

**Quality improved raw cocoa and cocoa-based products with  
flavour profiles on demand - From farm to chocolate bar  
(CocoaChain)**

**(CORNET)**

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<b>Industrial Branch:</b>	Confectionary Industry
<b>Duration:</b>	2016 – 2020
<b>Volume:</b>	€ 1.087.480,-- (total)

**Aim of the project:**

With 1,3 million tons per year, accounting for about 40 % of the total European production, Germany is one of the largest chocolate producers worldwide. The average European consumer ate 5,9 kg of chocolate in 2012. Germans

are the biggest consumers of chocolate in Europe with 11,7 kg per year and person. The key raw material in chocolate manufacturing are the seeds of the cocoa tree (*Theobroma cacao* L.). Peru, being one of the countries that cocoa is native of, has cocoa producing regions with

great genetic diversity and a strongly growing cocoa sector.

Especially for high quality dark chocolates cocoa of high sensory quality is required. The sensory quality of cocoa mainly depends on the cocoa tree genotypes planted and the post-harvest processing (i.e. fermentation and drying). During the latter the precursors of chocolate flavor are developed and the amount of bitter tasting components is reduced. Aberration in post-harvest process may result in off-flavor formation and mycotoxin contamination of the cocoa beans. Nevertheless, cocoa production still relies on an uncontrolled, spontaneous fermentation process, which does not permit proper process control. This spontaneous fermentation process is one of the main reasons for unsatisfactory great heterogeneity of cocoa and for frequent complaints on sensory attributes. In addition, in the last years the global cocoa production did not meet the manufacturers demand several times and deficits of up to 300.000 tons (2006/2007) occurred.

Because of these circumstances, chocolate manufacturers encounter increasing problems with the sourcing of cocoa with high and stable sensory quality. At the same time, cocoas with distinct flavor profiles, not contaminated by mycotoxins and from traceable origins gain more and more importance - in particular for small and medium enterprises.

Cocoa flavor is multi-dimensional. Beside the typical cocoa aroma, bitter and sour, floral, fruity and nutty notes may occur. Characteristic is also the astringency. The potential to develop specific flavor notes mainly depends on the genetic background of the cocoa trees. However, depending on the climatic conditions flavor intensity may vary. During fermentation and drying bitterness and astringency are decreased. In contrast, cocoa aroma intensity increases and may finally overlay fruity, floral and nutty notes. Through application of adapted fermentation and drying protocols distinct aspects of the flavor potential may be emphasized. Hereby, cocoas with distinct flavor profiles may be produced from one and the same starting material. The course of fermentation and thus also the development of the biochemical and the sensory profile strongly depends on the physiological status of the cocoa seeds. Besides seed endogenous substances, apparently also compounds from the fruit pulp may contribute to the biochemical and sensory

profile of cocoa seeds. The respective substances are produced in the fruit pulp during fruit ripening but, may also be formed by yeast strains during fermentation. The impact and in particular the interplay of the mentioned factors on the development of specific biochemical and sensory profiles is not fully understood. The potential contamination of cocoa with mycotoxins, especially with ochratoxin A, apparently mainly results from aberration during fermentation and drying permitting the establishment of the respective fungi.

Aim of the project is to establish a model processing chain, comprising all processing steps from the field to the final chocolate product („From Farm to Chocolate Bar“) will be. Within this chain, impact and interplay of cultivation conditions, cocoa genotype, cocoa seed physiology, fruit pulp, fermentation with selected starter cultures and drying on biochemical and sensory profile development in cocoa and chocolate are studied exemplarily.

#### Economic impact:

The German confectionary industry generates sales of approximately 12,5 billion € per year. A total export volume of 3,3 billion € made Germany the largest exporter of chocolates in 2011. The number of employees is more than 50.000. The German Confectionary Industry is strongly embossed by small and medium enterprises (SME) and the market for high quality chocolates produced by small and medium enterprises is highly developed.

The essential basis for high quality dark chocolates is cocoa of high and stable sensory quality. Based on the project results an optimized processing protocol (handbook) for cocoa will be provided. Application of the protocol will permit to obtain specific and distinct flavor profiles („Flavor on Demand“). The production of cocoa with manufacturer-specific flavor profile and quality assures the availability of raw materials for already existing products. Moreover, it provides new options for product innovation. NIRS, MIRS and chromatography-based quick methods are implemented for verification of this specific quality after each of the processing steps. Hereby, new options for quality assurance are provided. A strategy for minimization of mycotoxin contamination through starter culture-based stabilization of the fermentation process increases product safety. Finally,

recommendations based on the model processing chain, will permit improved access to the origin and will hereby contribute to the stabilization of the value added chain.

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