

## CHOCOLATE AND ITS EXOTIC COCOA FLAVOUR

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Chocolate, anybody knows, reveals a unique marvellous flavour, not existing in any other product. In the early 90th, a fruitful co-operation between the laboratory of plant physiology, Technical University of Braunschweig and Professor A.D. Shutov was initiated for several years. One special topic of my scientific interests is the physiology of useful tropical plants, especially cocoa (*Theobroma cacao* L.). Our interest was focused on the enzymatic degradation of the storage protein in cocoa seeds. During this short report, a summary of cocoa production shall be illustrated<sup>\*)</sup> and the significance of protein degradation for cocoa quality shall be explained.

"Raw cocoa beans" are produced in the tropics and are shipped to our industries for manufacturing chocolate. Arriving in the chocolate making plant, the beans are cleaned and the shells are removed. Subsequently the beans have to be roasted (at 120 – 130 °C), ground and rolled. The resulting viscous mass is used for both, cacao powder and chocolate. For manufacturing cocoa powder, fat, called "cocoa butter", is pressed off from this viscous mass. Cocoa beans contain 50 to 60 % of fat. Chocolate making starts with the viscous mass. An extra portion of cocoa butter and other ingredients are added depending on the recipe. A special process is applied, called "couching" on which the fine taste is said to be developed and the flavour is refined, coming from the tropical origin. Finally the liquid viscous mass is formed and is tempered.

What is the secret of this peculiar cocoa flavour? No else product exists revealing this characteristic note of cocoa flavour and taste. Although several processes during manufacturing affect the flavour, none of them would allow the typical flavour to occur, unless it was produced in the tropics during fermentation of the harvested cocoa seeds. The untreated seeds do not reveal any flavour. Thus, what happens during processing in the tropics? We have to consider the biology and the biochemistry of the cocoa fruits and seeds. In practice, the ripe cocoa fruits are harvested, opened, and the seeds, which are covered by a mucilaginous pulp, undergo a process of "fermentation" and drying. This important process in the tropics is under control of microorganisms which degrade the sweet, mucilaginous pulp. Decomposition products including acetic acid penetrate the seeds and induce post mortal reactions, which are essential for the formation of flavour. Our laboratory has studied this very complex process in Brasil, Ghana and Malaysia for understanding the special way of the formation of cocoa flavour. The important finding refers to the acidification of the seeds during fermentation. With strong acidity, no or very few cocoa flavour was found in the resulting raw cocoa beans. However, if nib acidification was moderate or low, strong cocoa flavour was found. So, we started analysing changes of seed constituents during fermentation, mainly proteolysis: The storage protein of cocoa seeds reveals the properties of a vicilin type globulin. This protein is degraded during germination but also during fermentation as soon as acetic acid penetrates the cotyledons and allows enzymes and substrate to react. An aspartic acid proteinase, splits at characteristic positions of the protein producing oligopeptides with hydrophobic ends. The pH-optimum is low at pH 3.5. A seryl-exopeptidase with its highest activity at pH 5.8 subsequently attacks these hydrophobic oligopeptides. Hydrophilic oligopeptides and hydrophobic amino acid are liberated. Cocoa flavour is found exclusively in raw cocoa beans after fermentation and drying which contain these hydrophilic oligopeptides and hydrophobic amino acid. The formation of basic cocoa flavour depends on how nib acidification proceeds and these two enzymes are allowed to act in the right sequence. The proteolysis in cocoa seeds in contrast to other seeds in detail was subject of co-operation with Professor Shutov.

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<sup>\*)</sup> Courtesy of Professor Reinhard Lieberei, University of Hamburg