国連大学生研究成果

Effects of heat moisture treatment on physical properties and textural quality of food products from Arenga and Sago starches

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Palm starch is important source of starch in Indonesia prepared from the pith of several genera of palm such as *Metroxylon* (spesies *Metroxylon Sago*) and *Arenga* (spesies *Arenga pinnata*). Characterization of sago starch from *Metroxylon sago* has been extensively studied, while information about arenga starch was very limited. Native starch usually has limited functional properties for certain processing such as dough development and textural quality. The physical modification such heat moisture treatment (HMT) is potential to improve the physicochemical properties of native starches. It is generally expected safer, less expensive and more ecological way than chemical modification. The objectives of research were (1) to compare some physical properties (rheological, gelling, thermal and swelling properties) of native arenga and sago starches and (2) to clarify the effects of HMT on physical properties of arenga and sago starches.

The results showed that amylose contents of arenga and sago starches were not significantly different at approximately 38%. Peak gelatinization temperature was also similar at approximately 67℃, but arenga starch showed a narrower range of gelatinization temperature than sago. The swelling power capacity of sago starch was higher than that of arenga. Arenga and sago starches at low concentrations showed shear thinning behavior, and sago formed more viscous sol than arenga. Based on frequency dependence of dynamic viscoelasticity, minimum concentration of sago starch for gel formation was 1.8% whereas that of arenga starch was 2.4%. At high concentrations, gel from arenga for gel formation starch was more rigid than that of sago. The breaking properties and texture profile of gels made from arenga and sago starches were also clearly different. Sago starch is more suitable as a thickener, while arenga starch is more suitable as gelling agent.

Optimum HMT for arenga and sago starches were determined at 120℃, 20% moisture content and heating time was 90 min and 60 min for arenga and sago starch, respectively. HMT altered all physical properties of native arenga and sago starches. HMT of starch shifted gelatinization curve to higher temperature and reduced gelatinization enthalpy. The minimum concentration for gel formation of HMT starches were increased to 4.2% and 4.5% for arenga and sago, respectively. Swelling power, pasting, rheological and textural properties of HMT starches were also significantly changed. HMT sago starch exhibited weak gel characteristics with narrow linear viscoelastic region. HMT promoted retrogradation in arenga and sago starches.

Both starches and the HMT modified samples showed different physicochemical characteristics, thus new utilization besides the traditional noodles and cakes is expected. The application of those starches for food processing is planned in the follow-up studies.

Enzymatic preparation of glycosides from free sugars

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Human milk oligosaccharides (HMOs) are important for the healthy growth of infants, since HMOs could act as the bifidus factor to obtain preferential bifidobacterial growth in intestine of breast-fed infants. The major components of HMOs are Type I sugars such as lacto-*N*-tetraose (Galβ1-3GlcNAcβ1-3Galβ1-4Glc, LNT), which contain lacto-*N*-triose II (GlcNAc β1-3Gal β 1-4 Glc, LNTri) structure at their non-reducing ends. The type I dominant composition of milk oligosaccharides is a specific feature of human milk, and not other mammals. We have tried to establish a practical enzymatic method to prepare LNTri in one pot. Finally we successfully prepared LNTri from lactose and UDP-GlcNAc using β1, 3-*N*-acetylglucosaminylt ransferase (GlcNAcT) coupled with a UDP-GlcNAc-regeneration system.

Biochemical approaches to evaluate the biological activity of legume seeds and other foods

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Legumes and nuts, besides their nutritional importance possess many bioactive phytochemicals, which may exert different health-promoting effects in reducing the risk of various oxidative stress-induced diseases. Alpha-glucosidase and pancreatic lipase are key enzymes involved in intestinal glucose and triglyceride absorption, respectively. Inhibition of these enzymes could be a key strategy in the control of hyperglycemia (diabetes) and heperlipidemia (obesity). Phenolic extracts of various legumes and nuts were evaluated for their antioxidant properties and inhibitory activities against α-glucosidase and pancreatic lipase. Mung bean seed coat which contains highest concentrations of phenolic compounds was found to be the most active scavenger of free radicals and also possess highest inhibition against α-glucosidase and lipase activities. Significant contribution from adzuki bean varieties and walnut were also noted in antioxidant capacities and enzyme inhibitory activities. HPLC analysis and identification of the active compounds indicated that C-glycosyl flavonoids, vitexin and isovitexin were the main contributors to the inhibitory activities of mung bean seed coat. However, vitexin, isovitexin and anthocyanins largely contributed to the bioactive functional properties of adzuki bean varieties. In addition, ellagic acid, gallic acid and flavan-3-ols, which are predominant in walnut showed higher inhibitory activities. Furthermore, results also demonstrated that the presence of glucose residue at 6 or 8 position of flavonoid A ring is more favorable for α-glucosidase inhibition and the hydroxyl substitution on B ring of anthocyanidins enhanced the inhibitory activity. In addition, the presence of galloyl moieties within the structure of flavan-3-ols was more responsible for α-glucosidase and lipase inhibitory activities. The results generated from this study may help to exploit the use of legumes and nuts as functional food ingredients for promoting health.

Study on Phytochemical of Extract from Thai Tropical Fruit and Its Byproduct

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Xanthone compounds in mangosteen (*Garcinia mangostana* Linn.) fruit have been reported to have biological activities such as antioxidant, anti-inflammatory and anticancer activities. The objectives of this research were to investigate qualitative and quantitative evaluation of xanthones in each part of mangosteen fruit and find effective method to prepare useful extract as food material which garantees high concentration of xanthones from mangosteen. Purification of the hexane extract of dried mangosteen peel was led to the isolation of two main xanthone compounds, α-mangostin and γ-mangostin which were separated by using silica gel column chromatography, and their structures were determined using NMR techniques. Quantitative evaluation of α-mangostin and γ-mangostin by using HPLC showed that extract from all parts of mangosteen fruit contained α-mangostin range from 2.05 to 382.24 and γ-mangostin range from 0.27 to 144.87 mg/g in solid base, respectively. The antioxidant activities were evaluated for ethanol extract of all parts in term of both DPPH and FRAP bioassay. Ethanol extract of yellow gum and dried peel of mangosteen showed high activity in these assays. The results from DPPH and FRAP assays showed that γ-mangostin was a major contributor to antioxidant capacities. The effective method to extract xanthone compounds from dried mangosteen peel in large scale was soaking and grinding method with 100 % ethanol, which gave 64 and 44 % recovery rate of α-mangostin and γ-mangostin, respectively. It was suggested that ethanol extract of mangosteen peel can be used for supplement or valuable material of processed foods.

Study of effective components of some vegetables in *Allium* on life-style disease

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This study using *in vitro* analysis provides insight about antioxidative activity and key enzymes relevant to hyperglycemia and obesity inhibitory effect of methanol extracts from seven *Allium* vegetables in relation to their total phenolic content, total flavonoid content and phenolic components.

The Onion Skin exhibited the highest 2, 2'-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging capability, followed with Onion Outer Layer, Chives Leaf and Garlic Chives. Total phenolics content in seven *Allium* vegetables ranged from 22.06 mg GAE/100g DW (Chinese Onion) to 983.18 mg GAE/100g DW (Onion Skin). Onion and Garlic Sprout, which have the higher total flavonoid content, the inhibitory activity of α-glucosidase were also at the higher level. Chives and Onion exhibited higher lipase inhibitory activities. Garlic which showed the very lower α-glucosidase inhibitory activity, was found a certain lipase inhibitory activity.

The effective phenolic components rutin, quercetin-3-D-glucoside, quercetin, kaempeferol, ferulic acid were quantified by HPLC with UV detector. Garlic is the only one that contained none of the flavonols (quercetin, rutin, kaempeferol, quercetin-3-D-glucoside). Onion skin are richer in quercetin (156.8 mg/kg DW) and kaempeferol (71.6 mg/kg DW), while Green Onion Leaf are richer in rutin (611.2 mg/kg DW) and ferulic acid (91.7 mg/kg DW). Garlic Sprout has the highest concentration of quercetin-3-D-glucoside with value of 145.1 mg/kg DW.

Onion, Green Onion, Chieves and Garlic Sprout may be recommended for their major potential functional properties.