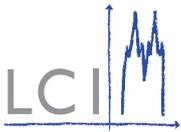


# Alkaloids: Theobromine and Caffeine

Theobromine and caffeine represent 99% of the alkaloids to be found in cocoa varieties. Recently it has been shown that the correlation between these two alkaloids may allow conclusions to be drawn about the origin and quality of cocoa.



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## The term alkaloid

The term "alkaloid" is comprised of the Arabian word al-qalya ("plant ash") and the Greek -oides ("similar to") and describes organic, nitrogen-containing compounds of natural origin with more or less distinctively alkaline properties. The term "alkaloid" was first proposed by W. Meissner in 1819. He defined alkaloids as alkaline-reacting plant substances. In subsequent decades this

this are atropine and scopolamine, which have been detected in nightshades (i.e. Solanaceae). By contrast, there are also alkaloids, such as nicotine, which occur in very distantly related plant families. Alkaloids can form and accumulate in different parts of plants.

It is still largely unknown why plants produce alkaloids. They are not life-essential compounds for the plants themselves;

## Cocoa-relevant alkaloids

The alkaloids to be found in cocoa (*Theobroma cacao* L.) are 99% comprised of theobromine and caffeine, where the caffeine content in cocoa averagely comes to only a tenth of the theobromine content level.

Both alkaloids – like theophylline in green tea – belong to the group of methylxanthines and differ only in terms of the number and position of their methyl groups. These compounds are water-soluble substances and have a slightly bitter taste. Cocoa, as opposed to coffee, has only a low stimulant effect since its caffeine content level is significantly lower. A recently conducted LCI project has shown that the ratio of theobromine to caffeine (T/C ratio) allows conclusions to be drawn about the origin and quality of the respective cocoa in question. In the case of single-variety chocolates it can thus be determined whether a product is made of fine cocoa or bulk cocoa (cf. Fig. 1) [1].

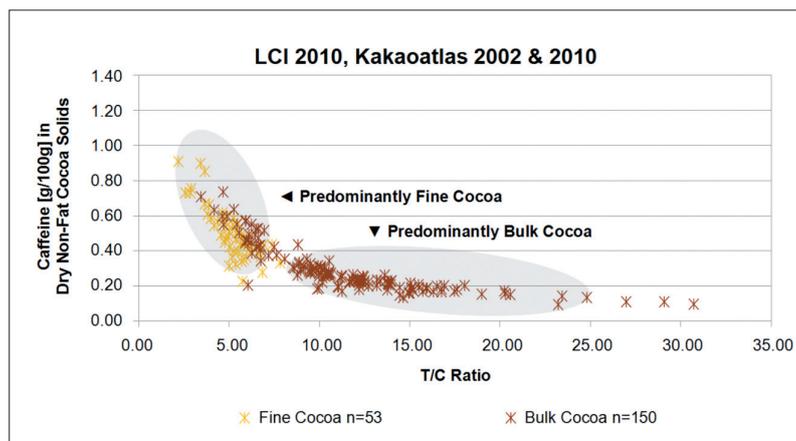


Fig. 1 T/C ratios, calculated from the LCI results and the Cocoa Atlas results for 2002 & 2010 [2, 3]

explanation of the term was modified and changed in many ways. The nomenclature of alkaloids is often described using trivial names, often derived from the systematic names of the plants from which they were first extracted. Another way for naming them is to use the systematic IUPAC nomenclature.

## A diverse group of substances

According to rough estimates, there are around 10,000 different alkaloids. They have been isolated not only from higher plants but are also to be found in microorganisms, fungi, and animals such as salamanders, toads, and fishes. One often finds structurally related alkaloids in closely related plants. An example of

alkaloid-free forms can meanwhile be cultivated. And yet the alkaloids in some plants serve as an effective animal and insect repellent or as a precursor to nicotinic acid which, in the form of NAD, is a coenzyme contributing to numerous redox reactions in cell metabolism.

Alkaloids are important for the human body in many diverse ways. On the one hand, many alkaloids have a toxic impact on the human body (e.g. solanine). On the other hand, certain alkaloids are also used for their stimulant effect, such as the caffeine contained in coffee, cocoa, or guarana. Alkaloids are also used abusively in the form of drugs such as morphine, cocaine, or hallucinogenic lysergic acid derivatives.

The LCI uses a high performance chromatographical (HPLC) method for determining theobromine and caffeine content levels in cocoa and cocoa products. Detection is subsequently carried out using a UV detector. This method makes theobromine and caffeine selectively quantifiable and not, as in the case of photometric methods, only determinable as a sum total of methylxanthine derivatives. The caffeine and theobromine levels are seen as a basis for assessing the origin and quality of the cocoa content of cocoa-containing products.

## References

- [1] Raters, M. et al. (2013) *Lebensmittelchemie* 67: 165
- [2] Lieberei, R. et al. (2010) "Kakaoatlas 2010"
- [3] Lieberei, R. et al. (2002) "Kakaoatlas 2002"