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Effect of Modification Methods on Gelatinization Properties and Colour Attributes of Kithul (*Caryotaurens*) Flour

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Abstract: ***The aim of the present study is to compare gelatinization properties and colour attributes of modified Kithul (Caryotaurens) flour with three different modification methods to find out the suitability as a new modified flour source for industrial use.Isolated flour was subjected to physical, chemical modifications to generate pre-gelatinized (PG), acid modified (AC) and dextrinized(DX) flour treatments. The colour attributes and thermal analysis of the native(RW) and modified flour were characterized. Results obtained revealed that Lightness (L*) was increased with following modifications than unmodified samples while redness(a*) and yellowness(b*) were reduced. Gelatinization initial temperature and enthalpy were significantly increased in DX flour treatment. All three modifications were significantly affected on gelatinization enthalpy with a comparison of RW flour samples. Finally, DX flour treatment provides most modified characteristics with highest thermal properties.***

Keywords: Kithul, (*Caryotaurens*), Modified flour, Functional properties, DSC, Gelatinization

1. Introduction

Starch is the most common organic compound on the Earth which as the main form of energy storage of fixed sunlight [1] through the photosynthesis by green plants. This polysaccharide which consists of amylose and amylopectin accumulate in starch granules (amyloplasts) in various parts in the tree such as fruits, tubers, roots and bark [2].Amylose and amylopectin play a key role of characteristics of the starch [2]. Starch is essential ingredient not only for food industry as bulking, thickening, gelling, binding agent [1] as well as stabilizer, edible film former [2], but also in pharmaceutical, textile [3], Cosmetics, plastics, adhesives and paper industries [1].Most commercial manufacturers overlook the Physico-chemical properties of comparative starches for their specific applications.However, existing few prominent starch sources could not fulfill high demand for industrial purposes [3]. Therefore, it is needed to be discovered newer, commercially viable starch sources.

Palms are a proper source for starch production which belongs to oldest families of plants on earth.Contemporary researchers pay their keen attention to discover novel sources of starch, which exist in the wild.Kithul (*Caryotaurens*) is a better response for this requirement, which is still kept as semi-wild species.This palm is native for India, Malaysia and Sri Lanka [4].

Albeit, the flour in native form presents some negative impacts in certain industrial applications[5]. Flour modification methods are often used to overcome these negative boundaries for wide applications in the industry not only food but also in textile, pharmaceuticals.

Starch modification is generally attained by altering hydrogen bond of amylose and amylopectin which are the main distinct polymer [6] componentsofstarch in a manageablemode as physical alteration or chemical degradation [7]. Pre-gelatinization (PG), Heat-Moisture treatment(HMT) and Annealing(ANN) are basicpractices of physical modifications [8] which have more attention in the industry due to free of chemical and easiness than other methods [9].

Acid modification realized by treatment of starch below its gel point in aqueous acid suspension [10] ,while Dextrination means to partial depolymerization which is achieved through hydrolysis and recombination of amylose and amylopectin [11].

The aim of the present study is to compare gelatinization properties and colour attribute of modified Kithul (*Caryotaurens*) flour with three different modification methods to find out the suitability as a new modified flour source for industrial use.

2. Materials and Methods

2.1 Sample Collection and Modification

Freshly prepared Kithul flour samples were used for following modifications and all were sifted through a 355µm sieve before further analysis.

2.1.1 Pre-gelatinized Modification (PG): This has done with slight modification of method of Knight,1969. A 1:1 flour solution (100g flour for 100ml deionized water)was incubated at 70°C for 5minutes.Gelatinized flour was dried in hot air dryer at 40 °C till moisture level dropped to 10% to 15 % [5].

2.1.2 Acidic Modification (AC): 50 ml of 0.1 M HCl solution was added to a mixture of 100g of flour and 50 ml of deionized water and mixed for 30 minutes. Then pH was adjusted to 7 with 1M NaOH.Neutralized flour was dried at

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room temperature (30°C) following washing and filtered through watchman(No:1) filter paper [12].

2.1.3 Dexrinized Modification (DX): 75g of flour mixed thoroughly with 60ml of 0.1M HCl.Then mixture was dried at 50°C for 24 hrs(Until moisture leveldropped to 5%).The dried flour again dissolved in 75ml deionized water and pH was adjusted to 7 by using 1M NaOH. Then flour was dried in hot air dryer at 40 °C till moisture level dropped to 10% to 15 % (Method of Caglarirmak and Cakmakli,1993 with Slight modifications)[12].

2.2Chroma meter Minolta (CR 400) colourimeter:

The instrumental measurement of Kithul flour colour was carried out with a Chroma meter Minolta CR-400 (Konica Minolta colourimeter, sensing, Japan) and the results were expressed in accordance with the CIELAB system.

The meter was calibrated with white tile (L* = 93.30, a* = 0.32 and b* 0.33). The samples were poured into glass dish (6.4 mm diameter diaphragm with an optical glass), with the surface of the sample was manually made flat and the measuring head of the meter was carefully placed on three different locations on the petri dish. The measurements were determined in triplicates and mean and standard deviations determined. The colour attributes were determined by colour coordinates of L^* (L^* = 0 [black] and L^* = 100 [white]), a^* ($-a^*$ = greenness and $+a^*$ = redness), and b^* ($-b^*$ = blueness and $+b^*$ = yellowness).

2.3Differential scanning calorimetry (DSC)

Thermograms for Kithul flour from tapped and non-tapped trees were taken by DSC (Model DSC TA instrument Q 200,USA).Flour was weighed on to the aluminium DSC pan and distilled water was added with micro syringe for 50% (w/w) mixture. Pan was sealed and allowed to stand for 1hr at room temperature. The scanning temperature range and heating rate were 30-140 °C and 5 °C/min, respectively, using empty pan as a reference . The onset temperature (To), peak temperature (Tp), conclusion temperature (Tc), and gelatinization enthalpy (ΔHG) were recorded.

2.4 Statistical Analysis: Results were analyzed using one-way analysis of variance (ANOVA) at 0.05 probability level with MINITAB software package (version 17 for Windows).

3. Results and Discussion

Table 1: Comparison of results on Colour attributes and DSC of Modified and Native Kithul flour Samples

Sample Name	Colour Attributes			DSC results			
	L*	a*	b*	T_o (°C)	T_P (°C)	T_C (°C)	ΔH (J/g)
RW	64.13± 0.40^c	6.37±0.24^a	14.56±0.34^a	68.69±0.24^c	78.73±0.29^b	92.79±0.24^a	13. 65±0.21^d
PG	66.48±0.23^a	5.53±0.21^b	12.72±0.19^b	69.93±0.09^b	79.54±0.19^a	90.77±0.25^b	14.38±0.19^c
AC	65.98±0.37^b	5.38±0.31^b	12.17±0.37^c	68.50±0.33^c	78.64±0.38^b	92.55±0.24^a	15.31±0.24^b
DX	66.31±0.33^{ab}	5.45±0.30^b	12.34±0.37^c	70.30±0.18^a	78.85±0.17^b	90.65±0.26^b	17.75 ±0.25^a
Gelatinization Temperature ; T_o=Initial T_P= Peak T_C = Conclusion ΔH=Enthalpy							
All Data are the average of three repetitions ± standard deviation. The values in a column followed by the same letter are not Statistically different at a significance level of 5%.							

The results of thermoanalytical analysis and colour attributes of native and modified Kithul flour shown in Table 1. The result obtained in colour attributes study showed that highest and lowest L* in PG (66.48) and RW(64.13) flour treatments respectively. However, the redness a* of flour samples were ranked as highest in RW(6.37) and no any significant difference showed among other treated samples. Though there was no any significant difference of yellowness (b*) among AC Modified and DX Kithul flour samples with lowest b* values, it could clearly identify significant increment in native Kithul(RW=14.56) flour among all the treatments.

A deeper study of the starch phase transitions is very important in food processing being it can be used to identify the molecular behavior of starch characteristics with temperature and moisture content.According to the previous studies the DSC thermogram which is represented the phase transition is distinctive to the botanical source of the starch by varying its properties such as granular structure and arrangement of polymers [13,14,15,16].

The gelatinization transitions of modified flour were shifted to higher enthalpy, compared to the untreated sample. It is possible that all treated samples had been partially gelatinized due to starch granule was unfolded and degraded during the modification. Highest initial gelatinization temperature was reported from DX flour treatment while highest peak temperature was raised from pre-gelatinized treatment. DX treatment showed maximum enthalpy as 17.75J/g, which was comparably higher 4.1J/g than untreated flour.

Figure 1 clearly shows the significant changes of gelatinization properties of DX flour treatment which is represented the deepest endothermic heat flow.

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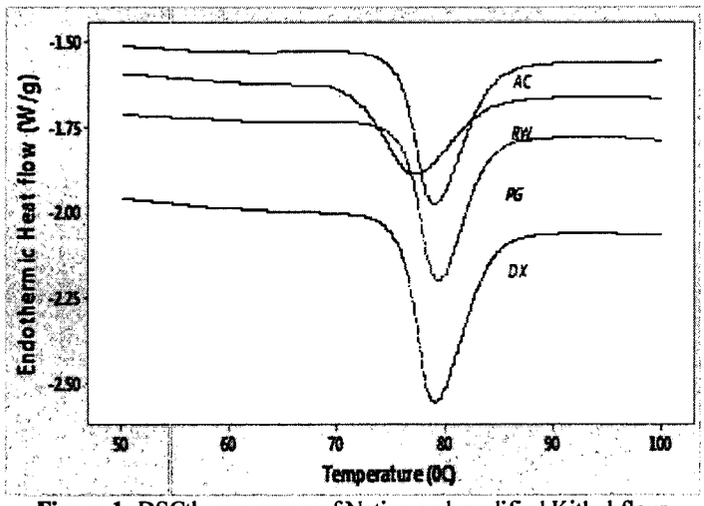

Figure 1: DSCthermograms of Native and modified Kithul flour

4. Conclusion and Further Work

Based on this study, it was clearly identified that used modification processes were effective in altering the characteristics of the Kithul (*Caryotaurens*) flour. L* of the flour was improved significantly in DX and PG flour treatments while a* and b* were decreased which could be more desirable in colour for industrial applications. Higher gelatinizing initial temperature and enthalpy were reported from Kithul flour treatment of DX with the comparison of thermographs of unmodified flour (RW) these all treatments were significantly affected by its structure. The DX modification of Kithul flour had the highest impact to its structure. Although chemical modification is not highly acceptable in the food industry, it will be useful to adjust pre-gelatinization than present treatment ,using somewhat higher temperature which is above the glass transition temperatureof native Kithul flour. However, these results provide clear evidence that DX, PG and AC flour treatments can be used as a deliberate working tool to operate the Kithul flour to meet specific needs with a view to effort expand application within the food industry.

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