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# Study on the quality parameter of curd by using β-carotene rich vegetable

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**Abstract**
The beneficial role of dietary fiber in human nutrition has lead to a growing demand for incorporation of novel fibers, esp. soluble fibers into foods. On the other hand, curd is considered highly nutritious due to metabolic products produced by LAB. Hence, fortifying curd with beta-carotene will help in formulating curd with dietary fiber. The study aims to prepare cost-effective curd with an amalgamation of β-carotene rich sources, viz; carrot, beet root, sweet-potato, using 4 different treatment for each. In the constructive phase of study, treatment $T_3$, curd incorporated with beet root in a proportion of 85:10, is the most consistent product amongst all the formulated curd samples. Also the statistical evaluation reveals that it's the most appreciated sample by the subjects, organoleptically. Whereas, all other physicochemical and microbiological traits of the curd fortified using beet root are similar to a standard curd under all upheld conditions of study.

**Keywords:** LAB lactic acid bacteria β-carotene, soluble fibers, dietary fibers, fortification

## Introduction
Being highly conjugated, it is deeply colored, and as a hydrocarbon lacking functional groups, it I very lipophilic. Medical uses β-carotene has been used to treat various disorders such as erythropoietic Protoporphyria. It has also been used to reduce the risk of breast cancer in women before menopause, and the risk of age-related macular degeneration (AMD) (WebMD. "Find a vitamin or supplement beta carotene". 29 MAY 2012).

## Curd
Yogurt, as well as milk, has a perfect balance of proteins, carbohydrates and fats. Yogurt holds on its own a prestigious status in the nutritional spectrum of foods (Shiby *et al.,* 2013). It is not a carbohydrate, although, it is plentiful in the sugar lactose; it is not a protein strictly, but is rich in proteins with up to 22 g per cup; and it is not a pure fat, yet it is abundant in healthy fatty acids. Yogurt makes a super-natural healer by virtue of high amounts of probiotic bacteria it contains, which add the extra medicinal value (Madhu *et al.,* 2013).

## Beet Root
Beet is root vegetable of the chenopodiaceous family whose edible part is its tuberous root. Its purple-red color is due to the presence of betalain pigments. These pigments are similar to anthocyanins and flavonoids, which were wrongly termed in the old literature as anthocynins containing nitrogen. Betalains are water-soluble pigments and are found only in ten families of the Centrospermae group and are divided into two classes: red betacyanin and yellow betaxanthin, which provide beet roots with their typical color (Fenena, 1995).

## Carrot
Carrots are more than versatile orange vegetable. Original carrots were purple and yellow, initially described in the 10$^{th}$ century in Iran and northern Arabia (Simon, 2000).

## Sweet potato
Sweet potato is one of the important vegetable crops in warm countries where it needs a warm growing season of 4-6 months. Such period is less than periods needed for most other root and tuber crops (Woolfe, *et al.,* 1992).

**Justification**

The nutritional compositional analysis of beetroot, carrot and sweet potato indicate that they are good source of dietary fiber which includes specially the soluble fiber. Thus it elevates curds nutritional and functional properties. A cheap product like curd with β-carotene rich fruits can serve as an excellent vehicle for improving dietary habits. The study focuses on combining the nutritional value of β-carotene rich fruits with the cost effective preparation of curd. Curd can be easily introduced in daily routine of the consumers. The study will follow four treatment ($T_0$, $T_1$, $T_2$, $T_3$) of three different samples (beet root, carrot and sweet potato). Curd is considered to be very nutritional products due to the presence of metabolic products produced by the lactic acid bacteria. But curd lacks in dietary fibers. By supplementing curd with β- carotene will help in enriching the standardized product with dietary fiber. The standardized product will be thus become a nutraceutical food since it gives both the properties of nutrition and medicinal value.

**Review of Literature**

Azgar, *et al.*, (1981) [1], The sweet potato, *Ipomoea batatas* L. (Lam.), is dicotyledonous plant belonging to convolvulaceae family. It is an extremely important crop mainly seen in tropical countries. It ranks seventh in the world from the viewpoint of total production. It is also a storehouse of many important pigment like β-carotene, anthocyanin etc. which act as good antioxidants.

Shen *et al.*, (1981), In general, amylase activities in sweet potato roots are increased by curing and storage especially during the first few months, then remain fairly constant or decreases to the levels at harvest.

Wang, *et al.*, (1984), Sweet potato is a rich sources of starch. It has 30% more starch than that of rice and corn and 49% than wheat under same condition.

Yamakawa (2000), some SP varieties contain colored pigments–anthocyanin, β-carotene and unidentified flavonoid.

Kusano *et al.*, (2000), very recently, sweet potato is labeled as an " antidiabetic" food because of some animal studies in which SP helped stabilize blood sugar levels and lowered insulin resistance.

Singh *et al.*, (2012), Curd or yoghurt is rich source of proteins, essential vitamins, minerals etc. it is a product of lactic acid fermentation of milk and is nutritionally more beneficial than milk. Yoghurt involves the use of specific symbiotic /mixed culture of lactobacillus bulgaricus and streptoccous thermophillus. It usually consists of heterogeneous mixture of lactic acid bacteria i.e. lactobacillus bulgaricus, streptoccous lactis, streptoccous diaticlactis, streptoccous clemoris, etc. basically curd is produced due to fermentation of milk and sugar lactose into lactic acid by lactic acid bacteria.

Ezekiel *et al.*, (2012), reviewed the beneficial phytochemicals in sweet potato and reported that in addition to supplying energy, sweet potato contain a number of health promoting phytonutrients such as carotenoids, folates, flavonoids, anthocyanins, kukoamines, and phenolics.

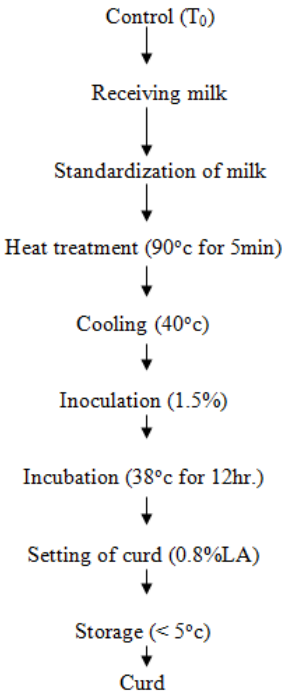
**Materials and Methods**

**Plan of work**

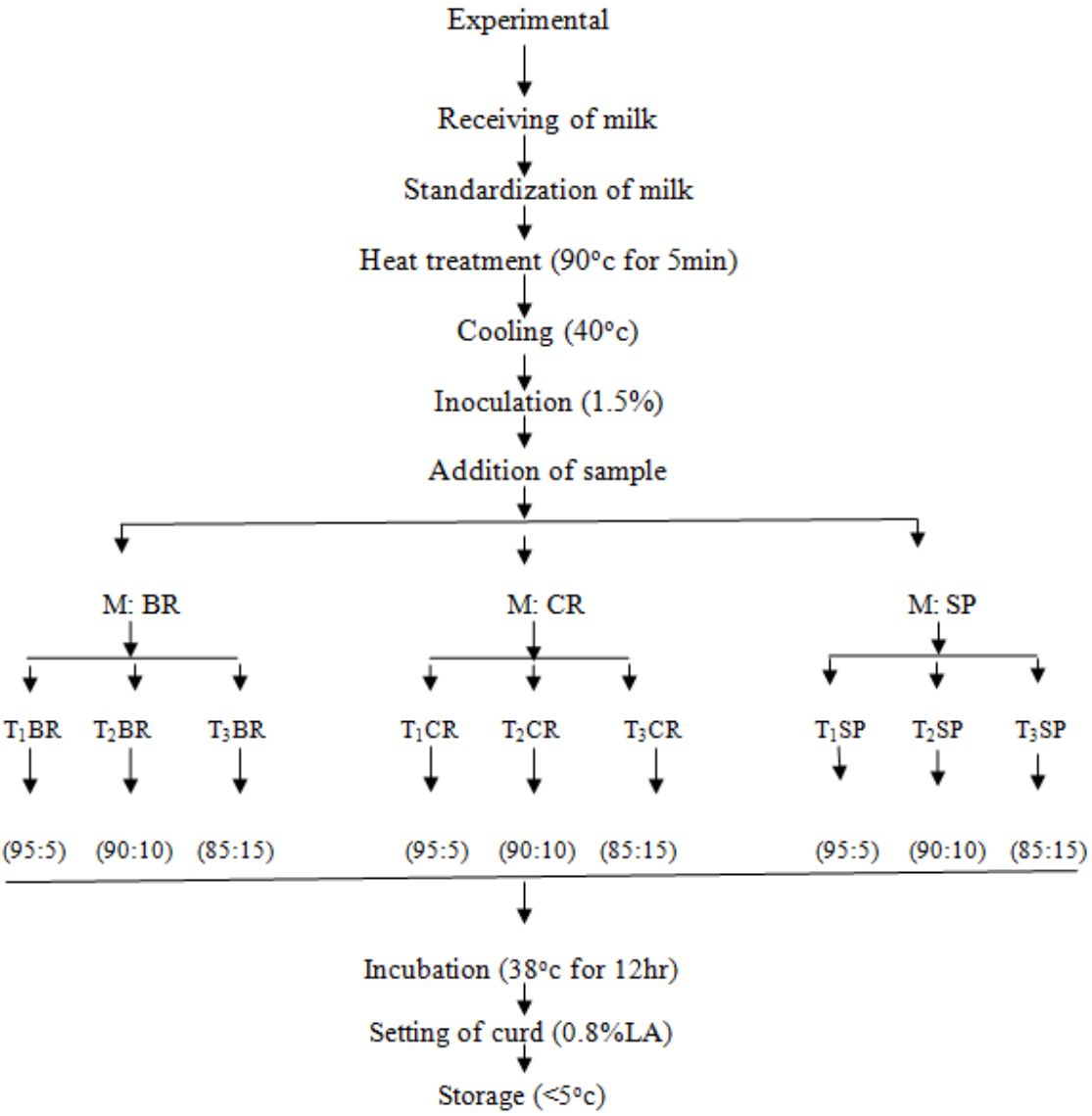
**Materials**

1. **Sample collection**: Three different vegetables samples were selected for the present study. These samples were collected from local vegetable vendors in Gangotri nagar, naini, Allahabad. The samples selected are; beet-root, carrot and sweet potato.
2. **Preparation of the starter culture:** The starter culture to be inoculated in the curd preparation will be cultured in the laboratory.
3. **Analysis of biochemical properties of the samples**: All the three samples will analyze for biochemical properties. Thin layer chromatography and column chromatography will be done for β-carotene analysis.
4. **Sample processing**: The vegetable samples will be processed before mixing to the milk for curd preparation. The samples are washed properly under running water, dried and then peeled. The samples are then boiled and macerated to form puree or the boiled samples are crushed and filtered with muslin cloth. These are then used in curd preparation.
5. **Preparation of curd with the help of β-carotene rich vegetables**: Curd will be prepared using fresh milk and mixture of three different preparations of sweet potato, beet root and carrot in different proportions. The starter culture was prepared by half liter of milk was taken and heated at 90°c for 15-20 minutes. It was cooled down to about 40°c. this heated milk was inoculated. This inoculated milk was left for incubation at 38°c overnight.
6. **Sensory evaluation:** The sensory evaluation of the squash will be carried by a panel of judges.

**Flow diagram adopted for control sample**



**Flow diagram adopted for experimental sample**




**Results and Discussion**

The data collected on different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference technique. The significant and non-significant differences observed have been analyzed critically within and between the treatment combinations.

| Parameters | Different parameters of treatments | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beet root | | | | Carrot | | | | Sweet potato | | | |
| | $T_0$ | $T_1$ | $T_2$ | $T_3$ | $T_0$ | $T_1$ | $T_2$ | $T_3$ | $T_0$ | $T_1$ | $T_2$ | $T_2$ |
| **Chemical analysis (in present)** | | | | | | | | | | | | |
| Protein | 3.31 | 3.79 | 4.11 | 4.38 | 3.59 | 3.81 | 4.05 | 4.33 | 3.42 | 3.72 | 4.02 | 4.30 |
| Fat | 3.55 | 3.46 | 3.42 | 3.34 | 3.55 | 3.45 | 3.40 | 3.35 | 3.55 | 3.49 | 3.45 | 3.39 |
| T.A. | 0.77 | 0.82 | 0.88 | 0.92 | 0.74 | 0.82 | 0.89 | 0.91 | 0.77 | 0.83 | 0.89 | 0.92 |
| pH | 4.82 | 4.68 | 4.57 | 4.46 | 4.85 | 4.72 | 4.56 | 4.43 | 4.84 | 4.71 | 4.58 | 4.45 |
| TS | 14.56 | 14.14 | 13.82 | 13.54 | 14.68 | 14.23 | 13.86 | 13.58 | 14.73 | 14.39 | 13.89 | 13.58 |
| Moisture | 85.35 | 85.86 | 86.16 | 86.46 | 85.32 | 85.76 | 86.14 | 86.42 | 85.27 | 85.61 | 86.11 | 86.42 |
| Ash | 0.72 | 0.73 | 0.78 | 0.82 | 0.73 | 0.74 | 0.78 | 0.82 | 0.72 | 0.74 | 0.82 | 0.020 |
| **Organoleptic analysis** | | | | | | | | | | | | |
| Color and appearance | 8.06 | 7.77 | 8.06 | 8.22 | 8.46 | 7.71 | 8.33 | 8.37 | 7.99 | 7.81 | 7.93 | 8.14 |
| Body and texture | 7.67 | 8.22 | 8.38 | 8.18 | 7.67 | 8.00 | 8.33 | 8.44 | 7.67 | 7.75 | 8.12 | 8.34 |
| Flavour and taste | 7.60 | 7.72 | 8.17 | 8.32 | 7.33 | 7.58 | 7.86 | 8.14 | 7.67 | 7.75 | 8.12 | 8.34 |
| Overall acceptability | 7.87 | 7.83 | 7.95 | 8.13 | 7.33 | 7.66 | 7.85 | 8.00 | 7.67 | 7.72 | 7.89 | 8.03 |
| **Microbial analysis** | | | | | | | | | | | | |
| Yeast and mould | 7.00 | 5.67 | 5.33 | 5.67 | 7.00 | 4.67 | 5.67 | 4.67 | 6.67 | 5.33 | 5.00 | 5.33 |
| Coliform | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| **Cost analysis** | | | | | | | | | | | | |
| Cost (Rs/ltr) | 39.65 | 41.81 | 43.99 | 46.12 | 39.65 | 42.46 | 45.46 | 48.04 | 39.65 | 43.69 | 47.73 | 51.76 |

**Summary and Conclusion**

**Physico-Chemical Analysis**

The highest mean score for moisture percentage of the β-carotene rich curd by beet-root (86.46) was obtained for the treatment $T_3$ followed by $T_2$ (86.18) and $T_1$ (85.86).the minimum score (85.35) was obtained by $T_0$ (control).

The highest mean score for moisture percentage of the β-carotene rich curd by carrot (86.42) was obtained for the treatment $T_3$ followed by $T_2$ (86.14) and $T_1$ (85.76).the minimum score (85.32) was obtained by $T_0$ (control).

The highest mean score for moisture percentage of the β-carotene rich curd by sweet potato (86.42) was obtained for the treatment $T_3$ followed by $T_2$ (86.11) and $T_1$ (85.61).the minimum score (85.27) was obtained by $T_0$ (control).

The highest mean score for total solid percentage of the β-carotene rich curd by beet-root (14.65) was obtained for the treatment $T_0$ followed by $T_1$ (14.14) and $T_2$ (13.82).the minimum score (13.54) was obtained by $T_3$.

The highest mean score for total solid percentage of the β-carotene rich curd by carrot (14.68) was obtained for the treatment $T_0$ followed by $T_1$ (14.23) and $T_2$ (13.86).the minimum score (13.58) was obtained by $T_3$.

The highest mean score for total solid percentage of the β-carotene rich curd by sweet potato (14.73) was obtained for the treatment $T_0$ followed by $T_1$ (14.23) and $T_2$ (13.89).the minimum score (13.58) was obtained by $T_3$.

The highest mean score for protein percentage of the β-carotene rich curd by beet-root (5.38) was obtained for the treatment $T_3$ followed by $T_2$ (5.12) and $T_1$ (4.79).the minimum score (4.43) was obtained by $T_0$ (control).

The highest mean score for protein percentage of the β-carotene rich curd by carrot (5.33) was obtained for the treatment $T_3$ followed by $T_2$ (5.05) and $T_1$ (4.81).the minimum score (4.59) was obtained by $T_0$ (control).

The highest mean score for protein percentage of the β-carotene rich curd by sweet potato (5.30) was obtained for the treatment $T_3$ followed by $T_2$ (5.02) and $T_1$ (4.72).the minimum score (4.42) was obtained by $T_0$ (control).

The highest mean score for fat percentage of the β-carotene rich curd by beet-root (3.55) was obtained for the treatment $T_0$ followed by $T_1$ (3.46) and $T_2$ (3.42).the minimum score (3.34) was obtained by $T_3$.

The highest mean score for fat percentage of the β-carotene rich curd by carrot (3.55) was obtained for the treatment $T_0$ followed by $T_1$ (3.45) and $T_2$ (3.40).the minimum score (3.35) was obtained by $T_3$.

The highest mean score for fat percentage of the β-carotene rich curd by sweet potato (3.55) was obtained for the treatment $T_0$ followed by $T_1$ (3.49) and $T_2$ (3.45).the minimum score (3.39) was obtained by $T_3$.

The highest mean score for carbohydrate percentage of the β-carotene rich curd by beet-root (5.96) was obtained for the treatment $T_0$ followed by $T_1$ (5.16) and $T_2$ (4.50).the minimum score (4.00) was obtained by $T_3$.

The highest mean score for carbohydrate percentage of the β-carotene rich curd by carrot (5.81) was obtained for the treatment $T_0$ followed by $T_1$ (5.23) and $T_2$ (4.62).the minimum score (4.08) was obtained by $T_3$.

The highest mean score for carbohydrate percentage of the β-carotene rich curd by sweet potato (6.03) was obtained for the treatment $T_0$ followed by $T_1$ (5.44) and $T_2$ (4.73).the minimum score (4.64) was obtained by $T_3$.

The highest mean score for ash percentage of the β-carotene rich curd by beet-root (0.82) was obtained for the treatment $T_3$ followed by $T_2$ (0.78) and $T_1$ (0.73).the minimum score (0.72) was obtained by $T_0$.

The highest mean score for ash percentage of the β-carotene rich curd by carrot (0.82) was obtained for the treatment $T_3$ followed by $T_2$ (0.78) and $T_1$ (0.74).the minimum score (0.72) was obtained by $T_0$.

The highest mean score for ash percentage of the β-carotene rich curd by sweet potato (0.82) was obtained for the treatment $T_3$ followed by $T_2$ (0.78) and $T_1$ (0.74).the minimum score (0.72) was obtained by $T_0$.

The highest mean score for titrable acidity percentage of the β-carotene rich curd by beet-root (0.75) was obtained for the treatment $T_3$ followed by $T_1$ (0.74).the minimum score (0.73) was obtained by $T_2$ and $T_0$.

The highest mean score for titrable acidity percentage of the β-carotene rich curd by carrot (0.75) was obtained for the treatment $T_1$ followed by $T_2$ and $T_3$ (0.74). the minimum score (0.73) was obtained by $T_0$.

The highest mean score for titrable acidity percentage of the β-carotene rich curd by sweet potato (0.76) was obtained for the treatment $T_2$ followed by $T_3$ and $T_1$ (0.75. the minimum score (0.74) was obtained by $T_0$.

The highest mean score for pH percentage of the β-carotene rich curd by beet-root (4.82) was obtained for the treatment $T_0$ followed by $T_1$ (4.68) and $T_2$ (4.57).the minimum score (4.46) was obtained by $T_3$.

The highest mean score for pH percentage of the β-carotene rich curd by carrot (4.85) was obtained for the treatment $T_0$ followed by $T_1$ (4.72) and $T_2$ (4.56).the minimum score (4.46) was obtained by $T_3$.

The highest mean score for pH percentage of the β-carotene rich curd by sweet potato (4.84) was obtained for the treatment $T_0$ followed by $T_1$ (4.71) and $T_2$ (4.58).the minimum score (4.45) was obtained by $T_3$.

**Organoleptic evaluation**

The highest mean score for color and appearance of the β-carotene rich curd by beet-root (8.22) was obtained for the treatment $T_3$ followed by $T_2$ (7.92) and $T_0$ (8.06).the minimum score (7.77) was obtained by $T_1$.

The highest mean score for color and appearance of the β-carotene rich curd by carrot (8.46) was obtained for the treatment $T_0$ followed by $T_3$ (8.37) and $T_2$ (8.33).the minimum score (7.71) was obtained by $T_1$.

The highest mean score for color and appearance of the β-carotene rich curd by sweet potato (8.14) was obtained for the treatment $T_3$ followed by $T_0$ (7.99) and $T_2$ (7.93).the minimum score (7.81) was obtained by $T_1$.

The highest mean score for body and texture of the β-carotene rich curd by beet-root (8.38) was obtained for the treatment $T_2$ followed by $T_1$ (8.22) and $T_3$ (8.18).the minimum score (7.67) was obtained by $T_0$.

The highest mean score for body and texture of the β-carotene rich curd by carrot (8.44) was obtained for the treatment $T_3$ followed by $T_2$ (8.33) and $T_1$ (8.00).the minimum score (7.67) was obtained by $T_0$.

The highest mean score for body and texture of the β-carotene rich curd by sweet potato (8.34) was obtained for the treatment $T_3$ followed by $T_2$ (8.12) and $T_0$ (7.76). The minimum score (7.75) was obtained by $T_1$.

The highest mean score for flavour and taste of the β-carotene rich curd by beet-root (8.32) was obtained for the treatment $T_3$

followed by $T_2$ (8.17) and $T_1$ (7.72).the minimum score (7.60) was obtained by $T_0$.

The highest mean score for flavour and taste of the β-carotene rich curd by carrot (8.14) was obtained for the treatment $T_3$ followed by $T_2$ (7.86) and $T_1$ (7.58).the minimum score (7.33) was obtained by $T_0$.

The highest mean score for flavour and taste of the β-carotene rich curd by sweet potato (8.32) was obtained for the treatment $T_3$ followed by $T_2$ (8.12) and $T_0$ (7.76).the minimum score (7.75) was obtained by $T_1$.

The highest mean score for overall acceptability of the β-carotene rich curd by beet-root (8.13) was obtained for the treatment $T_3$ followed by $T_2$ (7.95) and $T_0$ (7.87).the minimum score (7.83) was obtained by $T_1$.

The highest mean score for overall acceptability of the β-carotene rich curd by carrot (8.00) was obtained for the treatment $T_3$ followed by $T_2$ (7.85) and $T_1$ (7.87).the minimum score (7.83) was obtained by $T_0$.

The highest mean score for overall acceptability of the β-carotene rich curd by sweet potato (8.03) was obtained for the treatment $T_3$ followed by $T_2$ (7.89) and $T_1$ (7.72).the minimum score (7.68) was obtained by $T_0$.

**Microbiological Analysis**

The highest mean score for yeast and moulds of the β-carotene rich curd by beet-root (7.00) was obtained for the treatment $T_0$ followed by $T_3$ and $T_1$ (5.67).the minimum score (5.33) was obtained by $T_2$.

The highest mean score for yeast and moulds of the β-carotene rich curd by carrot (7.00) was obtained for the treatment $T_0$ followed by $T_3$ (5.33).the minimum score (4.67) was obtained by $T_1$ and $T_3$.

The highest mean score for yeast and moulds of the β-carotene rich curd by sweet potato (6.67) was obtained for the treatment $T_0$ followed by $T_3$ and $T_1$ (5.33).the minimum score (5.00) was obtained by $T_2$.

None of the samples of the β-carotene rich curd by beet-root i.e., control and experimental samples showed the presence of the coliforms at 0 day. The entire sample, at all the stages, were found gram-negative, which indicates proper hygienic conditions were maintained during the preparation and storage of the product.

None of the samples of the β-carotene rich curd by Carroti.e., control and experimental samples showed the presence of the coliforms at 0 day. The entire sample, at all the stages, were found gram-negative, which indicates proper hygienic conditions were maintained during the preparation and storage of the product.

None of the samples of the β-carotene rich curd by sweet potato i.e., control and experimental samples showed the presence of the coliforms at 0 day. The entire sample, at all the stages, were found gram-negative, which indicates proper hygienic conditions were maintained during the preparation and storage of the product.

**Conclusion**

For the constructive first phase of study, with an aim to develop beta-carotene rich curd; beet root as first vegetable was selected and therefore, the evaluation sensory, chemical and microbiological qualities of the beet root based curd was done using 3 treatments.

**Curd with beet-root**

However, organoleptic tests were performed using 3 parameters viz, color and appearance, body and texture, flavour and taste and overall acceptability. Accordingly $T_3$ was the most preferred treatment out of all; with great color and appearance, overall acceptability and also for flavour and taste. Above all it was the most microbiologically stable treatment.

**Curd with carrot**

Also, another vegetable, carrot is selected to carry out the second phase of experimental in order to, develop beta-carotene rich curd. Here also the various quality characteristics for all the 3 treatments studied precisely, the most liked treated as a curd product was $T_3$. For which the data of scores for flavour and taste, color and appearance, body and texture and overall acceptability in evaluation card was highest or in close proximity to the highest value. And it also performed as the most consistent treatment under all upheld condition.

**Curd with sweet potato**

The last phase, of experiment used sweet potatoes as beta-carotene source to the fortified curd. On evaluating the quality characteristics of the 3 treatments prepared as on the prescribed notes if parameters; $T_3$ was the most suitable treatment which stood up with the highest values with all the organoleptic tests. Factually it us the most microbiologically stable all treatment amongst.

So as a final conclusion, it can be stated that curd with treatment $T_3$ incorporated with beet root amongst all experimental phases was highly appreciated by subjects with highest mean scores on the score cards for experimental product.

**References**


1. Azhar A, Handy MK. Biotechnol. Bioeng. 1981a; 23:879-886.
2. Mustapa AN, Manan ZA, Mohd Azizi CY, Setianto WB, Mohd Omar AK. 2011.
3. Beom J, Yong S, Myung H. Antioxidant activity of vegetables and blends in iron catalyzed model system. J. food sci. and nutr. 1998; 3:309-314.
4. Boyette MD, Estes EA, Rubin AR, Sorensen KA. The post-harvest handling of sweet potatoes. North Carolina cooperative extension service. North Carolina state university, USA, 1997, 42p.
5. Hemme D, Foucaud-Scheunemonm C. Leuconostoc, characteristics, use in dairy technology and prospects in functional foods, International Dairy Journal. 2004; 14(6):467-495.
6. Schieber A, Marx M, Carle R. Simultaneous determination of carotenes tocopherol in ATBC drinks by high-performance liquid chromatography. Food chem. 2002; 76:357-362.