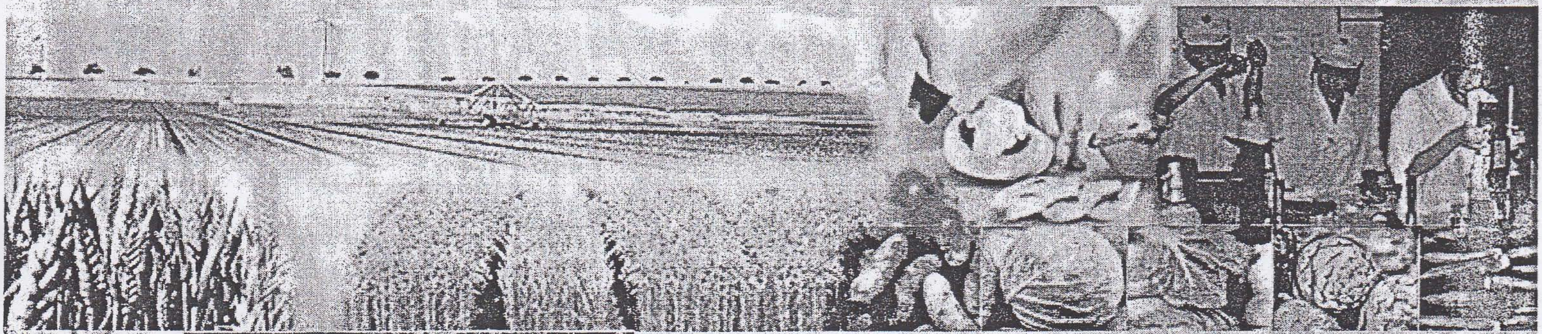
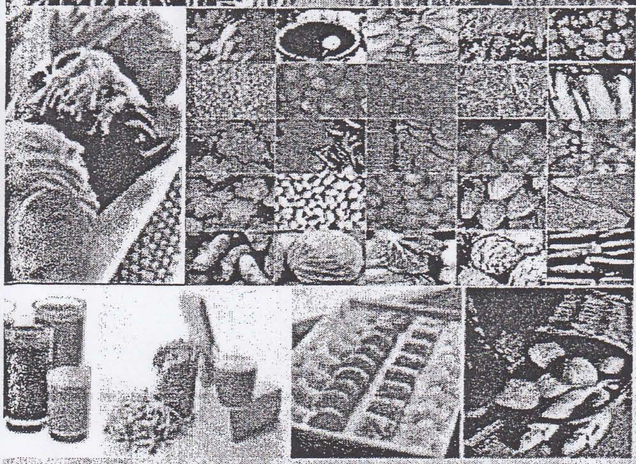
PROCEEDING

International Food Conference 2011
"Life Improvement through Food Technology"
Surabaya, October 28th - 29th, 2011





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Organized by

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SCHEDULE OF INTERNATIONAL FOOD CONFERENCE 2011

Friday, October 28th 2011

Time	Activities	
07.00-09.00	Registration, Coffee Morning	
09.00-09.30	**OPENING CEREMONY** **Indonesia Raya Anthem** **Welcome speech:** Rector of UKWMS, Dean of Food Technology Faculty UKWMS, Chairperson of Organizing Committee	
09.30-10.30	**FIRST PLENARY SESSION** **1)Margaretha Indah Epriliati, PhD** *(Department of Food Technology, Faculty of Agricultural Technology, Widya Mandala Surabaya Catholic University, Indonesia)* **Speech topic:** Constructing a Framework to Safeguard Food Technology for Betterment **2)Dr. Dahrul Syah** *(The Indonesian Association of Food Technologis;)* **Speech topic**: Indonesian Food Technologist; Expected Role in Context of National Development	**Moderator:** Drs. Sutarjo Surjoseputro, MS
10.30-11.30	**SECOND PLENARY SESSION** **3) Ihab Tewfik, PhD** *(Human and Health Science, School of Life Sciences, University of Westminster, United Kingdom; International Forum for Public Health, United Kingdom)* **Speech topic:** Modern Functional Meal: a Potential Answer to the Challenge of the Millenium Development Goals **4) Roy Sparringa, PhD** *(The National Agency of Drug and Food Control, BPOM, Indonesia)* **Speech topic:** Current Food Safety Issues in Indonesia: Challenge & Expectation	**Moderator:** Prof. Y. Marsono, PhD
11.30-11.45	PT Ditek Jaya	
11.45-12.30	Lunch break + Pray	
12.30-13.30	Poster Session	
13.30-17.00	Paralel Session	
17.00-18.30	Evening Coffee and Expo (in Indonesian Traditional Atmosphere)	

Saturday, October 29th 2011

Time	Activities	
07.00-08.00	2nd day registration	
08.00-10.20	Paralel Session	
10.20-10.45	Coffee break	
10.45 – 11.00	PT Campina Ice Cream Industry	
11.00-12.30	**THIRD PLENARY SESSION** 1)Prof. Son Radu, PhD (Food Science and Technology, Universiti Putra Malaysia, Malaysia) **Speech topic**: Microbiological Risk Assessment as a Decision Support Tool: Reactive and Proactive Case Studies 2) Phillipe J. Blanc, PhD (Institut National des Sciences Appliquees de Toulouse, France) **Speech topic**: Trends in food biotechnology - Natural Food Colorants: Biotechnology Aspect and Application in Food Industry 3)Johan M. Krop, PhD (Process and Food Technology, The Hague University of Applied Sciences, Netherlands) **Speech topic:** Food Technology And Production In A Global Perspective	**Moderator:** Prof. Endang S. Rahayu, PhD
12.30-12.45	Best and Favourite Poster Announcement	
12.45-13.00	Closing ceremony	
13.00-14.00	Lunch	

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LOW GLYCEMIC INDEX MODIFIED PLANTAIN FLOUR AS FUNCTIONAL FOODS

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ABSTRACT

One of the current tendencies in nutrition and health is consuming low-carbohydrate food products. Modified plantain flour was made from "var agung semeru" horn plantain (Musa paradisiaca formatypica). The flour were produced by spontaneous fermentation of plantain slices for 24 h at room temperature, retrogradation (two cycles of autoclaving following by cooling) process, and the combination of spontaneous fermentation with retrogradation process. The glycemic index (GI) of native and modified plantain flour was evaluated by teen volunteers. The results showed that the GI score decreased from moderate GI (65.84 - 66.03) to low GI (45.72 - 51.96) when two cycles of retrogradation process were applied. The combination process increased resistant starch content up to about five times, resulted in lowering the GI of the flour. It can be concluded that modified plantain flour by two cycles of retrogradation process or the combination process can be recommended for use in the diet of low GI. More research is needed to evaluate prebiotic properties of resistant starch-rich plantain flour.

Key Words: *plantain flour, spontenous fermentation, retrogradation process, glycemic index, functional food*

INTRODUCTION

Recent knowledge diet may modulate various functions in the body and may play beneficial effects in some diseases. Foods are expanding from emphasis on survival, hunger satisfaction, and preventing adverse effects to emphasizing the use of foods to promote a state of well-being and better health and to help reduce the risk of disease. They are called as functional foods. A functional food component can be a macronutrient if it has specific physiologic effects (e.g. resistant starch, n23 fatty acids) or an essential micronutrient if its intake is more than the daily recommendations (Roberfroid, 2000).

One of the current tendencies in nutrition and health is consuming low-carbohydrate food products. The glycemic index (GI) is a quantity which can be used to compare the glycemic responses of different foods containing carbohydrates. GI is defined as the area under the glucose response curve after consumption of 50 g of carbohydrates from a test food divided by the area under the curve after consumption of 50 g of carbohydrates from a control food, either white bread or glucose (Ludwig, 2000).

Plantain of var agung semeru (*Musa paradisiaca* formatypica), also called horn plantain, is widely cultivated in Lumajang Regency, East Java Province, Indonesia. The plantain is a major source of carbohydrate. Jenie *et al.* (2009) reported that *Musa paradisiaca* formatypica contain more than 70% starch on a dry weight basis and about 6% resistant starch (RS) content. RS is indigestible compounds of starchy food so the food has moderate GI (Juarez-Garcia *et al.*, 2006). Tribbes *et al.* (2009) reported that The RS content of banana flour was influenced by the combination of drying conditions. Drying condition on 55 °C/1.4 m s^{-1} and 55 °C/1.0 m s^{-1} presented higher content of resistant starch.

Modification processes on the plantain were conducted by retrogradation (two cycles of autoclaving-cooling) process and the combination of spontaneous fermentation on plantain slices with two cycles of retrogradation process. In this study, functional properties of modified plantain flour was evaluated based on the glycemic index as diet functional food.

MATERIALS AND METHODS

Material

Plantain of var agung semeru (*Musa paradisiaca* formatypica) was used for this study. The fully mature but unripe banana fruits were obtained from Central Supply in Lumajang Regency, which were harvested at 120 days after flowering.

Modified banana flour preparation

Native plantain flour (NPF) was prepared by peeling the fruits, cutting into 5 mm, drying at 50°C in a convection oven for 8 h, grinding to pass 80 mesh. Retrogradation process was conducted on the plantain slices. The fruits were peeled, and sliced into 5 mm. For spontaneous fermentation the slices were immediately rinsed in sterile distilled water (750 g/L), then incubated at room temperature for 24 h. The slices were drained and pressure-cooked (autoclave) at 121°C for 15 min, then cooled at room temperature and stored at 4°C for 24 h. Retrogdaration (autoclaving-cooling) process were repeated two cycles. After that, the plantain slices were dried at 50°C in a convection oven for 8 h and ground into 80 mesh. There were three kinds of modified plantain flour (MPF) i.e fermented plantain flour (FPF), retrogradated plantain flour (RPF), and fermented-retrogradated plantain flour (FRPF). Native and modified plantain flour were analyzed for chemical composition including moisture, ash, protein, fat and carbohydrate content (AOAC, 1999). Rapidly digestible starch (RDS), slowly digestible starch (SDS) and resistant starch (RS) content were determined according to Englyst *et al* (1992).

Experimental design

Non-diabetic volunteers (n = 10; 2 males, 8 females, aged 21 – 30 years) were offered a single meal of one of the four test foods on different days. The volunteers were administered 50 g glucose in 300 ml distilled water. The serving size was determined by calculating the quantity of the test food that will give 50 g carbohydrate when eaten. Blood samples were collected before feeding (0 min) and at 30, 60 90 and 120 min after the test meal was given. The subjects were not allowed to perform strenuous activities on the day of GI determination. The experimental design to evaluate the banana flour GI by volunteers (in vivo determination) was approved by Ministry of Health Republic of Indonesia through Ethical Approval No. LB.03.04/KE/8320/ 2010.

Determination of blood glucose

On the morning of each test, finger-prick capillary blood samples were collected to determine baseline glucose levels. Ten minutes were allowed for the test foods to be eaten and over 2 h following the start of each test meal, 0.5 mL capillary blood samples were collected at 0, 30, 60, 90 and 120 min. Blood samples were taken using a Easy Touch® device and blood glucose concentration was determinated by a Easy Touch® glucometer (Chiuan Rwey Enterprise, Ltd. Taiwan).

GI determination

GI was calculated from the blood glucose response curve of teen volunteers (subject). The incremental area under the curve (IAUC) for each test meal for each subject was calculated as the sum of the surface triangle and trapezoids of the blood glucose curve and the horizontal baseline running in parallel to the time axis from the beginning of the curve to the point at 120 min. There reflect the total rise of blood glucose concentration after eating the test food. The IAUC for test and control (50 g of pure glucose - IAUCS) was obtained in a similar way. GI for each food was calculated from the formulae:

$$GI = (IAUC/IAUCS) \times 100\%.$$

Statistical analysis

Chemical compotition of plantain flour were expressed as the mean values ± standard error of the two separate determinations. Comparison of means was performed by one-way analysis of variance (ANOVA) followed by Fisher's LSD (Least Significant Difference) at a significance level of 5% ($\alpha \leq 0.05$).

RESULT AND DISCUSSION

Chemical composition

Chemical composition of native and modified plantain flour are presented in the Table 1. The moisture content of modified plantain flour was slightly higher compared to native plantain flour. The difference may be attributed to the particular formulation of the flour. Slade and Levine (1991) explaned water content can be related to the relative abundance of amorphous starch zones in native flour, which influences water absorption to a large extent. There were no difference ($P \leq 0.05$) in fat and protein content of the flour, but there was difference ($P \leq 0.05$) in ash and carbohydrate content. The carbohydrate content decreased from 88.75 ± 0.06 g/100g to 85.66 ± 0.03 g/100g of flour.

For both modified banana flour, retrogradated plantain flour (RPF) and retrogradated-fermented plantain flour (RPF), had lower amounts of starch compared to native plantain flour (NPF). The starch can be degradated by microbial activity for 24 h spontaneous fermentation process. While the starch was leaching for retrogradation process.

The results demonstrated that during 24 h of spontaneous fermentation the amylose content was increase but the starch content was decrease. Amylose content increased from 13.56 ± 0.05 g/100g of starch (NPF) to 16.54 ± 0.53 g/100g of starch (FRPF). During fermentation debranching of amylopectin might occur and amylose with lower degree of polymerization (DP) was formed. Soto *et al* (2004) reported that the linear fragments of starch (amylose) can contributed to starch retrogradation and decreased the enzymatic susceptibility of starch.

Digestible starch

Rapidly digestible starch (RDS), slowly digestible starch (SDS) and resistant starch (RS) fractions are shown in the Table 2. RDS and SDS were calculated from the in vitro starch digestion at 30 and 120 min of enzymatic incubation respectively (Englyst *et al.*, 1992). The RDS was higher for the native plantain flour and significantly lower for all modified plantain flour. But the SDS was higher on fermented plantain flour. The result showed that spontaneous fermentation can reduce RDS but not for SDS.

Fermented-retrogradated plantain flour had the highest amount of RS than the others. Modification two cycles of autoclaving-cooling process could be able to increase the RS content significantly. RS content of native plantain flour (RS2) was 10.48 ± 0.06 g/100g of flour, while RS content of modified plantain flour (RS3) was 45.83 ± 0.96 g/100g of flour.

RS3 was formed by heating and cooling while RS2 was formed native starch granules and unstable if the granules were gelatinized by hydrothermal process. Autoclaving-cooling process can destroy the starch granular crystalline structure so decreased RS2 content. A high content of resistant starch was detected in the native plantain flour (30.4%), but the value decreased drastically after boiling the plantain flour (3.6%) (Ambriz *et al.*, 2008). Combination of debranching by using pullulanase with autoclaving processes (121 °C for 30 min) followed by cooling process (4°C for 24 h) can increase RS content of plantain starch up to six times (Soto *et al.*, 2007).

According to Goni *et al.* (1996), breakfast cereals have low (1-2.5%) to intermediate (2.5-5.0%) RS content depending on the process and processing conditions used. During extrusion cooking, high temperature and high shear forces cause increasing of the starch susceptibility to enzyme hydrolysis (Holm *et al.*, 1985). Other factors that explain the differences in RS quantities beside degree of starch gelatinization and particle size, are the type of cellular structure and the presence of other components such as dietary fiber and antinutrients (Rosin *et al.*, 2002).

A part of gelatinized starch is known to crystallize during storage, this phenomenon being faster at low temperatures, because the hydrogen bonds are strong in cool temperatures. The recrystallization conditions determine the crystal structure. Different retrogradation temperatures result in a significant polymorphism in starches isolated from corn, wheat and high amylose corn (Shamai *et al.*, 2003).

Glycemic index

Glycemic index of native and modified plantain flour are presented in Figure 1. Moderate GI were showed by native and fermented plantain flour. Juarez-Garcia *et al.* (2006) reported that unripe plantain flour is a starchy food that contains a high proportion of indigestible compounds such as resistant starch and non-starch polysaccharides, included in the dietary fiber content so the flour has moderate GI.

Retrogradated plantain flour (RPF) and retrogradated-fermented plantain flour (RPF), had low glycemic index than native or fermented plantain flour. The GI reduced from moderate (66) to low GI (46-52). This could be due to the fact that two cycles of autoclaving-cooling process could cause reducing of digestible starch and increasing RS content, thus making it resistant for amylase digestion and release of glucose into the bloodstream. This confirms the research of Frie *et al.* (2003) that storing rice in the refrigerator (4°C for 24 h) led to a reduction of the estimated glycemic index for all cultivars. Tahvonen *et al.* (2006) reported that cooling after cooking decreased the potato GI significantly.

According to Foster-Powell *et al.* (2002), the reasons for differing GI values of the same type of foods may be due to different processing methods, different testing methods of GI, different testing methods used for determining the digestible carbohydrate content of the test foods and inherent botanical differences. Roasting decreased the GI of unripe plantain flour from 65 to 57 (Ayodele and Erema, 2010). Astawan and Widowati (2011) reported that sweet potatoes showed low GI after frying process.

CONCLUSION

Modified plantain flour by retrogradation (two cycles of autoclaving-cooling) processes (RPF) and the combination of spontaneous fermentation with retrogradation process (FRPF) were able to reduce glycemic index of plantain flour. The modification process can increase the amount of resistant starch up to five times. RPF and FRPF can be suggested for dietary staples to control and reduce hyperglycemia of diabetic patient. More research is needed to evaluate functional properties of the modified plantain flour as the prebiotic candidate based on high resistant starch content.

ACKNOWLEDGMENTS

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REFERENCES

Ambriz, S.L.R., J.J.I. Hernandez, E.A. Acevedo, J. Tovar, L.A.B. Perez. (2008). Characterization of a fibre-rich powder prepared by liquefaction of unripe banana flour. *J Food Chem* 107: 1515–1521.

AOAC (1999). Official Methods of Analysis of AOAC International16th. USA

Astawan, M. dan S Widowati. 2011. Evaluation of nutrition and glycemic index of sweet potatoes and its appropriate processing to hypoglycemic foods. Indonesian Journal of Agricultural Science Vol 12 (1)

Ayodele, O.H., Erema, V.G. (2010). Glycemic indices of processed unripe plantain (*Musa paradisiaca*) meals. *African J Food Sci*. 4(8): 514 – 521.

Englyst H.N., Kingman S.M., Cummings J.H. (1992). Classification and measurement of nutritionally important starch fractions. *Eur J Clin Nutr* 46:S33–S50.

Foster-Powell, K., Holt, S.H.A., Brand-Miller, J.C., (2002). International table of glycemic index and glycemic load values. *American J Clinical Association* 76, 5–56.

Frei M, P Siddhuraju, K Becker. 2003. Studies on the in vitro starch digestibility and the glycemic index of six different indigenous rice cultivars from the Philippines. *J Food Chem* 83: 395–402.

Goni, I., L. Garcıa-Diaz, E. Manas, F. Saura-Calixto, (1996). Analysis of resistant starch. A method for food products. *J Food Chemistry*. 56:445–449.

Jenie, B.S.L., Widowati, S., Nurjannah, S., Nurhayati. (2009). Development of low glycemic and prebiotics properties banana flour products as functional foods. Report of National Strategic Research (Indonesian). Bogor Agricultural University.

Juarez-Garcia, E., Agama-Acevedo, E., Sayago-Ayerdi, S. G., Rodriguez-Ambriz, S. L., Bello-Perez, L. A. (2006). Composition, digestibility and application in breadmaking of banana flour. *J Plant Food for Human Nutrition*, 61, 131–137.

Ludwig, D.S. (2000). Dietary glycemic index and obesity. *J Nutr*. 130: 280–283.

Pascal G. (1996) Functional foods in the European Union. *J Nutr Rev*. 54:S29–32.

Roberfroid, M.B. (2000) Concepts and strategy of functional food science: the European Perspective. *Am J Clin Nutr*. 71:1660S–4S

Saguilan, A.A., S.G.S. Ayerdi, A.V. Torresa, J. Tovar, T.E.A. Oterb, L.A.B. Perez. (2007). Slowly digestible cookies prepared from resistant starch-rich lintnerized banana starch. *J Food Composition and Analysis*. 20:175–181

;hamai, K., Bianco-Peled, H., Shimonic, E. (2003). Polymorphism of resistant starch type III . *J Carbohy Polymers* 54, 363–369.

;lade, L., Levine, H. (1991). Beyond water activity. Recent advances based on an alternative approach to the assessment of food quality and safety. *Critical Review of Food Science and Nutrition* 30, 115–360.

;oto RAG, RM Escobedo, HH Sanchez, MS Rivera, LAB Perez. 2007. The influence of time and storage temperature on resistant starch formation from autoclaved debranched banana starch. *J Food Research Int* 40: 304–310.

Tahvonena, R., R.M. Hietanena, J. Sihvonena, E. Salminen. (2006) Influence of different processing methods on the glycemic index of potato (Nicola). *J Food Composition and Analysis*. 19: 372–378

Tribess, T.B., Hernandez-Uribe, J.P., Mendez-Montealvo, M.G.C., Menezes, E.W., Bello-Perez, L.A., Tadini. C.C. (2009). Thermal properties and resistant starch content of green banana flour (Musa cavendishii) produced at different drying conditions. *LWT-Food Science and Technology*. 42, 1022-1025.

Table 1. Chemical composition of native and modified plantain flour

Chemical Composition (%)	Plantain Flour			
	Native (NPF)	Fermentated (FPF)	Retrogradated (RPF)	Fermented-Retrogradated (FRPF)
Water[1]	5.03 ± 0.05^{d}	7.79 ± 0.03^{b}	6.72 ± 0.02^{c}	9.74 ± 0.03^{a}
Ash [2]	2.21 ± 0.05^{a}	1.77 ± 0.01^{c}	1.84 ± 0.04^{b}	1.67 ± 0.01^{d}
Fat [2]	1.02 ± 0.03^{a}	1.09 ± 0.03^{a}	1.07 ± 0.06^{a}	1.07 ± 0.04^{a}
Protein[2]	1.99 ± 0.03^{a}	1.89 ± 0.04^{a}	2.04 ± 0.06^{a}	1.86 ± 0.04^{a}
Carbohydrate[2]	88.75± 0.06^{a}	87.47 ± .030^{c}	88.32 ± 0.05^{b}	85.66 ± 0.03^{d}
Starch[2]	70.16 ± 0.12^{a}	69.79 ± 0.14^{b}	67.12 ± 0.86^{d}	67.67 ± 0.52^{c}
Amylose[3]	13.56 ± 0.05^{d}	15.44 ± 0.01^{b}	14.52 ± 0.01^{c}	16.54 ± 0.53^{a}

[1] wet basis
[2] dry basis
[3] dry basis based on starch
Values followed by the same letter in the same row are not significantly different ($P < 0.05$)

Table 2. Digestable starch of native and modified plantain flour

Chemical Composition (%)	Plantain Flour			
	Native (NPF)	Fermentated (FPF)	Retrogradated (RPF)	Fermented-Retrogradated (FRPF)
RDS*	38.15 ± 0.05^{a}	32.64 ± 0.16^{b}	21.53 ± 0.07^{c}	18.26 ± 0.33^{d}
SDS*	24.66± 0.01^{b}	32.80 ± 0.35^{a}	19.42 ± 0.14^{c}	18.39 ± 0.12^{d}
Resistant starch*	10.48 ± .06^{c}	6.24± 0.73^{d}	38.97 ± 0.32^{b}	45.83 ± 0.96^{a}

* dry basis based on starch
Values followed by the same letter in the same row are not significantly different ($P < 0.05$)

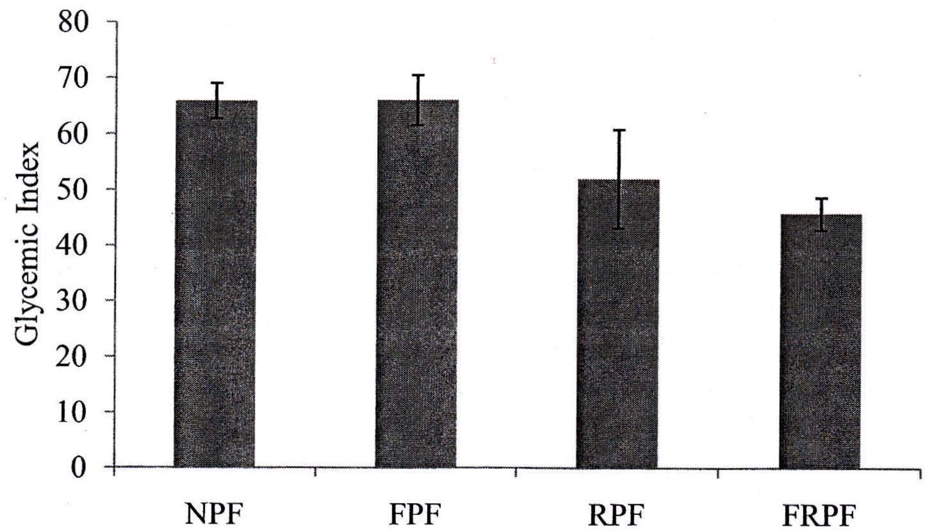

Figure 1. Glycemic index of native plantain flour (NPF), fermented plantain flour (FPF), retrogradated plantain flour (RPF) and fermented-retrogradated plantain flour (FRPF)