# UTILISATION OF COCOA BY-PRODUCTS FOR FOODS AND FOOD INGREDIENTS

Azizah Abdul-Hamid and Fatimah Abu Bakar

*Faculty of Food Science and Biotechnology*
*Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia*

***Keywords:*** cocoa by-products, natural antioxidant, antimicrobial, functional ingredient, cocoa powder.

## Introduction

Cocoa is the third most important agricultural commodity after oil palm and rubber in Malaysia. With total production of approximately 155,000 tonnes of dried cocoa beans in 1994, Malaysia has emerged as the fifth largest cocoa producer of the world. However, this figure represented only 10% of the whole cocoa that was extracted and used commercially. The remaining pod material is wasted at different stages of processing in spite of considerable volume of literature on its utilisation. The need for commercial exploitation of cocoa by-products from waste has received serious attention in several cocoa-producing countries. At present, local uses of cocoa by-products are confined to livestock feeding and fertilising at farm level. Little research has been conducted to further process cocoa by-products into food ingredients, particularly as antioxidant and antimicrobial compounds. Therefore, this project aims to identify potential functional ingredients like antioxidant and antimicrobial agent in cocoa by-products.

## Materials and Methods

Three types of cocoa by-products were used, namely cocoa nib, cocoa powder and cocoa shell obtained from Kokomal, Teluk Intan, Malaysia. Microorganisms tested were obtained from culture collection of Food Microbiology Laboratory, UPM. Antioxidants and antimicrobial agents were extracted using a Soxhlet extractor utilising seven different types of solvents to provide for a wide range of polarity. Antioxidant activities were determined using a diene conjugation formation method. Antimicrobial activity was evaluated using paper disc method followed by determination of Minimum Inhibitory Concentratiion (MIC). The effects of pH and temperature on the antioxidative activities of the extracts were also determined. Phosphate-HCL buffer was used for pH 3 and 5, while phosphate-NaOH buffer was used for pH 7.9 and 11. The temperature studied was 30 to 90°C. Determination of amino acid was carried out using Pico-Tag Method. All experiments were carried out in triplicate. Statistical analyses were accomplished using Statistical Analysis System software utilising Duncan's Multiple comparison test. Level of significance used was at p=0.05.

## Results and Discussion

The project revealed that cocoa by-products contained several functional ingredients that have potential for commercialization, (Abdul-Hamid et al. 1997). Out of 42 extracts from six cocoa by-products that were tested, 12 extracts from three by-products exhibited high antioxidative activities. Methanol and methanol-residue extracts (residue of petroleum ether extract) showed the highest activity (Abdul-Hamid et al. 1999a). Three samples exhibited strong antioxidative activities, namely natural cocoa powder, cocoa nibs and cocoa shell. On the other hand, alkalised and alkalised red cocoa powder showed very little antioxidative activities.

In the characterisation study, it was found that the extracts were stable up to 50°C, after which the antioxidative activity started to drop significantly. In addition, the antioxidative activity was found to increase with increasing pH from 3 to 11, indicating strong dependence on the pH of the system. This suggested that the active component in the extract might be flavonoid in nature. In this study, three different types of cocoa powder have been shown to contain quercetin, epicatechin and rutin. Selected extracts of cocoa by-products caused variable degree of inhibition on growth of microorganisms tested. MICs of the selected extracts range from 6.25 to 50mg/ml for gram-positive strains and 12.5 to 50mg/ml for gram-negative bacteria. Yeasts were inhibited only at higher concentration of 25 to 50mg/ml while moulds were found to be most resistant to cocoa by-products extracts (Abdul-Hamid et al. 1999b). Based on the results obtained from kinetic of killing assay, the presence of acid (pH) and other unknown compound/s in cocoa powder contributed to antimicrobial activities of the by-products. pH seemed to have a killing effect towards *Eschericia coli 0157:H7* and bacteriostatic effect towards *Bacillus cereus*. On the other hand, unknown compound was seen to have bacteriostatic effect towards *Staphylococcus aureus*. Adding selected cocoa by-products extracts at predetermined concentrations reduced the relative growth of microorganism in pasteurised milk. Microbial growth inhibition of the extracts added to pasteurised milk was dose dependent. However, the range of concentrations of the extracts used was not enough to preserve pasteurised milk at room temperature. In addition, the project revealed that cocoa powder has high content of protein (23%) and evaluation of this protein showed that natural cocoa powder contained reasonably high quality protein with predicted biological value greater than 70.

## Conclusions

The study revealed that various cocoa by-products contained several functional ingredients that have potential for commercialisation, namely antioxidants, antimicrobial agents and reasonably high quality protein. Methanol proved to be the best solvent in extracting antioxidant and antimicrobial from cocoa by-products. The antioxidative activities were found to be stable at temperature below 50°C and exhibited highest activity at neutral and alkaline pH. The results showed that cocoa by-product extracts exhibited variable degree of inhibitory activity against microorganisms tested, with exception of petroleum ether and diethyl ether extracts whose activities were negligible.

## References

Abdul-Hamid, A., Nik Mustafa, N.R., Ghazali, Z. and Abu Bakar, F. 1997. Functional Ingredients Derived from Cocoa By-Products. Presented at 113C UK Conference on Functional Foods: Consumers, Regulation and Marketing Strategies to maintain market share., London

Abdul-Hamid, A., Nik Mustafa, N.R. and Thed, S.T. 1999a. Extraction and Characterization of Antioxidant from Cocoa By-Products. *Food Chemistry* 64:199-202 Presented at SFRR-ASIA/COSTAM/UNESCO-MCBN workshop on Biological Oxidants and Antioxidants: Molecular Mechanisms and Health Effects. Sept. 4-7, Penang. (1997).

Abdul-Hamid, A., Ghazali, Z. and Abu Bakar, F. 1999b. Screening for Compounds with Antimicrobial Activities in Cocoa by-Products. *Tropical Science* (Submitted) Presented at Malaysian International Cocoa Conference. Nov. 26-27, Kuala Lumpur (1998).

*Supported by IRPA Grant 01-02-04-0117*