensory analysis for color, taste, aroma, consistency, flavor, and overall acceptability was carried out according to the 9 point hedonic scale. The results showed that, the moisture content of prepared yogurts decreased from 80.46% to 75.45% .The pH and acidity of prepared yogurts was increased from 4.6 to 5.4 and 2.1 to 4.8% respectively. Protein, carbohydrate, Ash and fat content increased with increase in concentration of beetroot powder from 4.49 to 4.57%, 10.15 to 13.58%, 0.92 t00.98%, 2.24 to 2.47% respectively. The gradual increase in the bacterial count was observed during storage of yogurt at 4°C. The overall sensory quality of prepared yogurt was rated as good to very good. Yogurt with 8% beetroot powder was liked in all sensory attributes. It was observed that there was increase in sensory scores of beetroot powder added yogurt.

**Keywords:** Buffalo milk, Plain yogurt, Beetroot powder incorporated yogurt.

## Introduction

Yoghurt can be defined as semi fermented often flavored milk food. It is known and consumed in almost all parts of the world. It is traditionally known by adding common strains of Lactobacillus and Streptococcus bacteria strains to raw milk. Other lactic acid bacteria (LAB) are also frequently used to produce a yogurt with unique characteristics.

Yogurt is a sour milk product and is one of the oldest and popular foods in Africa, Asia, Europe and USA because of its nutritive and therapeutic value. It is nutritionally beneficial product generally considered as safe with taste and is liked by many people. Yogurt's nutritional profile has a similar composition to the milk from which it is made but will vary somewhat if fruit, cereal or other components are added. Yogurt is an excellent source of protein, calcium, phosphorus, Vitamin B2, Vitamin B1 and Vitamin B12, and a valuable source of folate, niacin, magnesium and zinc. The protein it provides is of high biological value, and the vitamins and minerals found in milk and dairy foods including yogurt are bioavailable.

It is noteworthy to mention that there are different types of yoghurt. The variations may be due to the use of live and active culture for inoculation, the use of plain (natural) and or fruit flavour and the use of milk from different species of animal and plants.

Coloured yogurt, a popular type of yogurt is liked by masses and is known as colour stirred/blended yogurt. Yogurt prepared by adding natural colour obtained by seasonal fruits are very attractive. Natural colour and fruit blended yogurt is popular among masses and particularly children who dislike the flavour of plain yogurt. This modification has made the yogurt flavour attractive for them. Addition of colour and sometimes fruits makes the yogurt more delicious. The product contains both the nutritive effect of yogurt and refreshing taste of fruit. Beetroot is especially rich in fibres as well as in sugars, but has a moderate caloric value. The soluble and cell wall associated phenolics are bioactive compounds **(Kugler *et al.,* 2007; Pradhan *et al.*, 2010)**. It is an excellent source of iron, which serves to regenerate and reactivate the red blood cells and supply fresh oxygen to body. It has been regarded as a laxative, a cure for bad breath, coughs and headaches and even as aphrodisiac It is an excellent source of folate and a good source of manganese, and contains betains which may function to reduce the concentration of homocysteine, a homolog of the naturally occurring amino acid cysteine. High circulating levels of homocysteine may be harmful to blood vessels and thus contribute to the development of heart disease, stroke, or peripheral vascular disease. Beetroot is known to contain large amounts of soluble fibers, flavonoids and betacyanin. It helps to reduce the oxidation of LDL cholesterol and does not allow it to deposit on the walls of the artery. This protects the heart from potential heart attacks and stroke reducing the need for medication.

## Materials and Methods

The materials used for the production of flavoured yoghurt were beetroot, milk, starter culture (yoghurmet). Beetroot and other materials, (starter culture, skimmed milk and sugar) were purchased at the local market of Allahabad. The experiments were carried out in the Dept. of Food Process Engineering, Vaugh School of Agricultural Engineering and Technology, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad.

### *Dry beetroot pomace powder preparation*

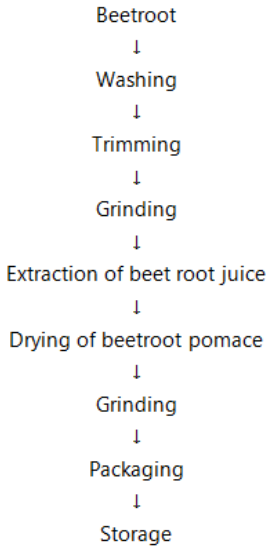


Fig.1 Flowchart of Beetroot powder production

### *Sample preparation*

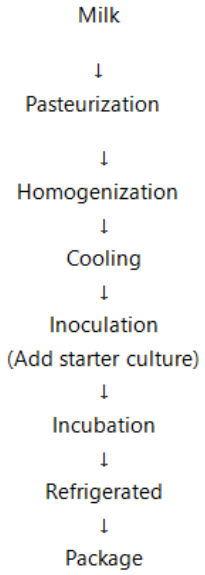


Fig. 2 Flowchart of yoghurt production

### *Nutritional Analysis*

Moisture, protein, fat, ash, titrable acidity and syneresis were determined according to standard methods (AOAC, 2005) given in Ranganna, 1986 respectively while carbohydrate was determined by calculation method. The pH was estimated by standard Stevens's method given in Ranganna in 1986 (Eutech instrument, model 510).

### *Microbiological Analysis*

The microbial analysis such as Standard plate count, Number of surviving Bifidobacteria was measured by Ranganna, 1966.

### *Sensory Evaluation*

Sensory evaluation was performed by 9 point hedonic scale to evaluate color, texture, flavor and overall acceptability of the yogurt samples (Meilgaard *et al*, 2007).

### *Statistical Analysis*

Four samples were analyzed for each property. Data were generated in triplicate and subjected to analysis of variance. Means were tested for significant differences by F-Test (Gupta, 1997). Significance was accepted at $p<0.05$

## Results and Discussion

### *Effect of Beetroot Powder on the Proximate Composition of Yogurt*

The protein, fat, carbohydrates, moisture, ash, pH and titrable acidity were determined for the control yogurt (plain yogurt) and beetroot powder incorporated yogurt as indicated in table 1. It could be noticed that supplementation of yogurt with beetroot powder associated with the increasing of protein, fat, carbohydrates, ash and acidity content. This increase in protein, fat, carbohydrates, ash and acidity due to relative increase of these nutrients in beetroot powder. Whereas the pH of the yogurt samples were decreased by addition of beetroot powder due to the acidic nature of beetroot. The storage studies were conducted at the interval of 0-7 days. During storage pH was decreased and acidity was increased. There were non-significant decrement in protein and ash content during the storage period of one week.

The changes in pH and acidity during the storage period of yogurt samples are illustrated in the Figure 1 and 2 respectively. The decrease of pH was observed throughout the storage period of one week and this may be due to the growth of bacteria that converts lactose into lactic acids. The same result was observed by (Damunupola *et al*., 2014). Seelee *et al.,* (2009) also reported that milk supplemented with 3% skim milk powder had aslight decrease in pH during the refrigerated storage over one weeks.

Titratable acidity (TA) of beetroot powder added yogurt samples increased gradually compared to the control during the storage for one weeks (Figure 2). The rich source of sugar provided by the beetroot powder may serve as a suitable substrate for the growth of microbes, which increased the acidity of yoghurt product. (Damunupola *et al.,* 2014). The TA of the yogurt samples were significantly low ($P<0.05$) at the first day and similar changes were observed for at 2, 4 and 6 days of storage.

Table 1: Physico- Chemical Composition and nutritional analysis of Yogurt

| Yogurt sample | pH | Acidity (%) | Moisture (%) | Protein (%) | Carbohydrates (%) | Fats (%) | Ash (%) | Syneresis (ml) |
|---|---|---|---|---|---|---|---|---|
| PY | 5.4 | 2.1 | 77.21 | 4.49 | 10.15 | 2.24 | 0.92 | 12 |
| BPIY 6% | 5.1 | 3.2 | 76.05 | 4.53 | 12.03 | 2.31 | 0.94 | 5 |
| BPIY 8% | 4.8 | 4.4 | 76.02 | 4.57 | 13.14 | 2.38 | 0.95 | 4 |
| BPIY 10% | 4.6 | 4.3 | 75.41 | 4.62 | 14.21 | 2.47 | 0.98 | 3 |
| F- TEST | S | S | S | S | S | S | S | S |
| S. Ed(±) | 0.043 | 0.037 | 0.016 | 0.045 | 0.013 | 0.023 | 0.018 | 0.10 |
| C.D (P=0.05) | 0.089 | 0.075 | 0.038 | 0.092 | 0.028 | 0.047 | 0.036 | 0.21 |

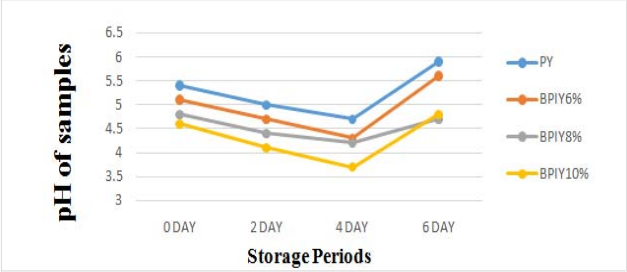


Fig 3: Changes in pH during the storage period of four yogurt samples

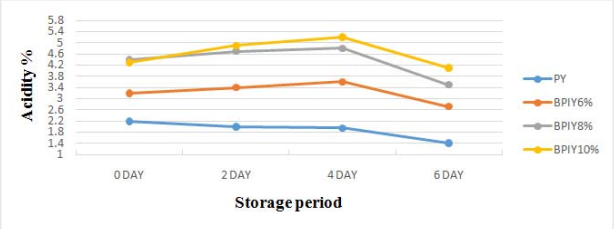


Fig 4: Changes in Acidity during the storage period of four yogurt samples

### *Microbiological Analysis*

The data on the total microbial count in control and beetroot powder incorporated yogurt samples showed (Table 2 and 3) an insignificant difference during the storage day of one week. Peak of the total microbial count was observed at 6 days of storage for control and beetroot powder added yogurt ($8.70 \times 10^5 \pm 0.10 \times 10^5$ and $8.31 \times 10^5 \pm 0.11 \times 10^5$) respectively. Total microbial count showed a reduction after 6 days of storage. This may be due to the inhibition of the growth of microorganisms as a result of acid production. Same result was observed by (Nwaoha et al., 2012). According to Tamime (1990) as cited in Seelee (2009) during fermentation, *S.thermophilus* produced lactic acid and formic acid which activate the growth of *L.bulgaricus* that produced diacetyl and acetaldehyde. These compounds reported to give the typical yogurt flavor. Coliform were observed during the latter part of the storage period.

### *Sensory Evaluation*

The results of the sensory evaluation shown that most preferred beetroot powder added yogurt was the one with the medium concentration (8%) of beetroot powder having a significant difference ($P<0.05$) compared to 6% and 10% concentrations. The panellists were able to distinguish a significant difference ($P<0.05$) in all attributes among the four yogurt samples. Yogurt incorporated by 8% beetroot powder were gained higher acceptance for all attributes tested. Beetroot powder was added to the yogurt with the intention of enhancing the colour and it was proved by gaining a higher score for the colour of beetroot yogurt than the plain yogurt.

## Conclusion

Nutritional quality i.e. addition of beetroot powder caused an increase in protein content of yogurt. The sensory parameters i.e. taste, color, aroma, flavor, consistency and overall acceptability of the beetroot powder incorporated yogurt was found highly acceptable by consumers it can be concluded that addition of beetroot powder enhanced the quality of yogurt. According to the sensory scores, the $T_2$ (i.e. BPIY8%) was the most accepted sample. With addition of beetroot powder, acidity, protein and carbohydrates were increased and further rise was observed when the proportion of powder was increased because of increase in quantity of organic acids. The pH value decreased with storage time. *L.bulgaricus* count increased because excess lactic acid produced by metabolic activity may have increased the *L.bulgaricus* count. *St. thermophilus*and *B. bifidum* showed irregular growth during storage .The fungi were not present in almost all samples upto 7 days of storage. On the basis of the findings, it can be concluded that addition of beetroot powder enhanced the quality and flavor of yogurt. Nutritional value of BPIY 8% (i.e. $T_2$) was the best.

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