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5283 / 2002 / 2182  
12/10/82  
10/10/82

STUDIES ON  
CURING OF COCOA AND COCOA WASTE

BY

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Thesis submitted in partial fulfilment of the  
requirements for the Degree of Master of  
Science, of the Faculty of Applied Science,  
University of Sri Jayewardenepura, Nugegoda,  
Sri Lanka.

January, 1982.

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ABSTRACT

This thesis covers chemical studies on the effect of maturity on selected chemical constituents of cocoa bean and its wastes, the utilization of cocoa endocarp, the utilization of cocoa pod pulp sweatings and the effect of maturation process (during curing) on the volatile carbonyls of cocoa beans. The work done in this thesis is characterised by the application of a large number of chemical analytical techniques.

The introduction describes the cocoa industry in Sri Lanka. The scope of the thesis is also described briefly in the introduction. In the literature review, the following are described briefly, the main chemical constituents of cocoa, the curing of cocoa, physical and chemical changes during fermentation and drying, more details on the cocoa industry in Sri Lanka, major products of cocoa industry and utilization of cocoa wastes.

The first part of the experimental work of this thesis describes the effect of maturity on selected chemical constituents of cocoa. The fat content of the bean increased remarkably during the final stages of maturation. The cocoa bean was found to contain six fatty acids (myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid) at all stages of maturity. Palmitic, stearic acid and oleic acid were the major fatty acids. The pectin content of the husk declined during maturity. The rate of decline was much higher in the endocarp than in the rest of the husk. The fully matured husk

contained 8.8 percent pectin while the endocarp contained 12.2 percent pectin. Study of the sugars of the pod pulp during development of cocoa fruit showed that mainly sucrose was present in the early stages. As maturation progressed sucrose content declined and glucose increased. Fructose was also detected during some stages of maturity. Alcohol content (produced from the sweatings after fermentation) increased with maturity especially in the last two weeks of development. The fully mature state resulted in the formation of nearly 10% alcohol. In unripe pods, methanol was also present in significant quantities.

The utilization of cocoa endocarp were studied extensively. The direct incorporation of cocoa endocarp in jam were investigated. The jams set well, but were highly coloured by a browning reaction giving a very poor appearance. To inhibit the browning reaction two mechanisms were employed: (i) heat inactivation by blanching and (ii) use of sodium metabisulphite. The jam prepared using treated endocarp pectin gave a suitable firm setting. No flavour changes were noted, but the jam had a slightly thicker texture in comparison to the standard product. The standard pectin jam and cocoa pectin jam were very similar in appearance, taste, colour and flavour. Some chemical parameters of cocoa endocarp and husk were studied.

The 3 general methods of isolating pectin were examined. In the alcoholic precipitation method solvent losses are inevitable and at a laboratory level 12.4% of the alcohol used was lost. In the  $\text{CaCl}_2$  method, the pectin extracted was of much lighter colour than the  $\text{AlCl}_3$  precipitated pectin. However, examination of the jelly arising from these two pectins show that  $\text{Al}^{3+}$  precipitated pectin set more rapidly and was lighter in colour; its viscosity was also much greater than the  $\text{CaCl}_2$  extracted pectin. The effect of blanching on pectin extraction was also investigated. It showed that during the blanching process about one percent of the pectin was lost but the quality of pectin isolated was far superior.

The utilization of cocoa pulp sweatings was studied on two different lines, directed towards (a) sugar derived products and (b) alcohol or an alcoholic beverage (by allowing the sugar to ferment naturally). In order to prevent the sugar from being fermented three methods of inhibition were tried out: (i) Valeria copallifera bark, (ii)  $\text{Ca(OH)}_2$  and (iii)  $\text{Na}_2\text{S}_2\text{O}_5$ . Results show that the sweatings were not a good starting material for preparation of sugar based products. The free amino acid content of the fresh and fermented pulp was found to be 96% and 1.1% mg respectively. Although 16 amino acids were detected in the fresh pulp, only 11 amino acids were found in the fermented pulp. The non-volatile organic acid present in the fresh and fermented pulp were also analysed. Results showed that depending on the treatment, the quantity of acid as well as the acidic constituents present varied. The studies on the effect of metals on cocoa bean and pulp showed that of the metals studied, aluminium posed the least problems. Field studies showed that sweating was nearly complete by 30 h and fermentation of sugar to alcohol began simultaneously with sweating. By the end of 18 h the sweatings contained the maximum amount of alcohol (11.7%). It is concluded that the best use of the sweatings is the conversion of the free sugars to alcohol.

The effect of the maturation process on volatile carbonyls of cocoa bean was investigated. The maturation process during curing increased total carbonyl content significantly. The major effects were the marked increase in butyraldehyde (combined, n and iso) content and the appearance of acetaldehyde and another carbonyl (probably nonanaldehyde). The  $\text{C}_5$  aldehyde concentration declined noticeably.

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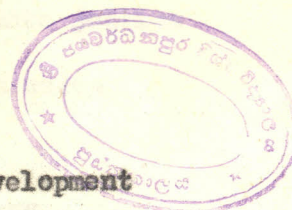
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