Preparation and Characterization of Poonyigyi from Red Kidney Beans

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Abstract

The research work is based on the preparation of poonyigyi from locally available beans by the fermentation process to produce the economical product. The red kidney beans are a variety of the common bean (*Phaseolus vulgaris* L.). Red kidney beans are mainly composed of carbohydrates and fiber, but are also a good source of protein. They are also rich in various minerals, vitamins, fibers, antioxidants, and other unique plant compounds. It is often considered the 'meat of the poor' and forms the main protein source for individuals in many countries. Red kidney beans were collected from Pakokku Township, Magway Region. Poonyigyi was prepared by natural fermentation process. The processes were conducted by varying the cooking temperature, amount of salt, volume of water and the fermentation period to improve the quality of product. The characteristics of poonyigyi such as ash, pH, total solids content, fat, fiber and protein were determined. Elemental compositions of beans, poonyigyi and beans residue were analyzed by EDXRF. According to the results of chemical analysis, cooking temperature(before fermentation) 100^{o}C for 7.5 hours, 6L of water, 12 hour fermentation time and 0.3g of salt were suitable for the preparation of poonyigyi from red kidney beans. Shelf-life of the products were also studied by the assessment of yeasts and moulds contamination in poonyigyi during storage.

Key words: Poonyigyi, fermentation, red kidney beans, nutritional value

Introduction

Food fermentation is advantageously used for food preservation and to obtain desirable flavor and digestibility. Beans were an important source of protein throughout old and new world history. Fermented beans will not usually produce most of the intestinal problems. Red kidney beans are an annual, climbing or sub-erect herbaceous bush growing 3 meters long. It is found growing in tropical and temperate zones. It cannot tolerate high soil acidity and the related aluminum and manganese toxicities. It has 2–3 m long pubescent stem, turns glabrescent when old. Leaf is trifoliate. Flower is papilionaceous, bisexual. Corolla is white, purple, yellow or pale pink, standard 9–12 mm long and glabrous. It is found blooming from July to September (Reynoso-Cam,2006).

Kidney beans are loaded with important nutrients, vitamins and minerals which are essential to living a healthy and prosperous life. Red kidney beans contain large numbers of bioactive molecules. Beans are used for burns, dysentery, acne, bladder, diabetes, cardiac, carminative, dropsy, depurative, diuretic, diarrhea and many other problems.

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Poonyigyi is one of the Myanmar traditional foods which is being made from paddy seeds or bean seeds. It is consumed as a side-dish all over Myanmar. It is reddish brown and quite viscous. In the present research work, poonyigyi was prepared by fermentation of red kidney beans. The effect of cooking, fermentation time, amount of salt and volume of water on the nutritional value of fermented poonyigyi were also evaluated. Beside this, elemental compositions of beans, poonyigyi and beans residue were analyzed by EDXRF. Shelf-life of the products was also studied by the assessment of yeasts and moulds contamination in poonyigyi.

Materials and Methods

Raw Materials

For the preparation of poonyigyi, red kidney beans were collected from Pakokku Township, Magway Region. Sodium bicarbonate and potassium sorbate were purchased from Golden Lady Chemical Sale Centre, Pabedan Township, Yangon Region.

Methods

Determination of Quality Parameters of Beans and Poonyigyi

Physico-chemical properties like moisture, ash and total solids content of beans, poonyigyi and beans residue were determined. Nutritional value of beans, poonyigyi and beans residue were determined by AOAC methods. The results are shown in Table (2). Elemental composition of beans, poonyigyi and beans residue were analyzed by EDXRF.

Preparation of Poonyigyi from Red Kidney Beans

Firstly, red kidney beans were sifted to remove dirt and undesirable matter. Then, the beans were washed and boiled with water. Sodium bicarbonate was added during boiling to soften the beans. After7. 5 hours, supernatant liquid was filtered and insoluble residue was left. The latter was mashed to obtain the soluble residue. The resultant liquid was fermented for 12 hours and then heated at 100^{o}C for 1.5 hours. During heating, the liquid was stirred until it becomes paste. After the resultant mass was cooling, poonyigyi was obtained. The experiments were also conducted by varying cooking temperatures (85^{o}C, 90^{o}C, 95^{o}C and 105^{o}C). The results are shown in Table (4).

Effect of Fermentation Time on the Characteristics of Poonyigyi

The same procedure as described in above experiment was carried out at the various fermentation times of 9hr, 12hr, 15hr, 18hr and 21hr.

Effect of Amount of Salt on the Characteristics of Poonyigyi

The effect of amount of salt on the properties of poonyigyi was studied.

Effect of Volume of Water on the Characteristics of Poonyigyi

Effect of volume of water on the nutritional value of poonyigyi was also studied.

Results and Discussion

Phytochemical investigations of beans are shown in Table (1). According to these result, phytocontituents of the beans indicates that it is a good source of secondary metabolites, which are vital in health protection, disease prevention and drug production.

The nutritional values of beans and beans residue from poonyigyi process are shown in Table (2). From the results in Table (2), it can be seen that the nutritional value of beans are compatible well with the literature value. According to these results, red kidney beans residue from poonyigyi preparation had more ash and fiber content than beans. So, red kidney beans residue can be used for other purposes. Table (3) shows that the elemental composition of beans and beans residue analyzed by EDXRF. Red kidney beans and its residue had macro mineral content. Macro-minerals (Ca, K etc.) are also important for health. Therefore, not only red kidney beans but also its residue can be applied for many uses.

The effects of potassium sorbate preservative on the shelf-life of poonyigyi are shown in Table (4). Shelf-life of the products were studied by the assessment of yeasts and moulds contamination. According to these results, 0.25 percent potassium sorbate is the most suitable amount for preparation of poonyigyi. According to Table (5), the cooking temperature 100^{o}C is suitable for preparation of poonyigyi from red kidney beans. Cooking temperatures like 85^{o}C and 105^{o}C were not suitable due to the characteristics of products such as colour and taste. According to the results in Table (6), 12 hours was the most suitable fermentation time for poonyigyi process due to its acceptable characteristics. It can also be observed that the product with 21 hours fermentation time had the highest protein content and longest shelf-life (7 weeks) but had a sour taste.

From Table (7), the product with 0.3g of salt had the highest protein and energy value among other samples. The products with 0.1g and 0.5g of salt had bland and salty tastes. From the result in Table (8), it can be observed that the volume of water also affected the nutritive value and characteristics of poonyigyi products. 6 L was the suitable amount of water for 100g of red kidney beans to prepare poonyigyi due to its protein and energy value. According to Table (8), increase in volume of water was found to increase cooking time and yield. According to the results in Table (9), quality of poonyigyi could be affected by several different parameters such as cooking temperature, fermentation period, amount of salt and volume of water. Elemental compositions of poonyigyi and commercial product were analyzed

by EDXRF and the results are mentioned in and Table (3). It can be observed that red kidney beans poonyigyi have high content of potassium.

Table (1) Phytochemicals Investigation of Red Kidney Beans

No.	Type of compound	Extract	Reagent used	Observation	Results
1.	Alkaloid	1%HCl	Mayer's reagent	White ppt.	+
			Wagner's reagent	Brown ppt.	
			Dragendorff 's reagent	Reddish brown ppt.	
			Hager's reagent	Yellow ppt.	
2.	Carbohydrate	H_2O	10% α -naphthol&$H_2SO_{4(Conc:)}$	Red ring	+
3.	Glycoside	H_2O	10% Lead acetate solution	White ppt.	+
4.	Phenol	H_2O	1% $FeCl_3$ solution	Black ppt.	+
5.	α-amino acid	H_2O	Ninhydrin reagent	Pink colour	+
6.	Saponin	H_2O	--	Stable foam	+
7.	Tannin	H_2O	1% Gelatin & 10% NaCl solution	ppt.	Trace
8.	Flavonoid	70%EtOH	Mg ribbon &Conc; HCl	Pink colour.	+
9.	Steriod	Petroleum ether	Acetic anhydride &Conc; H_2SO_4	Bluish green colour	+
10.	Terpenoid	Petroleum ether	Acetic anhydrite &Conc: H_2SO_4	Pink colour	+
11.	Reducing sugar	H_2O	Fehling's solution	Brick red ppt.	+
12.	Starch	H_2O	Iodine solution	Reddish pink ppt.	+
13.	Cyangenic glycoside	powder	H_2O Conc:H_2SO_4, sodium picrate paper	Yellow to pale brown colour change	Trace

Table (2) Nutritional Value of Red Kidney Beans and Residue from Poonyigyi Process

Sr. No.	Nutritional Value	Red Kidney Beans		Red Kidney Beans Residue
		Experimental Value	*Literature Value	Experimental Value
1	Ash (%w/ w)	3.05	6.4	8.28
2	Fat (%w/ w)	0.9	2.04	0.7
3	Protein (%w/ w)	19.25	13.01	19.1
4	Fiber (%w/ w)	4.3	5.96	6.84
5	Carbohydrate (%w/ w)	62.55	47.61	55.23
6	Energy (Kcal/100g)	335	261	305

* Gopalan and Balasubramanian 1991.

Table (3) Elemental Composition of Beans, Poonyigyis and Beans Residue analysed by EDXRF

Sr. No.	Element	Red Kidney Beans (%w/ w)	Red Kidney Beans Residue (%w/ w)	Prepared Poonyigyi (%w/ w)	Commercial Poonyigyi (%w/ w)
1	Ca	-	0.038	-	-
2	K	0.357	0.320	0.207	0.186
3	Fe	0.004	0.007	-	0.004
4	Mn	-	-	-	0.001
5	Zn	0.001	0.001	-	0.000
6	Sr	-	0.000	-	-
7	Ni	-	-	-	-
8	Rb	0.001	0.002	0.001	0.000
9	Cu	-	0.001	-	0.000
10	Cl	-	-	-	0.183
11	S	-	-	-	0.028
12	Br	-	-	-	-
13	CH	99.638	99.631	99.971	99.598
	Total	100	100	100	100

Table (4) Effect of Potassium Sorbate on the Shelf-life of Poonyigyi

Weight of Poonyigyi = 100g Date of Sample preparation = 5.12.2017

Date of Counting of plates =12.12.2017

Sr. N0.	Sample	Weight of Potassium Sorbate (g)	Yeasts and Moulds (cfu per g) (After 1 week)	Shelf-life at 30°C (week)	Shelf-life at 17°C (week)
1.	RKP1	0.1	1.4×10^7	0.5	1
2.	RKP2	0.15	2.2×10^6	1	2
3.	RKP3	0.2	6.5×10^2	3	4
4.	RKP4	0.25*	3.5×10^2	4	8
5.	RKP5	0.3	1.5×10^2	4	8

RKP = Red kidney beans poonyigyi cfu = colony forming unit * suitable condition

Table (5) Effect of Cooking on the Characteristics of Poonyigyi

Weight of red kidney beans = 100g Amount of salt = 0.2g
Volume of water = 6L Amount of potassium sorbate = 0.25g
Amount of sodium bicarbonate = 0.2g Fermentation temperature = (30-32°C) for 12hr pH of HGP = 6.1
RKP = red kidney beans poonyigyi *suitable condition

Sample	Cooking Temperature (°C)	Cooking Time (before fermentation) (hr.)	Cooking Time (after 12 hr fermentation) (hr.)	Physico-chemical Properties of RKP						Nutritional Value of RKP					
				Moisture (%w/w)	Colour	Taste	Total solids content (°Brix)	Shelf-life (week)	Weight of RKP (g)	Fat (%w/w)	Protein (%w/w)	Fiber (%w/w)	Ash (%w/w)	Carbo-hydrate (%w/w)	Energy (Kcal/ 100g)
RKP 1	85	11	3	63.23	brown	bitter	35	6	100	0.03	8.99	1.73	7.53	18.49	110
RKP 2	90	10.5	2.5	64.58	pale brown	slightly bitter	25	3	112	0.09	8.67	1.95	5.24	19.17	113
RKP 3	95	8.5	2	65.19	pale brown	slightly bitter	25	4	130	0.52	8.25	1.45	4.50	19.39	117
RKP 4	100*	7.5	1.5	65.62	pale brown	slightly bitter	25	4	150	0.94	8.17	0.73	4.26	20.28	122
RKP 5	105	6	1	65.82	pale brown	bitter	25	2	160	0.68	8.06	0.52	3.11	21.31	124

Table (6) Effect of Fermentation Time on the Characteristics of Poonyigyi

Weight of red kidney beans = 100g Amount of sodium bicarbonate = 0.2g Cooking temperature before fermentation = 100°C for 7.5hr Amount of salt = 0.2g Volume of water = 6L Amount of potassium sorbate = 0.25g Cooking temperature after fermentation = 100°C for 1.5hr

Fermentation temperature = (30-32°C)

Sample	Fermentat-ion time (hr.)	pH	Physico-chemical Properties of RKP					Nutritional Value of RKP					
			Moisture (%w/w)	Colour	Taste	Total solids content (Brix)	Shelf-life (week)	Fat (%w/w)	Protein (%w/w)	Fiber (%w/w)	Ash (%w/w)	Carbo-hydrate (%w/w)	Energy (Kcal/ 100g)
RKP 1	9	6.6	61.82	pale brown	slightly sweet	30	2	0.35	7.6	0.52	2.96	26.75	141
RKP 2	12*	6.1	65.62	pale brown	slightly sweet	25	4	0.94	8.17	0.73	4.26	20.28	122
RKP 3	15	5.6	61.16	pale brown	slightly sour	25	4	0.68	8.35	0.98	3.23	25.6	142
RKP 4	18	5.4	68.24	reddish brown	slightly sour	25	5	0.48	8.65	0.53	3.52	18.58	113
RKP 5	21	5.1	71.5	reddish brown	sour	25	7	0.43	8.84	0.09	4.01	15.13	100

RKP = red kidney beans poonyigyi Weight of RKP = 150g Amount of beans residue = 75 g *suitable condition

Table (7) Effect of Amount of Salt on the Characteristics of Poonyigyi
Weight of red kidney beans = 100g Amount of sodium bicarbonate = 0.2g Cooking temperature before fermentation = 100°C for 7.5hr

Volume of water = 6L Amount of potassium sorbate = 0.25g Cooking temperature after fermentation = 100°C for 1.5hr

Fermentation temperature= (30-32°C) for 12hr pH of RKP = 6.1

Sample	Amount of Salt (g)	Physico-chemical Properties of RKP					Nutritional Value of RKP					
		Moisture %w/w	Colour	Taste	Total solids content (°Brix)	Shelf-life (week)	Fat %w/ w	Protein %w/ w	Fiber %w/ w	Ash %w/ w	Carbo-hydrate %w/ w	Energy Kcal/ 100g
RKP 1	0.1	71.8	pale brown	bland	25	1	0.97	6.32	1.15	3.64	16.12	98
RKP 2	0.2	65.45	pale brown	slightly bitter	25	4	0.94	8.17	0.73	4.26	20.28	122
RKP 3	0.3*	63.5	pale brown	slightly bitter	25	4	0.31	8.87	1.71	2.91	22.7	129
RKP 4	0.4	63.23	pale brown	slightly salty	25	4	0.68	7.91	1.82	2.96	23.4	131
RKP 5	0.5	61.5	pale brown	salty	25	5	0.23	7.82	1.95	2.83	25.67	136

RKP = red kidney beans poonyigyi RKP yield = 150 g Amount of beans residue = 75 g *suitable condition

Table (8) Effect of Volume of Water on the Characteristics of Poonyigyi

Weight of red kidney beans = 100g Amount of salt = 0.3g Amount of sodium bicarbonate = 0.2g

Amount of potassium sorbate = 0.25g Cooking temperature before fermentation = 100°C for 7.5hr

Cooking temperature after fermentation = 100°C for 1.5hr Fermentation temperature= (30-32°C) for 12hr pH of RKP = 6.1

Sample	Volume of Water (L)	Cooking Time (before fermentat-ion) (hr)	Cooking Time (after 15hr fermentat-ion) (hr)	Physico-chemical Properties of RKP						Nutritional Value of RKP					
				Moisture %w/w	Colour	Taste	Total solids content (°Brix)	Shelf-life (week)	Weight of RKP (g)	Fat %w/ w	Protein %w/ w	Fiber %w/ w	Ash %w/ w	Carbo-hydrate %w/ w	Energy Kcal/ 100g
RKP 1	2	2.5	1	64.51	pale brown	slightly bitter	20	6	101	64.51	8.04	0.34	2.43	24.04	134
RKP 2	4	3	1.2	65.62	pale brown	slightly bitter	25	5	145	65.62	8.19	0.25	2.61	22.86	128
RKP 3	6*	7.5	1.5	63.5	pale brown	slightly bitter	25	4	150	63.5	8.87	1.71	2.91	22.7	129
RKP 4	8	10	2.5	67.81	pale brown	slightly bitter	25	3	170	67.81	8.26	0.16	3.21	20.49	116
RKP 5	10	11	3	67.92	pale brown	slightly bitter	25	2	200	67.92	8.17	0.11	3.52	20.14	115

RKP = red kidney beans poonyigyi *suitable condition

Table (9) Comparison of Physico-chemical Properties and Nutritional Values of Prepared and Commercial Poonyigyi Samples

Sample	Physico-chemical Properties				Nutritional Values					
	Moisture %w/w	Colour	Taste	Shelf-life (months)	Fat %w/w	Protein %w/ w	Fiber %w/ w	Ash %w/ w	Carbo-hydrate %w/ w	Energy Kcal/ 100g
RKP	63.18± 0.34	pale brown	slightly bitter	4	0.34 ± 0.04	8.79 ± 0.17	1.5 ± 0.64	3.03 ± 0.24	23.15 ± 1.01	131 ± 3.74
*Myin Pyan Brand	56.87	brown	slightly sweet	2	0.06	10.05	0.78	3.58	28.66	155

RKP = red kidney beans poonyigyi
*Purchased from Nyaung Oo Township, Mandalay Region.

Conclusion

The quality of the prepare poonyigyi depends on the right proportion of constituents like salt, water, sodium bicarbonate, potassium sorbate and fermentation period. The suitable cooking temperature and fermentation period were also found to be 100^{o}C and 12 hours at room temperature. The nutritional values of the prepared samples are cited with a commercial product. From this study, it can be concluded that red kidney beans were suitable beans for preparation of poonyigyi.

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