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Various Factors Influencing to Leren Beverage Production

N.P. Minh
Binh Duong University, Thu Dau Mot City, Vietnam

Abstract: Leren (*Calathea allouia)* has been cultivated around the globe and has been well accepted. It can grow on the poor fertilized soil especially, sand land. Tuberous and egg shaped roots have high starch content and are consumed when cooked. The crisp cooked tubers are very agreeable with a flavour like sweet corn. On the aspect of climate change, leren is amongs indigeous plants well apated to harshed hot weather. In recent years, it helps Vietnamese farmers in hunger elimination and poverty reduction. Normally, it has been consumed via cooking. There is little research mentioned to the processing of this kind of plant. Therefore, we investigated several factors affecting to the leren beverage production such as chemical content in raw material; Effect of temperature and time of hydrolysis to the reducing sugar formation, viscosity and sensory characteristics of leren beverage; Effect of sterilization to sensory, microorganism characteristics of leren beverage. This new beverage is not only convenient for human consumption but also accelerating its added value on the market. When leren tuber was hydrolized by 0.1% amylase at temperature 50, 55, 60°C in 0, 15, 30, 45, 60 min at pH 4.2; We noticed the optimal hydrolysis at 50°C in 45 min. By sterilization at different values 115°C in 10 min, 115°C in 20 min, 121°C in 5 min and 121°C in 10 min, we got the best leren beverage quality at 121°C in 5 min.

Key words: Leren, beverage, hydrolysis, sterilization, added value, sensory characteristics

INTRODUCTION

Leren *(Calathea allouia)* is a tropical, perennial plant that grows up tp 1.5 m tall. It is an oleiferous species which has been known and cultivated for a long time by the Vietnamese people. The importance of aria tubers as alternative food for the Amazon Region has been showed by several scientific papers. However, the tuber storage methods for trading and consumption are unknown. During ten weeks, simple methods adapted to the conditions of small farmers of the region were tested to determine the loss of weight and changes in internal and external characteristics of the tubers. The following treatments were utilized for the storing of the recently harvested tubers: paneiro (a type of cane basket), plastic bags with perforations, tow bags and freezer. The first three treaments were left at atmospheric temperature. The results showed that the storage in a freezer in spite of reducing the loss of water is not efficient after the seventh week for internal preservation and maintenance of a good trading aspect. The other treatments preserved the tubers in good trading conditions for periods greater than ten weeks, although, the treatment with tow bags which allowed a better aeration of the tubers, also caused them to loose weight more rapidly (Bueno and Weigel, 1983). Leren was a vegetable cultivated on a small scale by traditional growers in their vegetable gardens and the tuberous roots were eaten cooked as good substitutes for canned water-chestnuts (Bridgemohan, 2011). On the cultivation of leren, carried out in the region of Manaus-Amazonas-Brazil was used tires stacked every two and lined up side by side, forming double rows in 1×1×2 m spacing in open area with full sun. Filled car tires with substrates (vegetable soil+20 liters of organic compound) and every month, applied syrup lime sulphur to 1% and every 2 months, fertilizers protectors 100 mL per plant during 6 months. We evaluated: harvest-facility×time and loss of roots, productivity, quality of the roots. At the age of 11 months after planting, harvesting was held for these evaluations. The results showed that the average time of harvesting by grave has been reduced by 75%; the physical effort was much lower; the loss of roots was 0% and the average productivity was 1, 839 kg by the grave. The roots, even immature, presented size above 10 cm (Barros *et al*., 2016). Leren has been well accepted. The tuberous roots of leren are eaten cooked and their texture remains crisp even after long cooking, a characteristic which makes it very palatable (Martin and Cabanillas, 1976). *C. allouia* flour has high carbohydrate content (81%), lower levels of lipids (0.9%), protein (4.2%), fiber (1.9%), minerals and essential amino acids. *C. allouia* influenced (Bifidobacterium and Lactobacillus) population in the animals gut. Leren flour could be a tool for nutritional therapy (Teixeira *et al*., 2016). A non-conventional starch obtained from leren (*Calathea allouia*) was used as a

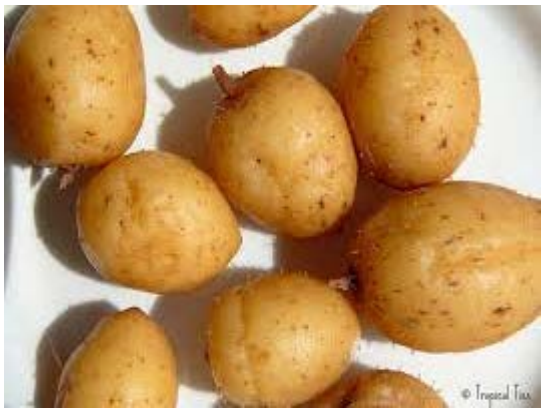

Fig. 1: Leren tubers (*Calathea allouia)*

polymeric matrix for the development of edible films (Gutierrez *et al*., 2018). There is little research mentioned to the processing of this kind of plant. Therefore, we investigated the leren beverage production by investigation of chemical content in raw material; Effect of hydrolysis (temperature and time) to the reducing sugar formation, viscosity and sensory characteristics of beverage; Effect of sterilization to beverage quality (sensory, microorganism) (Fig. 1).

MATERIALS AND METHODS

We collected leren tubers in Mekong river delta, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be conveyed to laboratory within 8h for experiments. Beside leren tubers, we also used other materials during the research such as ethanol 90°, NaHCO3, amylase, etc. Lab utensils and equipments included Soxhlet, pH meter, drying oven, autoclave, colorimeter, Kjeldahl, weight balance, homogenizer.

Research method

Investigate the effect of temperature and time of hydrolysis to the reducing sugar formation, viscosity and sensory characteristics of leren beverage: Leren tubers were washed to remove foreign matters and well cooked at 100°C in 15 min. Then their endosperms were thoroughly grinded ready for hydrolysis by 0.1% amlylase at temperature 50, 55 and 60°C in 0, 15, 30, 45, 60 min at pH 4.2. After hydrolysis, the hydrolized mixture will be sterilized at 121°C in 5 min. The optimal values of hydrolysis were calculated by the reducing sugar, viscosity and sensory characteristics of leren beverage.

Table 1: Chemical content in leren tuber

Description (%)	Values
Moisture content	65.14
Protein	4.55
Lipid	0.21
Reducing sugar	12.85

Each value is the mean of three samples (n = 3)

Investigate the effect of sterilization to leren beverage quality: Leren tubers were washed to remove foreign matters and well cooked at 100°C in 15 min (Table 1). Then their endosperms were thoroughly grinded ready for hydrolysis by 0.1% amlylase at temperature 50°C in 45 min at pH 4.2. After hydrolysis, sterilization was performed at different values 115°C in 10 min, 115°C in 20 min, 121°C in 5 min and 121°C in 10 min. The optimal values of sterilization were calculated by the sensory and microbial characteristics of leren beverage.

Statistical analysis: Data were statistically summarized by statgraphics.

RESULTS AND DISCUSSION

Chemical content in leren tuber: Leren tubers were analysed by different contents such as water moisture, protein, lipid, reducing sugar. Its contents were shown in Table 1. We could see clearly that the reducing sugar content in leren tuber was quite high (12.85%), so, it's very suitable for beverage production.

Effect of temperature and time of hydrolysis to the reducing sugar formation, viscosity and sensory characteristics of leren beverage: Effectiveness of hydrolysis was based on the formation of reducing sugar as well as fluid viscosity. Fluid uniformity was very important so we used amylase during the hydrolysis. We examined temperature 50, 55 and 60°C in 0, 15, 30, 45, 60 minutes at pH 4.2 during the hydrolysis. Reducing sugar formation, viscosity and sensory characteristics of leren fluid were depicted in Table 2-4, respectively. We clearly realized that the optimal hydrolysis occurred at 50°C in 45 min. So, we selected these values for further studies.

Effect of sterilization to leren beverage quality: With the purpose of improving product shelf-life, we conducted the sterilization for the leren beverage. Applying different values 115°C in 10 min, 115°C in 20 min, 121°C in 5 min and 121°C in 10 min, the optimal values of sterilization were elaborated at 121°C in 5 min (Table 5-7).

We also, analyzed nutritional value of leren beverage (Table 8). We noticed that major elements in this food were sufficient and healthy for human consumption.

Table 2: Reducing sugar formation in leren fluid after hydrolysis

	Temperature of hydrolysis			
Time of hydrolysis (min)	50°C	55°C	60°C	Average
0	12.49	12.49	12.49	12.49[d]
15	17.14	16.32	15.20	16.22[c]
30	19.37	18.94	17.41	18.57[b]
45	24.75	23.09	21.35	23.06[a]
60	24.82	23.12	21.44	23.13[a]
Average	19.71[a]	18.79[b]	17.58	-

Table 3: Viscosity in leren fluid after hydrolysis

	Temperature of hydrolysis			
Time of hydrolysis (min)	50°C	55°C	60°C	Average
0	7.34	7.34	7.34	7.34[a]
15	5.14	5.89	6.05	5.69[b]
30	4.29	4.97	5.04	4.77[c]
45	3.18	3.95	4.27	3.80[d]
60	3.11	4.06	4.30	3.82[d]
Average	4.61[c]	5.24[b]	5.40	-

Each value is the mean of three samples (n = 3). The same characters (denoted above), the difference between them was not significant (α = 5%)

Table 4: Sensory characteristics (score evaluation on scale of 1-5) in leren fluid after hydrolysis

	Temperature of hydrolysis			
Time of hydrolysis (min)	50°C	55°C	60°C	Average
0	1.50	1.50	1.50	1.50[d]
15	2.59	2.47	2.33	2.46[c]
30	3.15	3.01	2.94	3.03[b]
45	4.58	4.22	4.01	4.27[a]
60	4.60	4.25	4.07	4.31[a]
Average	3.28[a]	3.09[b]	2.97	-

Table 5: Viscosity and color (L, a) of leren beverage after sterilization

Sterilization		Color		
Temperature (°C)	Time (min)	L-value	a-value	Viscosity (cp)
115	10	73.21[b]	6.12[b]	3.15[c]
115	20	71.02[d]	5.07[d]	3.11[b]
121	5	75.59[a]	6.95[a]	3.05[a]
121	10	72.10[c]	5.22[c]	3.04

Table 6: Sensory score (on scale from 1-) of leren beverage after sterilization

Sterilization		Criteria		
Temperature (°C)	Time (min)	Color	Flavor	Taste
115	10	4.12[b]	4.08[b]	4.21[b]
115	20	3.11[d]	3.20[d]	3.17[d]
121	5	4.64[a]	4.61[a]	4.63[a]
121	10	3.44[c]	3.52[c]	3.47

Each value is the mean of three samples (n = 3). The same characters (denoted above), the difference between them was not significant (α = 5%)

Table 7: Microorganism and shelf-life of leren beverage after sterilization

Sterilization		Total plate count	
Temperature (°C)	Time (min)	(cfu/mL)	Shelf-life (days)
115	10	0	17
115	20	0	21
121	5	0	28
121	10	0	21

Table 8: Nutritional value of leren beverage

Composition (%)	Values
Soluble dry matter	16.75
Protein	3.17
Lipid	1.02
Sugar	12.36

Each value is the mean of three samples (n = 3)

CONCLUSION

Leren is adapted to a tropical climate with alternating rainy and dry seasons. Leren is mostly eaten as an appetizer. Processed products of leren have not been thoroughly studied. Leren is an under-exploited tropical tuber crop with potential for processing. We have successfully studied several factors affecting to the leren beverage production. This will be a primary foundation for other studies in utilizing the tropical plants to process into value-added products.

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