

Effect of Fermentation Time on the Vitamin C and Mineral Contents in Fermented *Vigna radiate* L. Bean Sprouts (Pirl Pin Pouk)

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Abstract

In this study, the effect of fermentation time on vitamin C and five mineral contents of bean sprouts were examined during fermentation. The result of vitamin C analysis showed a reduction in content from 9.5 mg/100g (day 2) to 3.7 mg/100g (day 4) during fermentation. It was observed that the pH values of fermented samples were not significantly different during the fermentation process. It is a high nutritional value as found that day 4 of the fermented bean sprouts sample was higher in ash lactic acid contents, water, ash contents, fat, fiber, protein, carbohydrate and energy value of other samples. Fermentation is one of the oldest technologies used for food preservation and is carried out to enhance taste, aroma, shelf-life, texture, nutritional values and other favorable properties of foods. There was a significant decrease in the mineral content from the 2 day to 3 day fermentation, ranging from 29.446 to 19.413% in calcium, 19.583 to 14.578%, in potassium, 2.099 to 1.182% in iron, 2.099 to 0.72% in zinc and 1.247 to 0.874% in phosphorous. Ca, K, Fe, Zn and P were detected in all three days of samples and the calcium and potassium were found in large amounts especially in 2 days of fermentation. From this research, it was found that day 2 fermented bean sprouts were rich in vitamin C and higher in some minerals contents and followed by day 3 and day 4 fermented samples. Vitamin C contents were decreased from 9.3 to 3.7 mg/100 g from 2 to 3 days.

Keywords: Bean sprouts, fermentation, nutrition values, mineral content, EDXRF

Introduction

Bean sprouts are high nutritional value such as protein, vitamins and minerals. Fermentation is one of the oldest technologies used for food preservation and is carried out to enhance taste, aroma, shelf-life, texture, nutritional values and other favorable properties of foods. Traditionally fermented foods are National Heritage and form an important part of the local culture. Nutritional and safety benefits have been attributed to fermented foods (Nout and Motarjemi, 1997). Sprouted beans are more nutritious than the original beans. The nutrients from the fermented bean sprouts are essential for human health. This research analysis was contented the effect of minerals on fermented bean sprouts during fermentation time. It are said to be rich in digestible energy, bioavailable vitamins, minerals and proteins.

Scientific classification of bean sprouts

Kingdom	:	Plantae
Family name	:	Fabaceae
Genus	:	<i>Vigna</i>
Botanical name	:	<i>Vigna radiate</i> (L.) R. Wilczek
English name	:	Bean Sprouts
Myanmar name	:	Pirl Pin Pouk
Species	:	<i>V.radiate</i>



Figure 1. Bean sprouts (Pirl Pin Pouk)

Benefits of Bean Sprouts

Bean sprouts also provide natural estrogen which functions just like estrogen synthesis. Estrogen within bean sprouts can improve bone density and stop bone loss (osteoporosis). Consumption of bean sprouts regularly by ladies might help them prevent cancer of the breast, menstrual problems, pre-menopausal symptoms, as well

as problems because of menopause. Bean sprouts usually are wealthy options for iron which is important for the creation of hemoglobin within the body. Hemoglobin is the protein that is contained in the red blood cells. Bean sprouts can also be known to be loaded with energy along with other nutrition which helps in eliminating the indications of mental as well as physical stress in addition to tiredness, bean sprouts start in Asia, exactly where they have been made as well as utilized many thousands of years.

Ascorbic acid (Vitamin C)

Vitamins can be divided into two groups, those that are soluble in fat, such as vitamins A, D, E and K and those that are soluble in water, such as vitamins B and C. All the vitamins are necessary for good health in humans and domestic animals.

Vitamin C, an antioxidant is a molecule capable of inhibiting the oxidation of other molecules (Nagarajaiah and Prakash, 2011). When a chain reaction occurs in a cell, it can cause damage or death to the cell. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibiting other oxidation reactions.

Materials and Methods

Preparation of Fermented Bean Sprouts Samples

Bean sprouts samples were collected from Hledan Market, in Yangon Region and samples were prepared by traditional fermentation process. The bean sprouts (pirl pin pouk) were washed in water to obtain clean samples. The clean bean sprouts samples were added some salt and submerged with the rice wash water solution in glass bottle for 2-4 days at room temperature.

Determination of Ascorbic Acid (Vitamin C) Content

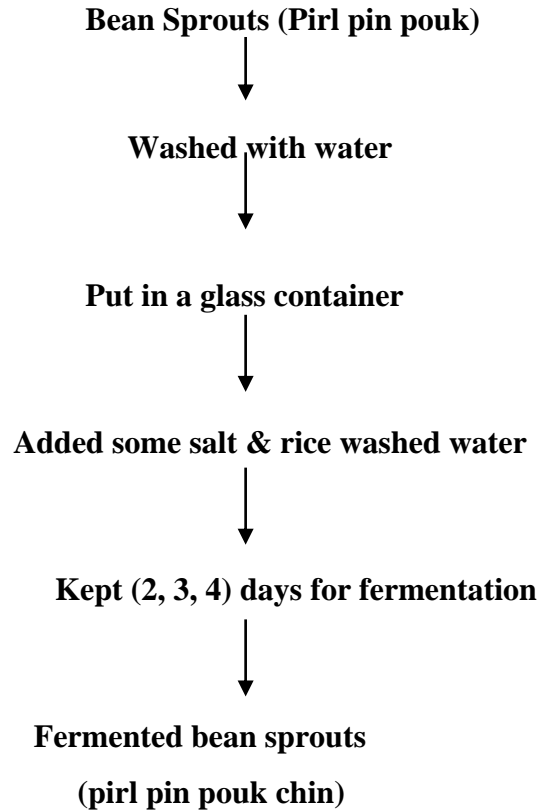
A 10 mL of each sample solution was taken by pipette and placed into a 250 mL conical flask and added 75 mL of distilled water, 2.5 mL of 0.006 M potassium iodide, 2.5 mL of 1 M hydrochloric acid and 3 drops of starch indicator solution. The sample was titrated with 0.002 M of potassium iodate solution. The end point of the titration was the first permanent trace of a dark-blue color due to the starch-iodine complex. Titration was repeated until concordant results were obtained.

Determination of Mineral Elements Content in Fermented Bean Sprouts by EDXRF

5 g of sample was first fabricated into tablet by using 'specac' model pellet making machine manufactured by Analytical Accessories Ltd., Kent, UK. The sample was placed in the sample chamber of EDX-700 spectrometer. The chamber was pumped up to vacuum. The vacuum pressure was about 38 Pa and the detector temperature was about 170 °C. Therefore, liquid nitrogen needs to be added at the time of analysis. Each sample was run for a counting time of about 100 seconds and spectrum obtained was stored and analyzed in PC based multi-channel analyzer using EDX-700 software. Similar studies were carried out on samples and its main ingredients. The extract from fermented bean sprouts sample using solvents for different polarity (Petroleum ether and ethyl acetate) were also analyzed for the elemental determination by this method (Yatkinet. *al.*, 2011).



Figure 2. The traditional method of fermented bean sprouts (pirl pin pouk chin)



Results and Discussion

Nutritional Contents in Fermented Bean Sprouts Samples

pH Values in Fermented Bean Sprouts Samples

Table (1) showed the pH values of fermented bean sprouts samples day 2, day 3 and day 4 fermentation time. The results were pH values of 4.4, 4.2 and 4.1 respectively. The pH values of fermented samples were not significantly different during the fermentation process. The results showed the acidic condition.

Table1. pH Values in Fermented Bean Sprouts Samples

Fermentation Time		pH
No.	(Day)	
1.	2	4.4
2.	3	4.2
3.	4	4.1

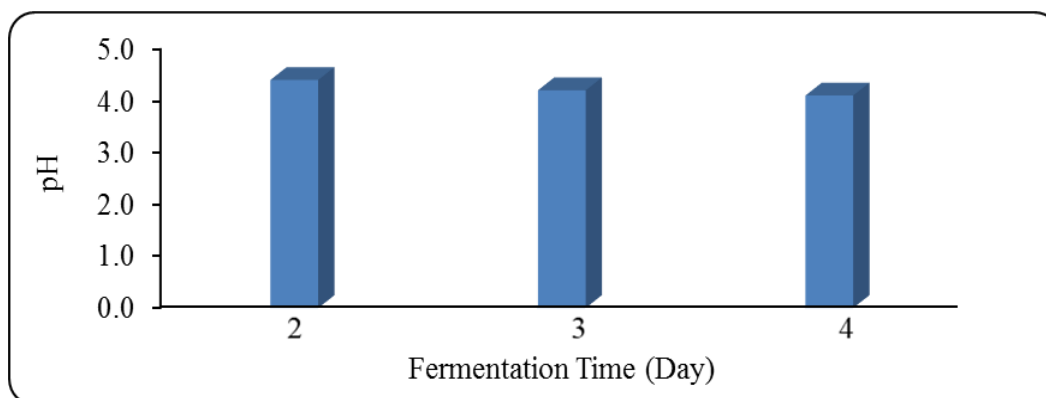


Figure 3. Histogram of pH values in bean sprouts samples

Acid Contents in Fermented Bean Sprouts Samples

Table (2) showed the lactic acid and acetic acid content percent of fermented bean sprouts samples day 2, day 3 and day 4 fermentation time. According to table, lactic acid content 0.918% was the highest in day 4 fermentation time period. And acetic acid content 0.096% was the highest in day 2 fermentation time period.

Table 2. Acid Contents in Fermented Bean Sprouts Samples

No.	Fermentation Time (Day)	Content (%)	
		Lactic acid	Acetic acid
1.	2	0.738	0.096
2.	3	0.828	0.061
3.	4	0.918	0.048

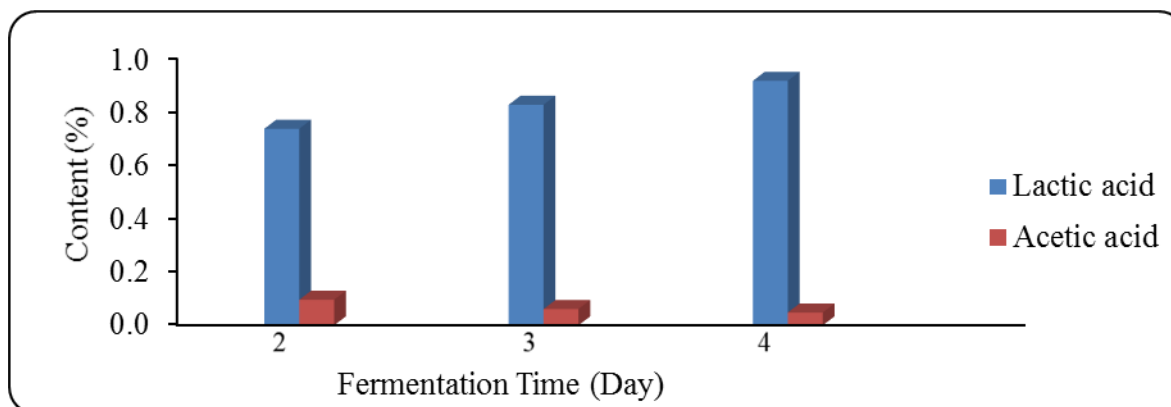


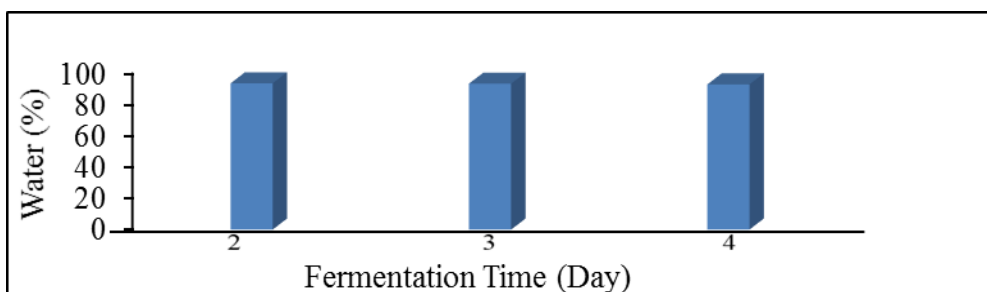
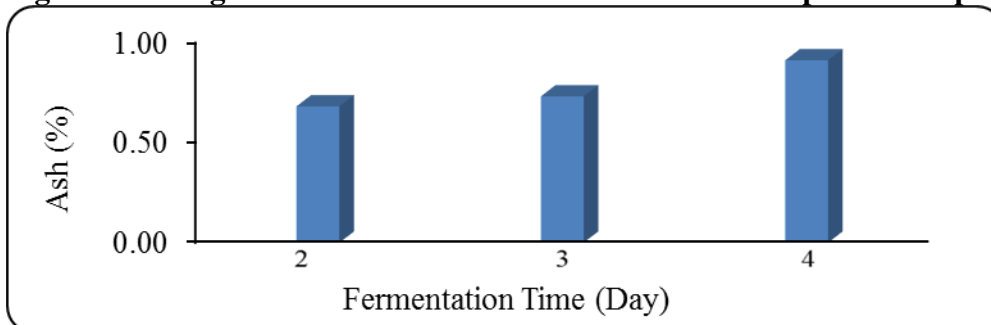
Figure 4. Histogram of observed values of lactic acid and acetic acid in fermented bean sprouts samples

Water and Ash Contents in Fermented Bean Sprouts Samples

Table (3) showed water and ash contents in fermented bean sprouts samples day 2, day 3 and day 4 fermentation time period. According to table, water content 93.69% was the highest in day 2 fermentation period. And ash content 0.91% was the highest in day 4 fermentation time period.

Table 3. Water and Ash Contents in Fermented Bean Sprouts Samples

No.	Fermentation Time (Day)	Content (%)	
		Water	Ash
1.	2	93.69	0.68
2.	3	93.48	0.73
3.	4	93.03	0.91

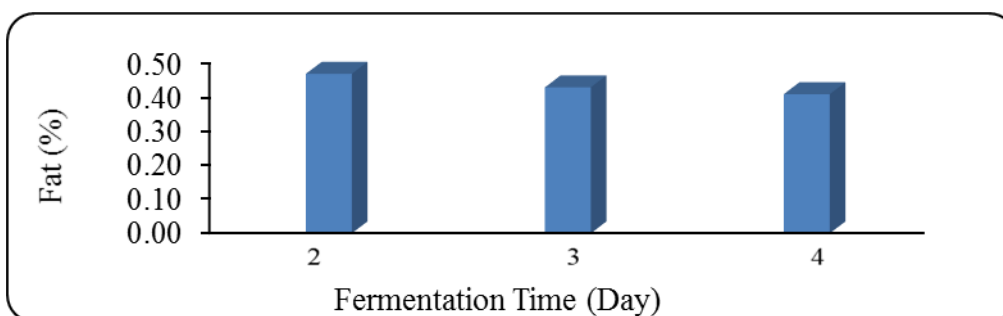
**Figure 5. Histogram of water contents in fermented bean sprouts samples****Figure 6. Histogram of ash contents in fermented bean sprouts samples**

Fat Contents in Fermented Bean Sprouts Samples

Table (4) showed that fat contents in fermented bean sprouts. According to table, the values of fat content were nearly the same, 0.47%, 0.43% and 0.41% respectively.

Table 4. Fat Contents in Fermented Bean Sprouts Samples

No.	Fermentation Time		Fat (%)
	(Day)		
1.	2		0.47
2.	3		0.43
3.	4		0.41

**Figure 7. Histogram of fat contents in fermented bean sprouts samples**

Fibre contents in fermented bean sprouts samples

Table (5) showed the fiber contents in of fermented bean sprouts. The results were fiber content of 1.18%, 1.11% and 1.09% respectively.

Table 5. Fiber Contents in Fermented Bean Sprouts Samples

Fermentation Time		Fibre (%)
No.	(Day)	
1.	2	1.18
2.	3	1.11
3.	4	1.09

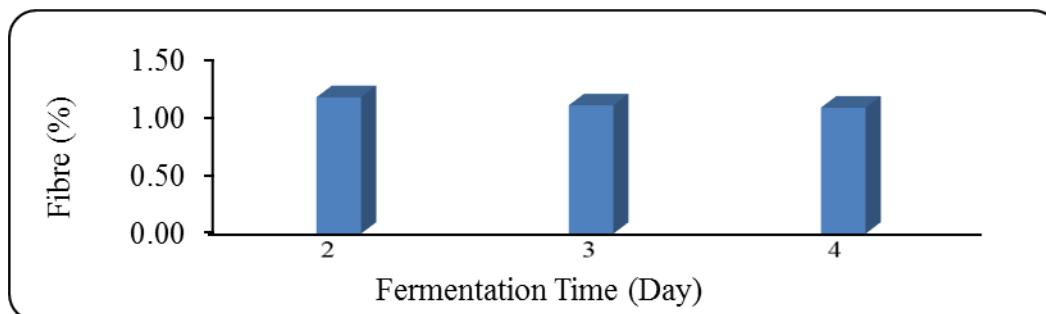


Figure 8. Histogram of fibre contents in fermented bean sprouts samples

Protein Contents in Fermented Bean Sprouts Samples

Table (6) showed that protein contents in fermented bean sprouts. The results of protein content were 1.71%, 1.68% and 1.59% respectively. Day 2 fermentation time period was the highest values of protein content.

Table 6. Protein Contents in Fermented Bean Sprouts Samples

Fermentation Time		Protein (%)
No.	(Day)	
1.	2	1.71
2.	3	1.68
3.	4	1.59

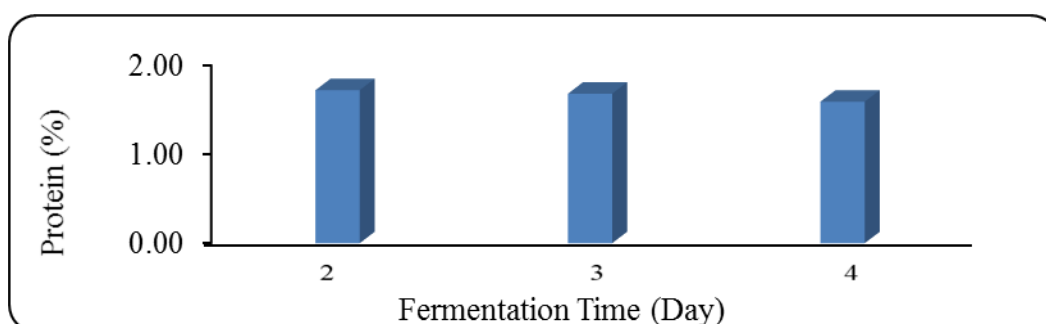


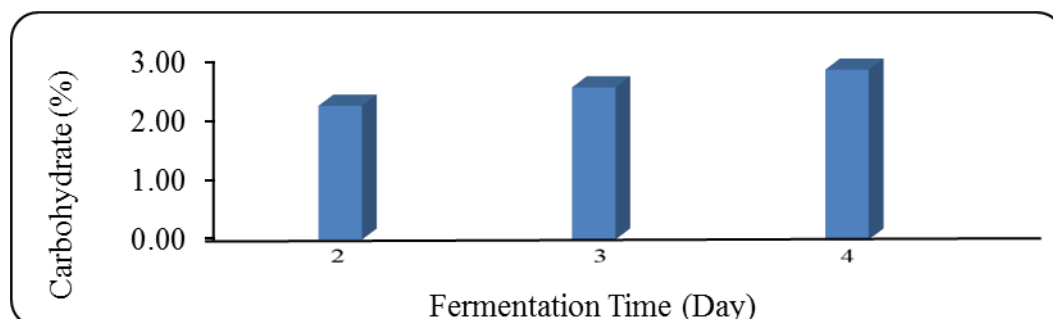
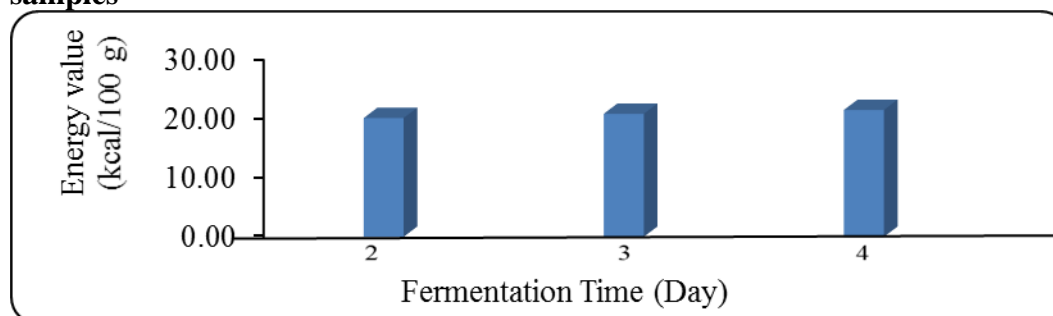
Figure 9. Histogram of protein contents in fermented bean sprouts samples

Carbohydrate and Energy Values in Fermented Bean Sprouts Samples

Table (7) showed that carbohydrate and energy values in fermented bean sprouts samples day 2, day 3 and day 4 fermentation time. According to table, carbohydrate content 1.71% was the highest in day 2 fermentation time period. And energy content 20.87 kcal/100g was the highest in day 3 fermentation time period.

Table 7. Carbohydrate and Energy Values in Fermented Bean Sprouts Samples

No.	Fermentation Time (Day)	Carbohydrate (%)	Energy Value (kcal/100 g)
1.	2	2.27	20.11
2.	3	2.57	20.87
3.	4	2.87	21.53

**Figure 10. Histogram of carbohydrate contents in fermented bean sprouts samples****Figure 11. Histogram of energy values in fermented bean sprouts samples****Vitamin C Content in Fermented Bean Sprouts Samples**

Vitamin C is important water-soluble vitamin already implicated in most life processes but principally functions as an antioxidant. It is present abundantly in fruits and vegetables where the common man in developing countries receives most of their daily intake (Falade *et. al.*, 2004).

In this analysis, vitamin C content in fermented samples was determined by the iodometric titration method. It was found that the day 2 fermented bean sprouts sample has a high vitamin C content of 9.5 mg/100 g, and the day 3 and day 4 samples have low vitamin C content of 5.1 and 3.7 mg/100 g. During the fermentation process, the vitamin C contents were decreased with increasing fermentation time.

Table 8. Vitamin C Contents in Fermented Bean Sprouts Samples

No.	Fermentation Time (Day)	Vitamin C (mg/100g)
1.	2	9.5
2.	3	5.1
3.	4	3.7

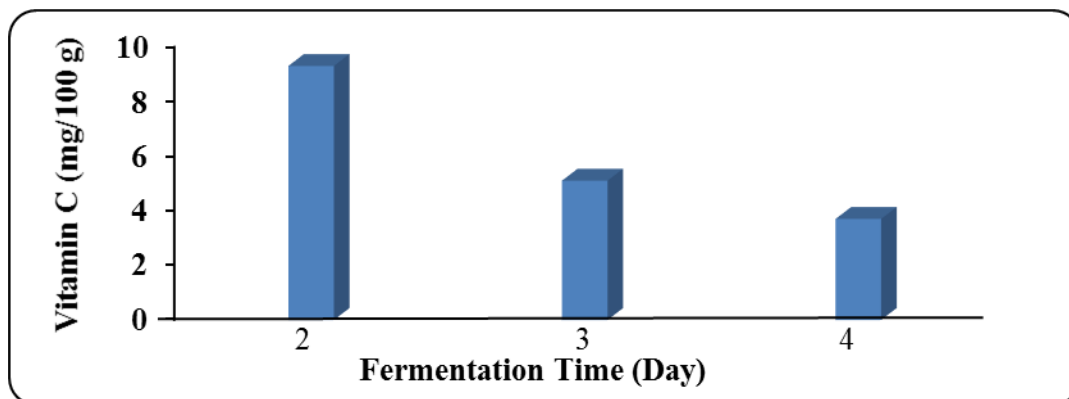


Figure 12. Histogram of vitamin C contents in fermented bean sprouts samples

Mineral Elements in Fermented Bean Sprouts Samples

The daily intake of minerals should be an optimal one, not too low nor too high, and this is especially important for mineral elements that are necessary for the body in trace amounts. The mineral elements occur in the body in several chemical forms such as inorganic ions and salts or constituents of organic molecules such as proteins, fats, carbohydrates and nucleic acids. They serve a wide variety of essential components of many enzymes and other biologically important molecules.

The determination of mineral elements in fermented samples was carried out by the Energy Dispersive X-Ray Fluorescence technique Ca and K were the most abundant elements in all fermented samples.

In this study, calcium contents of fermented samples were found to be in the range of (19.413 - 29.446 %). Potassium is essential in regulating the body's fluid volume. Potassium is also widely distributed in foods. Potassium is essential for the life activities of all cells in the body. The minimum requirement for K is 2000 mg/day in adults. Potassium contributes to the transmission of nerve impulses, the control of skeletal muscle contraction and the maintenance of blood pressure (Roginski*et. al.*, 2002). Potassium contents of fermented samples were found to be in the range of (14.578 - 19.583 %).

Iron plays a very important part in nutrition, being an essential constituent of the important substance hemoglobin (Sherman, 1964). Iron is an essential nutrient for men. It is probably one of the most widely known elements. Iron is found in the blood as part of hemoglobin in red blood cells and myoglobin in muscle tissue. Good sources of iron with a high nutritional density are meat, green peas and whole grain cereal products. Certain fruits and vegetables are poor sources of iron. A dietary deficiency of iron results in anemia. Iron contents of fermented samples were found to be in the range of (1.182 - 2.092 %).

Zinc is an essential beneficial element in human growth (Roginski*et. al.*, 2002). Zinc is present in every tissue and is essential as a component for enzymes involved in vital metabolic pathways. It is necessary for normal growth, prevention of anemia, general repair of all tissues and wound healing. The RDA is 10 mg for preschoolers and 15 mg for adults. Zinc contents of fermented samples were found to be in the range of (0.721 - 2.099 %).

Phosphorus is part of every human cell, most fluid balances throughout the body, core genetic processes and an intensive list of other processes central to our health (Carrigan*et. al.*, 2014). Phosphorus may be a lesser-known mineral than the other minerals with which it is commonly grouped (like calcium or magnesium), but it

is not one bit less important. Phosphorus contents of fermented samples were found to be in the range of (0.874 - 1.247 %).

Table 9. Mineral Elements Percent in Fermented Bean Sprouts by EDXRF

No.	Fermentation Time (Day)	Composition (%)				
		Ca	K	Fe	Zn	P
1.	2	29.446	19.583	2.092	2.099	1.247
2.	3	21.406	16.577	1.522	0.174	1.695
3.	4	19.413	14.578	1.182	0.721	0.874

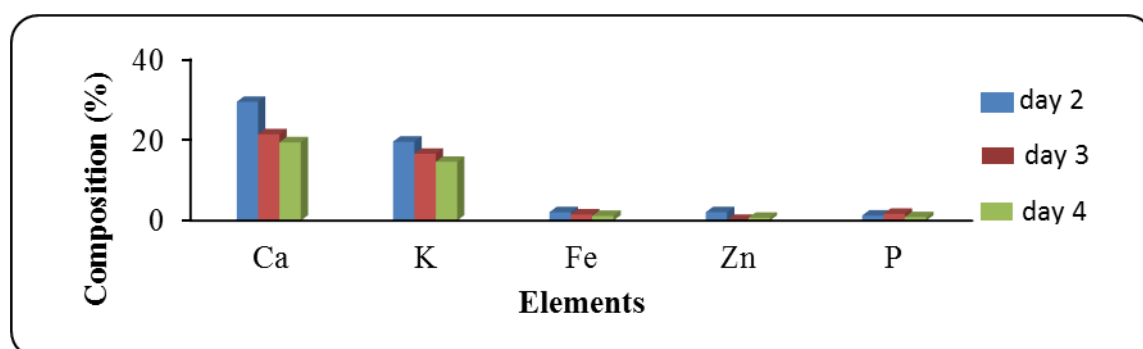


Figure 13. Histogram of mineral elements percent in fermented bean sprouts samples

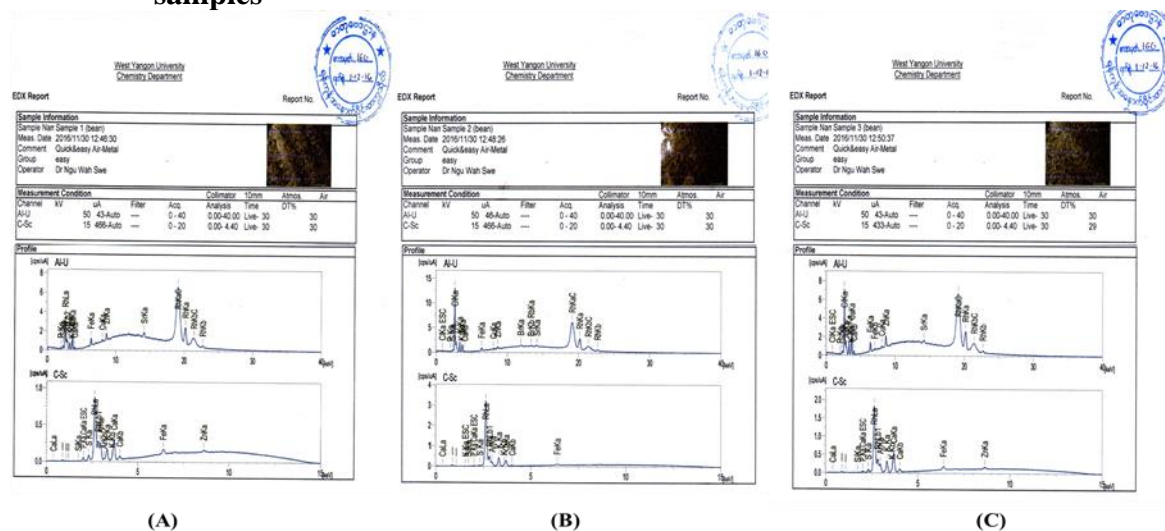


Figure 14 . EDXRF spectrums of fermented bean sprouts samples [A (Day 2); B (Day 3); C (Day 4)]

Conclusion

In this research, the nutrients and some physicochemical properties of fermented bean sprouts samples were studied. Bean sprouts samples were collected from Hledan Market, in Yangon Region. Fermented bean sprouts samples were prepared by traditional fermentation process from samples as a function of times [(2-days of fermented bean sprouts), (3-days of fermented bean sprouts), (4-days of fermented bean sprouts)].

The pH values of fermented samples were not significantly different during the fermentation process.

Lactic acid content 0.918% was the highest in day 4 fermentation time period. And acetic acid content 0.096% was the highest in day 2 fermentation time period.

Water content 93.69% was the highest in day 2 fermentation period. And ash content 0.91% was the highest in day 4 fermentation time period.

The values of fat content were nearly the same, 0.47%, 0.43% and 0.41% respectively.

Fiber contents were found to be 1.18%, 1.11% and 1.09% respectively.

In the fermented bean sprouts samples the vitamin C contents were found to be 9.5 mg/100 g (day 2), 5.1 mg/100 g (day 3) and 3.7 mg/100 g (day 4).

The minerals elements (Ca, K, Fe, Zn and P) were found in fermented bean sprouts samples. Minerals content in fermented samples were found to be in the ranges of Ca(29.446 - 19.413 %), K (19.583 - 14.578 %), Fe (2.099 - 1.182 %), Zn (2.099 - 0.72 %), and P (1.247 - 0.874 %).The fermented bean sprouts samples showed high in Ca and K among the minerals.

From this research, it was found that day 4 of fermented bean sprouts was higher in carbohydrate, energy and lactic acid contents than of other fermented days. It can be concluded that this paper can point out the effect of fermentation time on mineral contents and vitamin C content in fermented bean sprouts (pirl pin pouk chin) can be provided for consumers.

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