Journal of Advances in Science and Technology

Vol. VI, Issue No. XI, November-2013, ISSN 2230-9659

A STUDY ON BIOCHEMICAL IMPLICATIONS OF FOOD MICROBIOLOGY

AN INTERNATIONALLY INDEXED PEER REVIEWED & REFEREED JOURNAL

Journal of Advances in Science and Technology
Vol. VI, Issue No. XI, November-2013, ISSN 2230-9659

A Study on Biochemical Implications of Food Microbiology

Manurita

Abstract – Heat treatment is one among the common methods often adopted for food processing. Food materials containing carbohydrates along with proteins or amino acids on heat treatment tend to undergo a sort of darkening. This was first observed and recorded by Mallard. The colour change so observed, popularly known as Mallard Browning is a non-enzymatic Various studies have indicated that the browning reactions between sugars and amino acids or proteins affect the nutritional value of the food material. It has been established that browning brings down the availability of sugar and amino acid in food materials. Various aromatic, volatile, heterocyclic colored compounds have been reported as a result of the Mallard type browning reaction .Some of the Mail-lard reaction products are found to be flavor producing , some are antioxidants and some of them are reported to be mutagenic in nature. Some of the Mallard reaction products have also been found to be able to inhibit bacterial growth. The physiological, toxicological and nutritional aspects of various Mallard reaction products have been studied.

---------------------------♦-----------------------------

INTRODUCTION

It has been reported in the study of model systems of glucose and glycine that there was considerable decrease in the concentration of both glucose and glycine during heat-treatment. Sulphites and sulphur dioxide were found to inhibit the Mallard type browning reactions in food materials. The present work is designed to study the effect of temperature, concentration and duration of heat-treatment on model systems of glucose-lysine and glucose-glycine over an extended period of reaction.

Food materials of different classes were analysed and the contents of neutral detergent fibre, acid detergent fibre and the hemi-cellulose (NDF-ADF) were determined. Prolonged heating and overheating of food materials containing carbohydrates along with proteins during cooking by heat-treatment has been observed to affect the nutritive value of food materials by the Mallard type browning reaction. The influence of various conditions of food processing on this reaction has been studied.

During the process of screening of various types of food materials for determining the content of dietary fibre, it was found that food materials of plant origin such as grains, pulses, legumes, nuts, seeds, roots, tubers, condiments, spices and vegetables are potential rich sources of dietary fibre. Consumption of a fibre-rich food has been recommended in various human disorders. **A** variety of novel and rich natural sources of dietary fibre has been identified during the detailed screening of food materials for dietary fibre content. Some of the food materials such as peduncle, rhizome and inflorescence bud of banana plant which are only rarely consumed were identified as good sources of dietary fibre. Some of the other food materials rich in dietary fibre include ash gourd, rice-bran, wheat-bran, stem of elephant foot-yam, snake gourd, cucumber, different varieties of spinach, curry leaves, tamarind leaves and jack-fruit nuts. The Parboiling of paddy increased significantly the neutral detergent fibre content and hemi-cellulose content of rice. This establishes the superiority of parboiled rice over unprocessed rice. Whole wheat powder is found to be much superior to refined wheat flour in view of the fibre content. Wheat-bran and wheat-husk are good sources of dietary fibre and can be recommended as human dietary supplements after refining them properly. Parboiling of wheat did not produce any change in the fibre content.

All of the methods studied for the processing of jackfruit nuts did not make any change in their fibre content. There is a slight increase in the fibre content of ground nuts on frying. This increase may be due to the formation of non-volatile Mallard reaction products. Drying of ginger is an ideal processing method for its prolonged preservation since drying does not produce any decrease in the fibre-content. Natural ripening of fruits significantly reduced the neutral detergent fibre content. It may be due to the enzymatic degradation of the hemi-cellulose fraction of the fibre. But the changes in content of other nutrients such as vitamins and proteins should be considered during ripening for evaluation of the superiority of unripe fruits over ripe fruits for human consumption.

Mercury was observed to be present in different levels in all the food materials screened in the present work. Only a few food materials are found to contain mercury in amounts greater than 0.1 pm. Hence proper way of food processing are essential before human consumption to reduce the risk of contamination by mercury. The bile acid binding property of the dietary fibres from a vegetable source and an animal source was compared with that of a synthetic bile acid sequestering agent. In vitro study of the interaction of sodium cholate with the fibres - neutral detergent fibre from green gram and chitosan (a deacetylated fibre product of the fibre chitin of animal origin), under various conditions prevailing in the human intestine have shown that both of these fibres are capable of binding bile acids considerably in a pattern similar to that of choles-tyramine.

Hence food materials rich in such fibers are advisable as a bile acid sequestering agent. Even though the extent of binding of bile acid is less than that of equal weight of choles-tyramine, the natural fibre-rich food materials are strongly recommended for human consumption as they are better tolerated than synthetic drugs. Man is exposed to various forms and levels of toxic contaminants through the food. Mercury is a potential contaminant of foods. Mercury gains entry into the human body through the food materials of plant and animal origin.

RESEARCH METHODOLOGY:

Hydration of fibers occurs by adsorption of water to the surface of the macromolecules and by entrapment within the interstices of the fibrous or gel matrix. The presence of sugar residues with free polar groups confers a significant hydrophilic capacity to polysaccharides. But intermolecular binding such as the ether cross-links between chains of cellulose molecules has the opposite effect. Particle size is a factor affecting the water holding capacity s3-5s. Fermentation by colonic bacteria profoundly alters the capacity of the fibre for water absorptions. Viscous fibers such as guar and pectin reduce the rate of absorption of glucose , by the partitioning of water-soluble nutrients into the gel structure which reduces the rate of diffusion of glucose towards the absorptive mucosal surfaces.

Organic molecules such as bile acids, other steroids, various basic compounds and bacteria may reversibly bind to fibre as it passes along the gastrointestinal tract. The cation exchange property is due to the presence of free carbonyl groups on the sugar residues. The binding of calcium is based on the uronic acid content of fibre residues.

The acid detergent residue of food materials were determined by the method of Goering and Vanoestl'. In this method a weighed quantity of the food material that had been ground to pass through 1 mm sieve was placed in a Berzelius beaker for refluxing. Added a definite volume (100 ml for 1.0 g. of dry food material) of the acid detergent solution (a 2% solution of cetyletri methyl ammonium bromide (CTAB) in 1.0 N sulphuric acid) and decalin (2 ml per 100 ml of the mixture) to the sample and heated to boiling. The mixture was refluxed for one hour. The mixture was cooled, washed the residue with hot water cetone and finally with hexane. The residue was then collected and dried at 105 forenhieght hours and weighed as the acid detergent fibre residue of food material.

Mercury is omnipresent in the environment; in air, water and soil - naturally and by human activities. In industrialized as well as upcoming neo-industrialized nations, huge quantities of effluents containing mercury are being expelled by mercury based industries, thus contributing to the pollution of the environment.

Plants growing in an atmosphere contaminated with mercury may accumulate mercury in their various parts such as roots, stern, leaves and seeds. Agriculturists may use insecticides and pesticides containing mercury for better yield. Indiscriminate use of fungicides containing mercury for preservations of seeds and legumes is a common practice. Plants and seeds exposed to such a high level of mercury are often being fed to animals, thus passing on the toxicity to them and causing accumulation of mercury in their body parts .

Aquatic organisms also are exposed to toxicity by mercury from water, contaminated by mercury and quite often from regimented form of the toxic metal likely to be deposited at the beds of rivers and lakes. Human beings may be exposed to contamination of mercury through food materials of plant and animal origin. The maximum level of provisional tolerable weekly intake of total mercury has been fixed at 0.3 mg per person of 60 kg body weight, in which 0.1 mg is inorganic and 0.2 mg is organic mercury. Exceeding these limits could lead to physiological disorders and could even cause death.

MATERIALS AND METHODS

All of the chemicals used were of analytical reagent grade. The water used was double distilled with potassium permanganate. Standard solutions of glucose, lysine and glycine were prepared separately in water. Equal volumes of solutions of glucose and the amino acid were mixed in various test tubes and covered with glass balls. They were heated in a thermostatic hot air oven at a definite temperature for a definite period of time, simulating heat-treatment during food processing.

The tubes were withdrawn periodically and cooled to room temperature. The volumes were made upto the initial volume with water. The browning was measured at 420 nm in a spectrophotometer. The experiment was repeated by varying the concentrations of glucose and amino acid (lysine/glycine), temperature and time of incubation.

RESULTS AND DISCUSSION

At temperatures less than 100 ^{0}C, incubation of glucose with lysine or glycine for different time intervals did not produce any detectable browning as measured by the absorbance at 420 nm. At 100 incubation of 0.05 M glucose with equal volume of 0.05 M glycine or lysine resulted in a progressive increase of browning with increase of period of incubation.

At 100^{0}C of equal volumes of 0.5 M solutions of glucose and glycine also produced a progressive increase in browning with increase of time. At 110^{0}C incubation of 0.05 **M** glucose and 0.05 **M** lysine resulted in a general rise of absorbance at 420 nm till 1.75 hours followed by a gradual decrease in absorbance.

There is a general increase in the extent of browning with time in the model systems studied at 100^{0}C Incubation of solutions of glucose and amino acid at higher concentration caused a higher rate of browning reaction. The decrease in absorbance observed during the later stages of incubation at 110 may be due to the loss of volatile coloured products of the Maillard reaction. Hence it may be concluded that prolonged heating and overheating of foods may lead to loss of nutrients by Mallard browning.

Dietary fibre has been receiving much attention in recent years. It is not a single entity. Until recently the term 'crude fibre' was used to designate indigestible residue in foods. This is the residue of plant foods left after successive extractions with lipid solvent, dilute acid and alkali'. Crude fibre includes only a portion of cellulose, and lignin in foods. So the term 'dietary fibre' is used to represent the indigestible materials in foods. **A** more reliable definition of dietary fibre was given as 'dietary fibre consists of remnants of the plant cells resistant to hydrolysis by the alimentary enzymes of man'. Later this definition was modified to include hemi-cellulose, cellulose, lignums, pentose's, non-digestible oligosaccharides, pectin, gums and waxes.

These are mainly the structural components of plant cell. The plant gums and mucilage's are not cell wall components, but are formed in specialized secretory plant cells. The composition of fibre in the vegetable food material depends on the age, species and anatomical source of the material.

Dietary fibre includes polysaccharides and lignin. Polysaccharides in dietary fibre include cellulose and a diffuse group of substances such as hemi-cellulose, pectic substances, mucilages, gums and algal polysaccharides. Cellulose is a P-1, 4-linked polymer of glucose. It is insoluble in alkali'. Other polysaccharides include a large number of hetero-glycans which contain a mixture of pentoses, hexoses and uronic acids.

REFERENCES:

- MAILLARD, L.C.; C.R. Hebd. Seances ***Acad.*** *6,*154, 66-68.
- HODGE, J.E.; J. Agric. Food Chem., **1,** 928-943.
- SHALLENBERGER, R.S. and BIRCH, G.G.; Sugar Chemistry, Avi Publishing Company, Westport, CT, (1975), 169-198.
- PARTRICIA CERUTTI et al..; **J.** Food Sci., **50.**
- GRASSAM, G. KASHANI and GUY VALADON, L.R.; ***3,*** *Food* Technology, 19, 247-253.
- TSEN, C.C.; REDDY, P.R.K.; EL-SAMAHY, S.K. and GREHRKE, C.W.; *Rcs* amp. Ser., 215, 379-394.
- MILLER, RAYA and OLSON, KJELL; Pernemalm Per Aake - &t= - -Secon-d Se . k, B38(8). 689-694.
- YAMASHITTA NORIKO; DOIRA, HIROSHI: JAHAN NAZME and OMURA HIROSHISA; Nippon Eiyo, Shokuryo Gakkaishi, 36(3), (1983). 202-204.