

In Vitro Screening of Food Functionalities of Commonly Consumed Bangladeshi Vegetables and Rice

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Bangladesh is an agro based country. Vegetables that grow in Bangladesh serve as a major source of daily food in general. However, the potency of these everyday consumed vegetables in terms of antioxidant, antimutagenic, antitumor and antibacterial activity against pathogenic microbes and spoilage bacteria etc. has never been known. So attempts have been made to study above parameters taking twelve representative vegetables samples namely: red amaranth (*Amaranthus gangeticus*), spinach (*Spinacia oleracea*), coriander leaves (*Coriendum sativum*) cauliflower (*Brassica oleracea var botrytis*), green bringle (*Solanum melongena*), cabbage (*Brassica oleracea*), kolmi shak (*Ipomoea aquitica*), radish (*Raphanus sativus*), green banana (*Musa paradisiaca*), amaranth leaf (*Amaranthus viridis*), purple bringle (*Solanum melongena*), and mushroom (*Genoderma lucidium*).

H-ORAC activity was found to be in the range of 32.42 (green Banana) - 343.13 (kolmi shak) $\mu\text{mol TE (Trolox}^{\text{®}}\text{ equivalent)}/\text{g DW}$ (Dry weight). DPPH-RSA was 288.315(mushroom)-753.42 (kolmishak) $\mu\text{molTE}/\text{gDW}$. TPP was ranged from 36.12 (coriander leaf) to 328.91 (purple bringle) mg GAE (galic acid equivalent) /g DW. Kolmi shak showed highest antioxidant activity in terms of H-ORAC and DPPH-RSA. Correlation between H-ORAC & DPPH-RSA, HORAC & TPP, and DPPH & TPP were found to be 0.60, 0.09 and 0.03 respectively.

The DMSO extract of all these vegetables demonstrate antimutagenic effect on Trp-P2 induced mutagenicity to *Salmonella typhimurium* TA98 while tested with Perilla as standard. The anti-mutagenic activity demonstrated by all these vegetables showed wide range of variation with Red amaranth with highest activity (69.11 %) and Coriender leaves with lowest 6.76%.

The DMSO extract of Eggplant (green), Water spinach, Red amaranth and Eggplant (purple) showed highest anti tumor activities in P388 leukemia cell line. Six vegetables extract showed antibacterial activity against spoilage bacteria. Coriender leaves, showed maximum activity against three spoilage bacteria namely *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Bacillus subtilis*. Water Spinach's extract was found to be active against four pathogenic bacteria.

The physicochemical and pasting (rheological) properties between Bangladeshi traditional and high yielding variety (HYV) of Indica rice has been compared. 7 representatives of traditional indica parboiled rice namely Dudhkolom, Ashiana, Kajalsail, Dadkhani, kataribhog, Jalidhan and 7 high yielding varieties namely BRR22, BRRI23, BRRI28, BRRI 29, BRRI 31, BRRI40, BRRI 41 have been chosen based on their popularity and availability. The flour particle size obtained after grinding ranged from 204.05 μm (Ashiana)-311.85 μm (Magursail) for traditional variety and 224.87 μm (BRRI 31)-281.70 μm (BRRI 28) for HYVs. The overall hardness of the rice grain range from 262800 N/m² (Kataribhog)- 458200 N/m² (Magursail) for traditional varieties and 343800 N/m² (BRRI 29)- 461300 N/m² (BRRI 31) for HYV. In white index BRRI 22 has been found to be the most white rice grain among all fourteen varieties.

Amylose content (AC) ranged from 21.18 % (Kajal sail)-25.81% (Dudhkolom) for traditional variety and 22.16%

(BRRI 31)-30.37% (BRRI 22) for HYV. The protein content of traditional varieties lie between 6.09 % (Dudhkolom)-8.76% (Jolidhan) and that of HYV lied between 7.82 % (BRRI 41)- 9.09 %(BRRI 31). Gel consistency test reveal that all the varieties have soft gel consistency.

Rheological properties namely peak viscosity (PV), trough viscosity (TV), breakdown viscosity (BV), final viscosity (FV) and setback viscosity (SV) have been determined for all the 14 samples. It has been found that varietal differences cause significant difference in these parameters.

Thirty different free amino acids with variable amount have been detected in all the fourteen samples. Seven tasty amino acids (Ala, Gly, Gln, Glu, Asn,Thr, Asp) have been detected in all varieties. Kataribhog contain the highest amount of these tasty amino acid and Kajalsail the least. Different amount of Gamma amino butyric acid (GABA) has been found in all the varieties. BRRI 22 contain the highest (12.33mg/gm dry basis).

Quality Control of Food Material Using Ultra-Grinding Method

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Quality of rice bread prepared with different particle sizes of rice flour was studied to evaluate the effect of ultra-grinding method. *Japonica* (Koshihikari) and *Indica* (Rinks-nakate) rice varieties ground with hammer mill and jet mill methods were used to prepare bread samples at 20, 30 and 40% rice flours. The sample prepared from wheat flour was used as control sample. The results showed that increasing of rice flours caused decrease of expansion volume and increase of hardness characteristics. The bread substituted with jet-milled rice flours had the lowest volume in both of the rice varieties. Moreover, the texture values of all samples were increased with increase of storage time. The addition of water in the formula increased expansion volume and decreased hardness of bread samples. In the second experiment, the pretreatment of raw rice with cooking process was studied to improve bread quality. The bread samples substituted with cooked Koshihikarai and Khao Dawk Mali 105 (Jasmine rice) rice having different particle size resulted to the loaf volume and hardness values were improved. A suitable gelatinization process for making rice bread must be more studied in future years.

Practical Production of Oligosaccharides Employing Multiple-enzymes System

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There are many kinds of oligosaccharides which have important functions. The low quantity and difficulty to synthesis limited the utility value of such oligosaccharides. Fortunately, oligosaccharides could be synthesis or exploited by phosphorolytic enzymes (phosphorylase).

D-Galactosyl- β 1 \rightarrow 4-L-rhamnose phosphorylase (GRP) could produce Gal- β 1,3-Glc, which was a new oligosaccharides, from glucose and Gal-1-P. We named Gal- β 1,3-Glc as Novus-Lactose, because the structure of Lactose was Gal- β 1,4-Glc. The Novus-Lactose could be one important candidate Functional Oligosaccharide in food and health products due to its distinctive structure.

For the construction of the enzymatic procedure, it is important to establish a routine method to measure the enzymatic activity. We developed a protocol for the enzymatic colorimetric quantification of orthophosphate (Pi) using pyruvate oxidase and peroxidase. The following relationship was derived from linear regression with a correlation coefficient greater than 0.996: $y = 0.46x$ ($x = [\text{phosphate}]$ (mM); $y = \Delta\text{Abs}_{505}$). The calibration curve was not affected by the presence of labile phosphate esters. The method is capable for continuous monitoring of the reaction activity of GRP.

We have attempted the one-pot enzymatic synthesis of Novus-Lactose from sucrose employing multiple-enzymes system: sucrose phosphorylase (SP), UDP-glucose-hexose 1-phosphate urydylal transferase (GalT), UDP-glucose 4-epimerase (GalE), xylose isomerase (XI), and GRP (Fig.1).

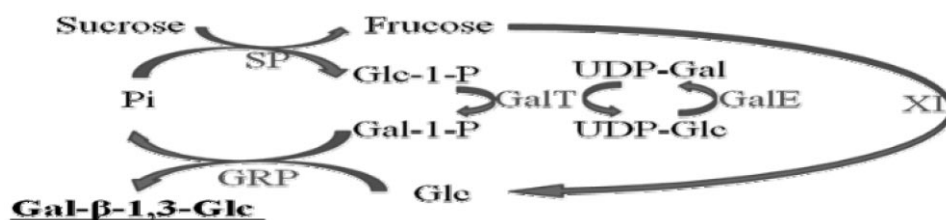


Fig.1 Multiple-enzymes system for synthesizing Gal- β -1,3-Glc

We initially fixed the concentrations of substrates and cofactors as 1.0 M Sucrose, 400 mM phosphate, 10 mM MgCl₂, and 1 mM UDPG. Then we fixed the concentration of GalT, GalE, XI, and GRP as optimum concentration 31.2, 81.2, 400, and 100 ($\mu\text{g}/\text{ml}$), respectively. We try to optimize the SP concentration and found it between 31.2 to 125 ($\mu\text{g}/\text{ml}$) The maximum concentration of Gal- β -1,3-Glc reached 322 mM in 14 d at 30 $^{\circ}\text{C}$ with SP, GalT, GalE, XI, and GRP at 25, 125, 325, 1600 and 400 ($\mu\text{g}/\text{ml}$), respectively.

CFD Analysis of Bubble Distribution in Non-Catalytic Reactor for Production of Biodiesel Fuel

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Biodiesel fuel is a biodegradable of diesel fuel that is produced through trans-esterification between vegetable oil and methanol. The non-catalytic biodiesel fuel production method called superheated methanol vapor in the bubble column reactor which is used in this research has advantage; no requiring purification before and after reaction, due to the not existing of catalyst, so both initial and running costs are to be reduced. However the reaction rate of biodiesel fuel production is still lower than other method (catalytic method). The previous studies noted that the contact surface between the methanol bubble and the oil acts as the limiting factor for enhancing the reaction rate. The contact surface area is influenced by the bubble size distribution, which in turn affected by the reactor design. Therefore, this study is devoted to the analysis of the bubble distribution in non catalytic reactor to increase the reaction rate of biodiesel fuel production using the Computational Fluid Dynamics (CFD) method. CFD can minimize the experimental design cost and time by simulating various experimental conditions to show a real phenomenon, with a reasonable accuracy and precision.

A transparent reactor using nitrogen and water system were used to verify the CFD modeling. By comparing this model with experiment result using high speed camera, it was found that 3D CFD modeling, turbulent flow and non-equilibrium wall function give the best similarity with experimental result. The result proves that the increase of inlet gas velocities increase the gas holdup and contact surface area significantly.

Based on the proper CFD modeling, ten scenarios of treatment and design of obstacle installed in the column reactor were simulated to find the highest contact surface area and reaction rate. Both of simulation and experimental result show that by utilizing of the obstacle in the reactor, contact surface between oil and methanol vapor increase and the reaction rate of biodiesel fuel production also increase by use of the obstacle. The CFD modeling represented well to describe the bubble behavior, and reaction rate was estimated by results of CFD.

Research Study of Nutritional and Healthy Functional Components of Vegetables and Fermented Traditional Foods of Mongolia and Japan

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The functional foods and supplements for human health are studied and developed using traditional food and ancient foods. Sometimes traditional foods are very important as source of function food, because there are many no-identified compounds in the foods. It is possible that Mongolian traditional foods also may have new functions for human health. Traditional Mongolian milk products can be classified as non-fermented and fermented milk products. Fermented milk products can be further sub-divided into products of lactic acid fermentation (Tarag, Khoormog, Byaslag, and Eezgiii) and products of lactic acid fermentation combined with alcoholic fermentation (Airag, Undaa, Arkhi, Aarts and Aaruul). We have focused on the 3 food functions, which were typical health functions and very important for human health. Therefore, angiotensin-converting enzyme (ACE) inhibitory activity, α -glucosidase inhibitory activity, and anti-oxidant activity of traditional daily products in Mongolian country area were assayed in this report. Furthermore these traditional daily products and vegetables were performed overall evaluation of food function for some human health points. Mongolia milk products were crushed and extracted with distilled water. The extracted samples were used for assays of anti-oxidant activity, α -glucosidase inhibitory activity, and ACE inhibitory activity. For identification of compound having ACE inhibitory activity in Mongolian dairy products, ultrafiltration and reverse-phase HPLC fractionation were performed. The relatively high active fraction was used as sample of mass spectrometry analysis. About ACE inhibitory activity of various traditional milk products, 12 Aaruul samples, 3 Eezgii, and 2 Byalag were used for ACE inhibitory activity. Highest group was Aaruul (mare), and Aaruul (cow) was almost same value. It seems that the difference is depend on fermentation process. So we tried to purify the active components in Aaruul (mare). Most active sample was selected from Aaruul (cow and mare) and also Eezgii (cow) group. And ultrafiltration and RP-HPLC were performed. At the HPLC, 8 peaks of inhibitory activity were detected in the chromatography fraction. One of the active fractions was selected and analyzed as active material for mass spectrometry. From result of electrospray ionization fourier transform ion cyclotron resonance mass spectrometry, 2 peaks of the sample were detected. In according to the molecular weight and another data, the 362.05 peak may be almost guanosine 5'-monophosphate (5'GMP), and 346.06 peak may be adenosine 5'-monophosphate (5'AMP). ACE inhibitory activity of 5'-monophosphate of various nucleotides was measured. It became clear that 5'GMP was weak inhibitor of ACE and Mongolian milk products contained the 5'GMP from these results. Generally mare milk is more condensed than other milk, cow, yak and sheep. And when Mongolian milk products were made, it needs to ferment for long time. These are the reason that the mare milk product has more active components than other daily products. This is the first report that 5'GMP is weak inhibitor of ACE. We used 10 kinds of milk products and vegetables for α -glucosidase inhibitory activity. Aaruul (camel and yak) and Camembert had no inhibitory activity of the α -glucosidase. On the other hand, intensity of sea buckhorn, which is a kind of goumi, was 0.343, and value of beetroot was height one 0.823 in used samples. It is known that there are large amount of sugar in beetroot. Therefore glucosidase activity may be interfered by the sugar. Anti-oxidant activity of Mongolian milk products and Mongolian vegetables was measured by lag-time method. Milk products including of Japanese products have almost same values (6.5 – 13.4 μ M Trolox eq.). However the vegetable was more active, especially beetroot had highest activity. It suggested that the high anti-oxidant activity of beetroot is derived from the vitamin C and betaine. We tried to overall estimation for health functions of Mongolian local milk products and local vegetable and fruit. It suppose that the overall estimation of functional food is one useful selection method and first trial in order to select effective foods for human health.