

**GLOBAL JOURNAL OF ADVANCED ENGINEERING TECHNOLOGIES AND SCIENCES****DEVELOPMENT OF CINNAMON FLAVOURED INSTANT PORRIDGE POWDER USING AMYLASE TREATED KITHUL FLOUR (*Caryota urens*)****K. Kuhanneya\*, R. A. U. J. Marapana<sup>1</sup>, P. Ranasinghe<sup>2</sup>**<sup>\*1</sup> Department of Food Science and Technology, University of Sri Jayawardenepura, Sri Lanka<sup>2</sup>Herbal Technology Section, Industrial Technology Institute, Sri Lanka**ABSTRACT**

Traditionally, Kithul flour which is extracted from *Caryota urens* L. palm has been used in variety of health foods including Kithul gel and thick porridge. However, as yet there is no significant improvement in these traditional products in order to suite modern consumer preferences. Therefore, this study was focused to develop a ready to serve porridge powder with low gelatinization and improved bioactive properties using enzyme hydrolyzed Kithul flour. Kithul flour purchased from market was used for this study and different concentrations of heat resistant alpha amylase were used for hydrolysis of kithul flour. After digestion, maltose content was evaluated using ditro-salicylic acid method. Then samples were tested for gelatinization. Hydrolyzed samples with low gelatinization were selected for the development of less viscous porridge. The porridge samples were prepared after number of primary experiments with different flour: amylase: cinnamon extract ratios as 100g: 0.1g: 0.1ml, 150g: 0.1g: 1ml and 100g: 10g: 0.5ml. Sensory evaluation was conducted for 30 untrained panelists. The results were analyzed using computer aided MINITAB 17.2.1 statistical analysis package according to Kruskal Wallis test at 95% level of significance. The best sample with 100g: 10g: 0.5ml flour: amylase: cinnamon extract ratio was selected from the analysis. Total Antioxidant content of the developed product was not significantly different from the commercial kithul flour. Proximate analysis was carried out, where the Moisture, Fat, Carbohydrate, Ash, crude fiber, protein content of commercial kithul flour and cinnamon flavoured instant Kithul porridge powder was (14.2%,6.4%),(0.12%,0.2%),(84.7%,92.2%),(0.3%, 0.3%), (0.7%, 0.6%), (0.8%,0.9%) respectively. The developed porridge is a potential alternative for traditional product with attractive properties including less thickness, sweetness without added sugar, easy to prepare and enhanced bioactive properties due to incorporation of herbal extract like cinnamon.

**KEYWORDS:** Amylase, Cinnamon flavoured, Kithul Flour, Porridge.**INTRODUCTION**

Food habits in the world have changed in the recent past, more people are dependent on fast food and Instant food. Therefore developing an instant food with nutrient rich and health benefitting properties is very beneficial and challenging to the food industry. Kithul (*Caryota urens*) flour is an underutilized flour source so developing such products helps to strengthen the kithul industry with rural economy in Sri Lanka. Kithul (*Caryota urens*) flour has higher gel-forming ability than other flour in the food industry, Alpha amylase is added to hydrolyse the kithul starch and give a suitable texture for the porridge and also this increases the amount of Maltose which additionally gives the sweetness taste to the porridge. Traditional Kithul porridge was made by using kithul flour, salt, and sugar (optional) as ingredients. All the ingredients except salt in a saucepan is mixed and then cooked on a low fire and stirred for some time. (It should not be boiled for a long time because it becomes thick and solidifies quickly). Later salt is added. Take off the fire at suitable temperature. Serve while hot otherwise when cooling it solidifies. Add a lot of water to dilute the thickness if necessary. This cannot be served after cooling. Whereas normal kurakkan/rice porridge is prepared by using water, kurakkan(millet) flour, rice flakes, coconut cream/milk, garlic chopped, red onion, salt as ingredients. Here all the ingredients are mixed except coconut milk/cream and salt. Kurakkan or rice flour has less gelatinizing property so it should be boiled for few minutes. Cook on a low fire and stir till it becomes thick. Later when thick add the coconut milk and salt to taste and stir. Boil and stir and this can be served after cooling too. Kithul products have medicinal properties, and are used in treatments in the ayurvedic medical system practiced in Sri Lanka. Uses recorded in National Science Council of Sri Lanka publications. In Ayurveda recommends the use of *Caryota urens* for seminal weakness and urinary disorders, the juice is applied on the forehead for hemicranias. In traditional medicine porridge prepared from *Caryota urens* flour is used to treat gastric ulcer, migraine, hypertension, headaches, snake bite poisoning, as well as rheumatic swellings. The fruits contain calcium oxalate crystals which is a skin and membrane irritant which is not edible. *Caryota urens* species are known as Sugar palm also, which is used in ancient medicine to treat hemicranias and rheumatic swelling. Ancient medicine technologies recommend these flowers of the trees are used as a home remedy and improve the hair growth. The roots of the trees are used as the tooth ailments. The sap of fishtail palm is sweet in nature. So it is used to produce sugar which is known as jiggery Palm heart also used locally as flour, especially for control of diabetes and in ayurvedic medicines. Kithul flour has antioxidants and polyphenols which makes the porridge more healthy. In this study mainly

*Cinnamomum Zeylanicum* is added as a Flavour to the porridge but it also helps as an antidiabetic agent. Cinnamon can be useful for lowering HbA1c in type 2 diabetics. Strong evidence suggests that cinnamon polyphenols (CP) exhibit insulin-like activity in cells, animals and people with type 2 diabetes. Anti-diabetic Sung Hee *et al.* have reported data of anti-diabetic activity of *Cinnamon* in db/db transgenic mice<sup>14</sup>. It has been shown by Subash *et al.* that oral administration of cinnamaldehyde produces significant antihyperglycemic effect lowers both total cholesterol and triglyceride levels. Therefore due to these positive attributes it should be promoted to develop nutritious porridge. Thereby this will be beneficial for the rural economy development

## MATERIAL AND METHODS

### Formulation and development of Instant Kithul porridge powder

#### *Determination of Maltose content in the product by plotting curves and determining texture of the Maltose content in the product*

10mg and 20mg amylase were added to each samples of 2% and 3% starch solution and four samples were prepared and allowed for hydrolysis as mentioned below at 60°C with water added 100ml. Every 2hr, 4hr, 6hr samples were taken and DNS test was done and absorbance were recorded. Then graph was plotted absorbance Vs Concentration. From comparing with the standard curve the maltose concentration was calculated.

#### Gelation Studies

After the overnight digestion, from the above flour dispersions samples 1,2,3,4 each, 5ml were taken. The flour suspensions were thoroughly mixed for 5min, the test tubes were heated for 30 min at 80°C in a water bath followed by rapid cooling under running cold tap water for 2hr. least gelation concentration was determined when the amylase activity is low in hydrolyzing where the samples were thick. Samples suitable for a porridge consistency were selected for sensory analysis.

#### Cinnamon water extraction method

This method was carried out as mentioned by (Shori and Baba, 2012). 10 grams of *C.zeylanicum* bark was taken and powdered and was mixed thoroughly with 100ml of distilled H<sub>2</sub>O. The mixture was incubated overnight in a water bath at 70°C followed by centrifugation (HERMLE Z383K; 1000rpm) for 15 min at 4°C. The clear supernatants were harvested and used as *C.zeylanicum* water extracts in the making cinnamon flavour Kithul porridge.

#### Quantification of cinnamon extract

Weight two empty petriplates and name as 1 and 2 (W<sub>1</sub> and W<sub>2</sub>)

Add 10ml of the two extracted sample to each petriplates and place in the oven for 70°C for 4 hours

Weigh both petriplate after drying (W<sub>11</sub>- W<sub>22</sub>)

Calculate the amount of cinnamon present in the cinnamon water extract

#### Sensory Evaluation 1 & 2

From DNS method and gelation studies samples were prepared as shown in the table below

*Table 1. Samples prepared for sensory evaluation 1*

	SAMPLE 203	SAMPLE 411	SAMPLE 731
Kithul Flour : Amylase	100g : 0.1g	150g : 0.1g	100g : 10g
Digestion time	6-7 hours	6-7 hours	6-7 hours
Water	150ml	150ml	150ml

Three samples were prepared as above, to each 100g, 100g and 150g kithul starch 80ml water was added and a slurry was prepared in a beaker, to that 100mg, 100mg, 10g of amylase was added respectively. According to the ratios given in Table 2.1 All three samples were kept 6-7 hours for digestion. After the digestion, all three samples were transferred to three respective plates and oven dried overnight at 60°C to evaporate the excess water and to obtain the powdered sample. The powdered samples were taken after overnight drying and crushed into uniform powder

After selecting the sample with acceptable Texture and sweetness from sensory 1, Sensory Evaluation 2 was held to analyze the odour, appearance, spice flavour and overall acceptability for final formulation for 30 untrained panelists with use of ballet papers.

**Table2. Samples prepared for the sensory evaluation 2**

	SAMPLE 781	SAMPLE 701	SAMPLE 723
Kithul Flour : Amylase	100g : 10g	100g : 10g	100g : 10g
Digestion time	6-7 hours	6-7 hours	6-7 hours
Cinnamon water extract	0.1ml	0.5ml	1ml
Water	150ml	150ml	150ml

Samples were evaluated subjectively using 5 point hedonic scale. Both results were analyzed using computer aided Minitab® 17.2.1 statistical analysis package according to Kruskal Wallis at 95% level of significant level.

#### **Quantification of maltose present in the digested Kithul starch slurry by DNS method.**

Sample selected from the sensory panel was analyzed to quantify the maltose content. To 10g of kithul starch 13ml of water was added and slurry was prepared and mixed well.

1g of amylase was added and was allowed for 6-7 hours digestion.

Then 1ml of the slurry was taken and diluted into 20, 40, 80, 100 times. DNS test was done and absorbance was recorded. Amount of maltose was calculated.

#### **Determination of total polyphenolic Content (TPC) and Antioxidant content in the original commercially available kithul flour and final developed cinnamon flavoured kithul porridge powder.**

Total polyphenolic content was calculated by the method mentioned by (Singleton *et al.*, 1999). The total antioxidant content was analyzed by Oxygen Radical Absorbance Capacity Assay (ORAC) (Ou *et al.*, 2001) and the total Antioxidant content was analyzed by Ferric Reducing Antioxidant Power (FRAP) Assay (Benzie and Szeto, 1999)

#### **Proximate analysis of the Commercial flour and final product**

Proximate analysis was carried out for the commercial flour and for the best sample selected by sensory evaluation by the below mentioned AOAC methods. Moisture content (AOAC 925.10), crude fat content (method described in operating manual of Gerhardt fat extractor- Soxtherm unit), protein content (Method described in operating manual of VELP Scientifica, adopted from AOAC 2000- Kjeldhal method), Ash content (AOAC 923.03), crude fiber content (AOAC 920.86). Total carbohydrate was calculated by difference sum of above categories.

#### **Determination of Maltose by HPLC method**

Maltose content was analyzed and quantified by HPLC method for sugar analysis.

## **RESULTS AND DISCUSSION**

#### **Determination of Maltose content in the product by plotting curves**

##### *Developing Standard Maltose curve*

As the first step for Maltose content determination in the product developed, a standard curve for standard Maltose was intended to be plotted. In this step several trials were carried out with several dilution series of Maltose and for each trail a graph was plotted. The R<sup>2</sup> value for each graph was observed and among them the best graph which has a R<sup>2</sup> closer to the value 1 was selected as it show the best linear graph among all graphs. It was selected as the standard curve for Maltose.

##### *Determining Texture and the Maltose content in the product*

The corresponding equation for the standard curve was obtained as follows

$$y = 6.1967x - 0.0589 \quad (1)$$

Beer-Lambert Law an unknown reducing sugar concentration can be calculated by the above equation after taking the absorbance results of the sample.

**Table 3. Comparison of Maltose content**

	CONCENTRATION OF MALTOSE (mg/ml)		
	2hrs	4hrs	6hrs
KITHUL FLOUR:AMYLASE			
2%:10mg	0.08	0.10	0.10
2%:20mg	0.17	0.19	0.20
3%:10mg	0.01	0.13	0.13
3%:20mg	0.11	0.12	0.18

Concentration of Maltose for four different ratios of Kithul starch: Amylase was calculated by using the standard Maltose curve and was found that 2%:20mg had the highest Maltose concentration and 3%:20mg had the second highest Maltose concentration after Digesting with  $\alpha$ -Amylase in the Interval of 2hr, 4hr and 6hrs.

This was done to get the highest Maltose content producing ratio, so that the porridge will be hydrolyzed more and contain a liquid like consistency, also naturally a sweet taste is developed when Maltose is in higher concentration, therefore additional sugar (sucrose) need not be added.

#### Gelation study of the digested four samples

**Table 4. Different Gelation observation for digested samples**

Sample No.	Amount of Kithul flour( g)	Amount of amylase(mg)	Amount of water( ml)	Texture
1	2	10	5	Liquid
2	2	20	5	Viscous liquid
3	3	10	5	Soft gel
4	3	20	5	Slightly viscous than Sample No.2

This was done to select a suitable consistency for the porridge and from observing the texture sample No 2 and No4 was taken for the formulation of sensory evaluation. Considering the Gelation property is important for porridge preparation because this helps us to determine the Flour: Amylase ratio for the desirable texture.

#### Cinnamon water Extraction and quantification of dry matter

This was done to quantify the amount of cinnamon present in the Instant porridge powder. From this the dry matter of cinnamon was 0.85g from Petriplate 1 and 0.85g from Petriplate 2. This was the dry matter of Cinnamon from 10ml of the cinnamon water extract after oven drying for 4-5 hours.

#### Sensory Analysis of Instant Kithul Porridge powder

##### *Results of the maltose concentration and gelatinization property for the product. (Sensory 1)*

The best texture and high maltose containing samples were considered, others were not suitable for texture and sweetness.

**Table 5. Results of the three samples from sensory 1**

Sample	Kithul starch: amylase ratio
203	100g : 0.1g
411	150g : 0.1g
731	100g : 10g

From the previous maltose content determination study and gelation study the samples 2 (203) and 4 (411) were taken for sensory evaluation and an additional new ratio of Kithul starch and Amylase was also taken with higher Amylase concentration so that the rate of digestion will be high. This is done because overnight digestion is consuming more time and also sometimes improper smell development can be noticed. Since the digestion is maintained at 60°C microbes can be developed due to more available time, moisture and nutrient content. To avoid this the digestion time can be reduced by adding more Amylase.

Sensory evaluation 1 was held for 30 untrained panelists to analyze the texture, sweetness and overall acceptability first. This is determined by the ratio of Kithul flour: amylase.

According to the p values, the texture, sweetness and overall acceptability of the three samples are significantly different among the three samples.

Sensory analysis results showed that, for 731, 203 and 411, the highest average rank value for the overall acceptability, appearance, odour, and spice flavor was achieved by sample coded 701 hence it was selected as the best sample.

From the result of Sensory 1, sample 731 was selected and to that formula, three different concentrations of Cinnamon water extract was added to analyze the spice flavor and sensory evaluation 2 was done to select the best overall accepted final product in respect to odour, spice flavor, appearance. (Sample 781, 701, 723)

### Results of Sensory Evaluation 2

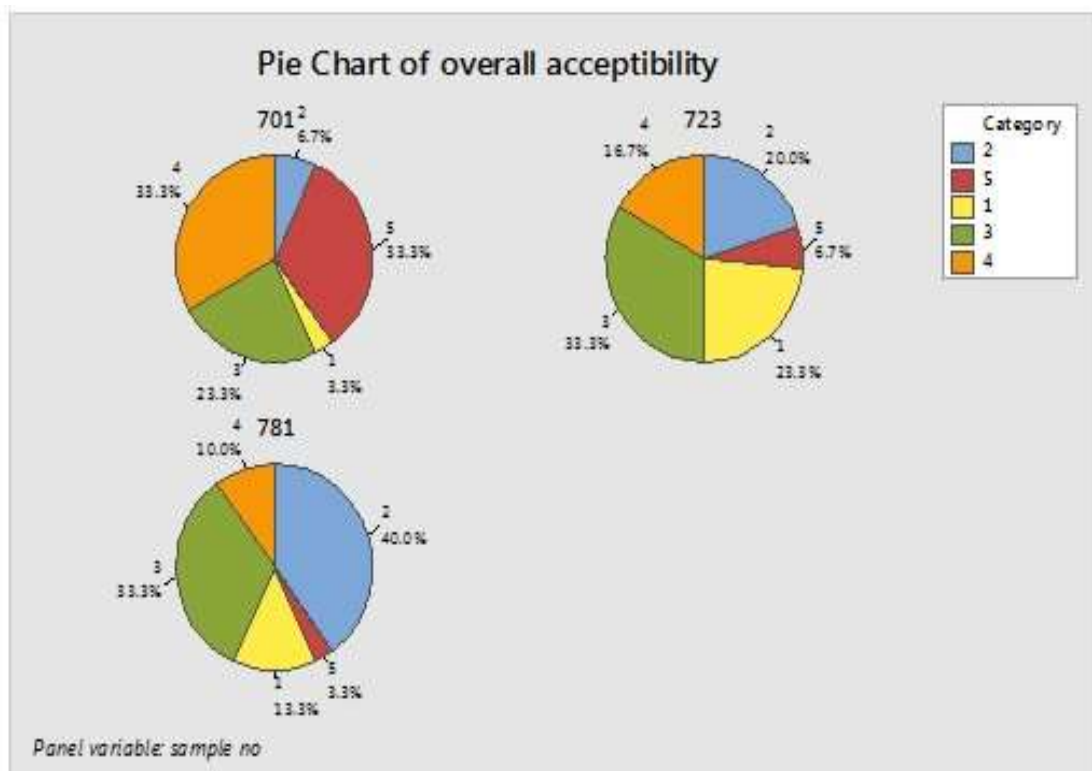


Figure 1. Results for overall acceptability

Around 66.6% of the sensories confirmed that the overall acceptability of the sample 701 is very good and good. According to the p values, the overall acceptability, odour and spice flavor of the three samples are significantly different. But the appearances of the three samples are not significantly different from each other.

Results were analyzed using computer aided MINITAB 17.2.1 statistical analysis package according to Kruskal-Wallis test at 95% level of significant level. All sensory properties have been evaluated using pie charts.

### Quantification of Maltose content in the sample selected from the sensory evaluation.

The Maltose content was measured in mg per 10g of the product. The maltose contents were 71.59, 69.01, 72.82 and 72.79. Therefore the average maltose in mg per 10g of product was 71.55.

**Results of Total Polyphenolic Content and Total Antioxidant content of commercially available flour and developed product****Table 6. Polyphenol and antioxidant content results for commercial kithul flour and developed product**

	TPC	FRAP	ORAC
	mg Gallic/g of sample	mg Trolox/g of sample	mg Trolox eq/g of sample
Commercial Flour	11.49 ± 1.03	0.76 ± 0.15	2.62 ± 0.36
Kithul Porridge Powder	very low value	0.72 ± 0.08	3.08 ± 0.53

Total Polyphenolic content of Commercially available Kithul flour was 11.49 mg Gallic/g of sample but the total polyphenolic content of the developed product was undetectable and was not within the standard concentration range, indicated negative values which means TPC was not detected in the product. Due to the oven drying during the preparation of the slurry TPC can be lost.

Ferric Reducing Antioxidant Power was not significantly different from each other. Results of ORAC are not significantly different from each other.

According to Senavirathna, Total polyphenolic content in *Caryota urens* raw flour and antioxidant potentials of raw flour is 79±3mg GAE/100g FW and 3±2 µmol/g respectively. The TPC result of this study is less may be because commercially available Kithul flour was used. Commercially available kithul flour can vary in the total Polyphenolic content and antioxidant potentials due to its extraction and processing methods.

**Results of Proximate Analysis of the final product**

According to the proximate analysis of the Cinnamon flavoured Instant kithul porridge powder, results are in the following table.

**Table 7. Proximate analysis results for commercial kithul flour and developed product**

Food Constituent	Commercial Flour	Product
Total Carbohydrate (By Difference) wet basis	84.7	92.2
Available Carbohydrate (wet basis)	84.0	91.6
Moisture %	14.2 ± 0.2	6.4 ± 0.2
Protein %	0.8 ± 0.04	0.9 ± 0.04
Fat %	0.12 ± 0.01	0.2 ± 0.01
Ash %	0.3 ± 0.04	0.3 ± 0.1
Crude Fiber%	0.7 ± 0.02	0.6 ± 0.2

Moisture % of commercial flour was high when compared to the product; it can be due to the packing material used to pack the commercial flour. Commercial flour was packed in polythene packing and this is done is a small scale house hold business, where the processing and packaging might not be under standard conditions. But the moisture % of the product is very low comparatively, which indicates a longer shelf life because microbes cannot grow there when moisture is low. Additional preservatives are not added due to this.



Low moisture % in the product helps to retard microbial growth. Low fat content and addition of cinnamon water extract helps it to make healthier. High Carbohydrate helps to give energy. Minerals available also make it a healthy instant porridge powder.

Packaging material of the cinnamon flavoured instant porridge powder is the triple layer aluminium packaging which helps in extending the shelf life.

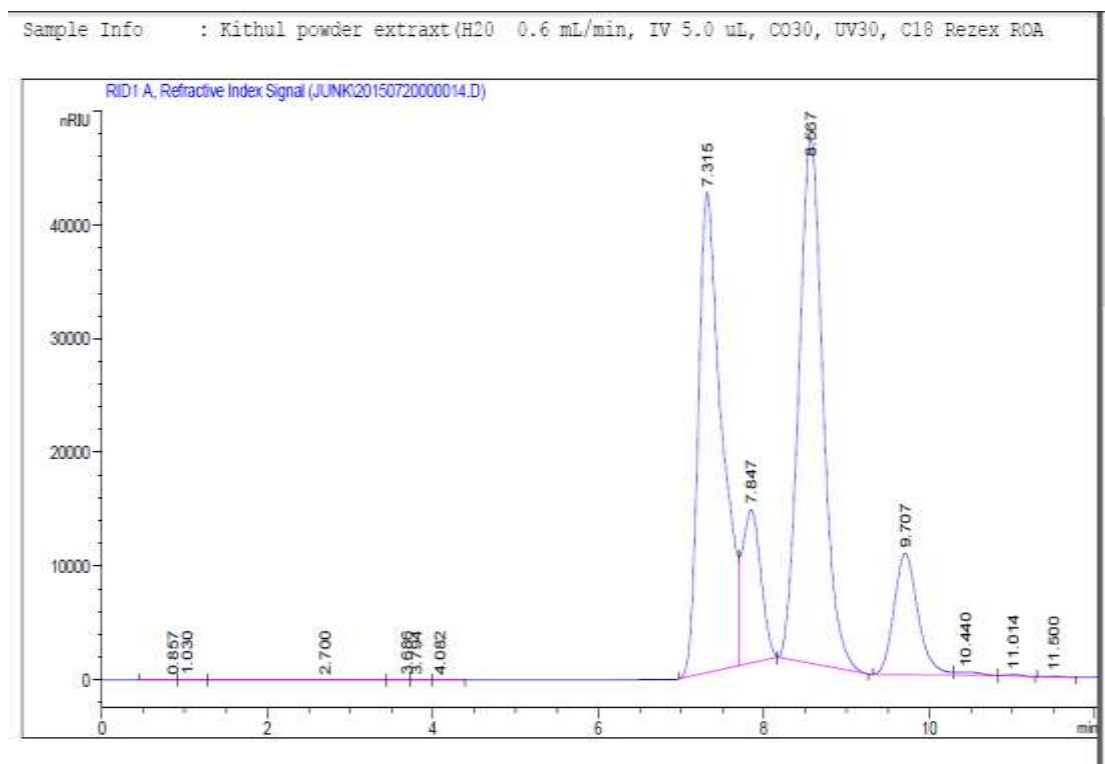
Protein content was 0.8% in the commercial flour and 0.9% in the Kithul Porridge Powder, which is not significantly different from each other. Fat content was very low (0.12%), due to the commercial extraction method fat can be removed, but the fat content in the product was 0.2% which is higher than the initial commercial flour and this can be due to the addition of cinnamon water extract. Palm flour is a carbohydrate rich plant food resource and a non-leguminous plant, therefore the fat and protein content is low.

The crude fiber content of the commercial Kithul Flour is 0.7% and the kithul porridge powder is 0.6%. The fiber content can be different due to flour extraction method. Literature provides facts as in dry method removed portions of pith were dried, pounded and sieved from a piece of cloth.

Depending on the extraction procedure the Ash content also vary, by addition of sand particles could be present by passing through the strainer or cloth. As per the results of this study, the total Ash content of the commercial Kithul flour and Kithul porridge powder was 0.3%.

Carbohydrate content was calculated by difference of sum of above five components. Since the moisture content of flour directly effect on this calculation there was a variation of the carbohydrate content. Therefore total starch determination is the better way to identify the starch component of the Kithul flour and the porridge powder.

#### Result of the Product (Digested Kithul) porridge powder analyzed by HPLC method



**Figure 2. HPLC results of the final product**

Retention time 8.567 peak corresponds to the presence of Maltose.

In 100g of Product (Digested sample) 1.09g of Maltose was quantified

In 100g of Commercial Flour 0.03g of Maltose was quantified. Usually Maltose should be absent in Kithul Flour, but since this is a commercial flour there can be other components in the matrix.

**CONCLUSION**

The sample containing a ratio of Kithul flour: Amylase: Cinnamon extract, 100g: 10g: 0.5ml was selected as the product from the sensory evaluation. The developed cinnamon flavoured Kithul porridge powder is nutritious, which is rich in carbohydrate and contains 1.09g of maltose, less in fat and protein content, a good source of antioxidants and all the other nutrients.

The developed porridge is a potential alternative for traditional product with attractive properties including less thickness, sweetness without added sugar, easy to prepare and enhanced bioactive properties due to incorporation of herbal extract like cinnamon.

This is a cost effective product which can earn considerable profit, as marketing nutritious and instant porridge.

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