Sauerkraut as a Probiotic Food

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Abstract - Sauerkraut is a naturally fermented cabbage which is a nutritious fermented vegetable product highly appreciated for its particular sensory characteristics. It is considered as a probiotic food as it contains live microorganisms which actively enhance health of consumers. It is said to improve the balance of gut microflora and confer resistance against pathogenic microorganisms. The preparation of sauerkraut does not require a starter culture. The first stage of sauerkraut fermentation involves anaerobic bacteria which is why the shredded cabbage and salt need to be packed in an airtight container. This process was found to be lactic acid fermentation. The microorganisms responsible for the characteristic change in the sauerkraut were isolated and identified. At the initial stage, the bacterium which was found to be *Leuconostoc mesenteroides* produces lactic acid and CO_2 due to which the conditions within the container becomes too acidic for the particular bacteria to survive. This was followed by yeast mainly *Saccharomyces cerevisiaea* after 3days of fermentation. After 5 days, *Lactobacillus* sp namely *L. plantarum* and *L.brevis* appeared in sauerkraut. The fermentation was studied for seven days. Though bacteria and yeast were prevalent in this microbial succession in sauerkraut fermentation process, the overall microbial load was dominated by bacteria. The lactic acid bacteria involved in fermentation are considered as probiotic source of the food process. Probiotics in foods provides several health benefits in human such as reduction of serum cholesterol, enhanced immune system and others. Thus developing probiotic foods from cheap sources is an emerging trend nowadays.

Keywords: Leuconostoc, Lactobacillus, sauerkraut, yeast

I. INTRODUCTION

People have been fermenting vegetables for centuries to increase the stability of fresh foods to make the foods safe to eat in the absence of refrigeration and to enhance their flavor. Fermentation also increases the nutritional content by producing vitamin B and improves the digestibility. Today vegetable fermentation is done on a large-scale in factories as well as in households throughout the world. Cabbage has been fermented in various fashions by different cultures throughout history. The simplest product in which no additional seasonings are added is generally referred to as sauerkraut. It is very popular in America and European countries. Sauerkraut is not very popular in Asian countries like India and Sri Lanka. The taste should be enhanced to suit the Indian consumers. In India in fact cabbage is cultivated in most parts of the country. However due to its perishable nature the cabbage is available only for a short period. A higher percentage of the total production is destroyed due to lack of processing. People consume cabbage as cooked vegetable curry or raw salad. Usually during cooking, vitamin C which is an essential component of cabbage is destroyed if the processing is not done properly [1]. Therefore vitamin C and other nutrients can be preserved through fermentation and availability of cabbage can easily be increased throughout the year. Sauerkraut is made by shredding cabbage and allowing it to ferment with the addition of 2.2-2.8% salt (NaCl). Lactic acid is the major contributing factor to the taste and shelf life of sauerkraut [2]. The objective of the present study is to isolate and identify the beneficial microorganisms which are naturally involved in sauerkraut fermentation. Sauerkraut can be introduced as a cheap and important probiotic food other than the conventional dairy products such as yoghurt, cheese etc.

II. MATERIALS AND METHODS

A. Preparation of Sauerkraut

White cabbage was bought in the local market in Jaffna. It was washed and dried. Shredded cabbage was taken in a plastic bag and weighed. 2.5% NaCl was added and mixed well. Cabbage was pressed down firmly with the base of an Erlenmeyer flask to force out any trapped air bubbles. A thin film of juice should accumulate at the top. The beaker was covered with a polythene paper and maintained under anaerobic conditions. It was allowed to ferment for seven days. The pH, percentage of acidity and microbial count were studied at 24 hrs interval for seven days.

B. Preparation of inocula

10ml of sauerkraut sample was taken and dissolved in 90ml sterile water. Then 1ml of sample was transferred into 10ml sterile water. It is called the initial inoculum. Samples were taken 24hrs interval to determine the pH, acidity, plate counts and type of microorganisms involved in the fermentation.

C. Standard plate counts

The initial inoculum was serially diluted and 10^{-5} and 10^{-6} dilutions were plated on MRS broth (Man Rogosa and Sharp agar) and nutrient agar (for bacteria) and yeast extract malt extract agar (for yeasts) to determine the number of different types of microorganisms in the sauerkraut at various time intervals. The plates were incubated at 37 °C and 28 °C for 48 hrs respectively. The colonies were taken and sub cultured for identification of bacteria and yeasts. The biochemical tests were done on the isolates for identification of bacterial species based on the key designed by [3] and Key designed by [4] for identification of yeasts. The biochemical tests used were Growth in nutrient broth with 3% NaCl, Catalase test, Growth in nutrient broth with 6.5% NaCl, Growth in nutrient broth at pH 4.8, sugar fermentation (acid and gas production), nitrate reduction test, tryptone glucose yeast extract broth test and gelatin test. The biochemical test done for yeasts was sugar

fermentation (acid and gas production). The yeasts were identified from the shape of the cells and change in color of the colonies as well.

III. Results and Discussion

The production of sauerkraut involves succession of bacteria and yeast. At the start of fermentation, the bacterium *Leuconostoc mesenteroides* caused the acidification which was followed by the yeast *Saccharomyces cerevisiae* that improved the nutritional quality in terms of flavor. The presence of bacteria and yeast in microbial succession has been reported in sauerkraut by [5]. The salt added to sauerkraut extracts liquid from the vegetable serving as a substrate for the growth of lactic acid bacteria [6]. During this fermentation study, when the acidity increased (2%) it favored the development of some other bacteria namely *Lactobacillus plantarum* and *Lactobacillus brevis* after five to seven days. The viable count of the bacterial population ranged from 10^5 to 10^6 from 3 days to 7 days of fermentation. The viable count of yeast was found to be 10^5 on the third day. The increase in microbial count was accompanied by an increase in acidity from 0.35% to 2% and decrease in pH from 5.74 and 3.2 respectively. Bacteria and yeasts are responsible for the production of acid and gas from simple sugars in the sauerkraut juice. This produced the particular flavor in sauerkraut. Thus the beneficial microorganisms in sauerkraut, bacteria and yeast were identified and the viable count was determined. The series of microorganisms during the production of sauerkraut found in this research was also supported by a study made by [7]. The present study also suggests the value of consumption of non dairy products as a source of probiotic foods.

IV. Conclusion

Probiotics are essential to promote health in human. It is a very good source of probiotic bacteria (mainly lactic acid bacteria) other than the dairy products. The conditions of fermentation should be optimized to enhance the growth of lactic acid bacteria in sauerkraut. The influence of seasonal variation on the growth of lactic acid bacteria in sauerkraut should be studied. The nutritional quality is increased in sauerkraut by avoiding the loss of vitamins which usually occurs during cooking.

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