INTRODUCTION

Bamboo shoots are regarded as future health food due to its high nutritional content. The shoots are low in fats and cholesterol, high in dietary fibres and rich in mineral content and also has antimicrobial properties (Singh et al., 2012), however, bamboos are found to contain cyanogenic glycoside, a natural plant toxin (Haque and Bradbury, 2002). Cyanogenic glycosides are nitrogenous phytoanticipins and are used by various plants as effective defensive mechanism against predators (Zagrobelny et al., 2004). Cyanogenic glycoside is not toxic on its own. However, when cell structures of a plant are disrupted, cyanogenic glycoside will be brought together with the corresponding α-glucosidase enzyme. It will be subsequently broken down to sugar and a cyanohydrin which rapidly decomposes to an aldehyde or a ketone and releases the toxic hydrogen cyanide (Moller and Seigler, 1999). The cyanogenic glycoside in bamboo is reported to be taxiphyllin, which is p-hydroxylatedmandelo-nitrile triglochinin (Haque and Bradbury, 2002). Consumption of bamboo species with high level of total cyanogenic content is significantly associated with food poisoning and occasionally Konzo (a neurological disorder) (Sayanika et al., 2013). A case of mass cyanide poisoning in Thailand who were exposed to HCN produced in a well containing pickling bamboo shoots was reported by Sang-A-Gad et al. (2011). Mesu is a naturally fermented bamboo shoot product consumed by the ethnic people of Sikkim. It is commonly used as pickle by mixing with salt, mustard oil and green chillies and is also used for preparing curry by frying and mixing it with cooked meat (Tamang and Sarkar, 1996). To search out the likelihood of cyanide intoxication from consumption of mesu, the present study was conducted to investigate the release of the hydrogen cyanide from taxiphyllin during mesu fermentation.

MATERIALS AND METHODS

Preparation of Mesu

Mesu was prepared using the indigenous traditional method listed by Tamang and Tamang (2009). Young tender bamboo shoots of the species Dendrocalamus hamiltonii, locally known as choya bans were collected from in and around the village areas. The overlapping sheaths that tightly clasped the young shoots were removed to extract the edible part in the laboratory. The bamboo shoots were then sliced into small pieces for fermentation by adopting the indigenous traditional method. The chopped bamboo slices are pressed tightly into a green hollow bamboo stem (fermentation vessel). The tip of the vessel was then covered tightly with banana leaves and left to ferment under natural anaerobic conditions (26 ± 4°C) for 16-18 days. Completion of fermentation is indicated by the typical Mesu flavor and taste: sour and acidic (Tamang and Tamang, 2009).
**Determination of pH, acidity and HCN concentration**

Changes in pH, acidity, concentration of reducing sugars and HCN was periodically studied at an interval of 3 days upto 24 days. All the results were expressed as mean of triplicate determination.

pH was determined by using Eutech pH meter (EC pH 1500 -42s) after calibration with standard buffer solutions. The acidity was determined by standard protocol of AOAC (2000) by titrating the samples with 0.1N NaOH using phenopthalein. Reducing sugars were determined by the standard method of Nelson Somogyi (Nelson, 1944). Glucose was used as standard solution and absorbance was measured at 620nm in a spectrophotometer.

The cyanogenic content of the bamboo shoot during fermentation was analysed by picrate paper procedure developed by Egan et al. (1998). The method was performed with the help of cyanide analysis kit procured from Australian National University, Australia. 25mg of the bamboo shoot was grounded in a pestle mortar and placed in a flat bottomed plastic bottle. Immediately 0.5 mL of 0.1 M phosphate buffer (at pH 6) was added and mixed together. Immediately yellow picrate paper attached to a plastic strip was added in the bottle and closed tightly. Another sample was prepared as above but with no bamboo shoot, to serve as a blank. As a control to check on the method, a whatman filter paper disc loaded with buffer and linamarin in a bottle was placed one upon another and a pinklinamarin paper was added. To it 0.5mL water and a yellow picrate paper was added. Immediately the bottle was closed with a screw cap lid. The bottles were allowed to stand for 16-24 hour at room temperature (20-35°C). The plastic backing sheet was carefully removed from the picrate paper. The picrate paper was immersed in 5.0 ml of water for 30 min with occasional gentle shaking. Absorbance at 510 nm of the picrate solution was read against blank. The total cyanogen content in ppm was calculated as total cyanogen content (ppm) = 396 x absorbance x 100 / z. where z is the weight of ground up bamboo shoot taken.

**RESULTS AND DISCUSSION**

Mesu is produced by natural lactic acid fermentation of bamboo shoot using traditional indigenous method. The key microorganisms isolated from Mesu are *Lactobacillus plantarum, Lactobacillus brevis, Lactobacillus curvatus, Leuconostoc citreum* and *Pediococcus pentosaceus* (Tamang and Sarkar, 1996). It has been reported that natural lactic acid fermentation of sliced mash of bamboo shoot begins as soon as proper packing condition is given (Giri and Janmenjoy, 1998). A result of the periodical study on the changes in concentration of reducing sugars and acidity during Mesu fermentation is given in Fig.1. It is observed that there is a decrease in the concentration of reducing sugars and increase in acidity during the period of study. Reducing sugars are the most important substrate for microbes to undergo fermentation. The sugars are being utilised during fermentation resulting in accumulation of acid leading to lowering of the pH (Fig. 2). The mean pH value decreased from 6.1 at 0 day to 3.5 at 24 days. Acidity increased significantly from 0.28% at 0 day to 1.16% at 9 days after which the rise was not significant. A sharp decrease in the concentration of reducing was found until day 9 of fermentation (2755 μg/g to 706 μg/g) which may be due to rapid utilisation of sugars by the microbes. This finding is consistent with the report that soibum fermentation is accompanied by decrease in the amount of reducing sugar and its subsequent conversion into acid as a result of which a rise in the acidity and decrease in pH is observed (Singh et. al.)
Degradation of cyanogenic glycosides during Mesu bamboo shoots during fermentation is revealed from Fig. 3. A sharp consistent decrease till day 9 of fermentation (66% removal) is observed. With the rapid utilisation of sugars by the microbes, acids are accumulated. The accumulated acid catalyses the degradation of taxiphyllin into glucose and hydroxybenzaldehyde cyanohydrin. Benzaldehyde cyanohydrin then decomposes to hydroxybenzaldehyde and hydrogen cyanide (Giri and Janmejay, 1994). The sharp decrease in the HCN during the initial period of fermentation may be aided by the presence of specific plant glucosidase as some of the plant cells are alive after packaging resulting in the action of glucosidase on taxiphyllin. The plant glucosidase thus have a role in freeing of the HCN from taxiphyllin during initial period of fermentation course (Thiyam et al., 2010). Sarangthem and Singh (2013) has also reported that fermentation decreases the antinutritional content in bamboo shoots. Cyanide removal is 76% during fermentation decreases the antinutritional content in bamboo shoots. Cyanide contents were found to be different in different species of bamboos (Satya et al., 2010). Variation in the degradation of taxiphyllin during fermentation of bamboo shoots using the same fermentation procedure was observed from samples to samples (Singh et al., 2011).}

**REFERENCES**


