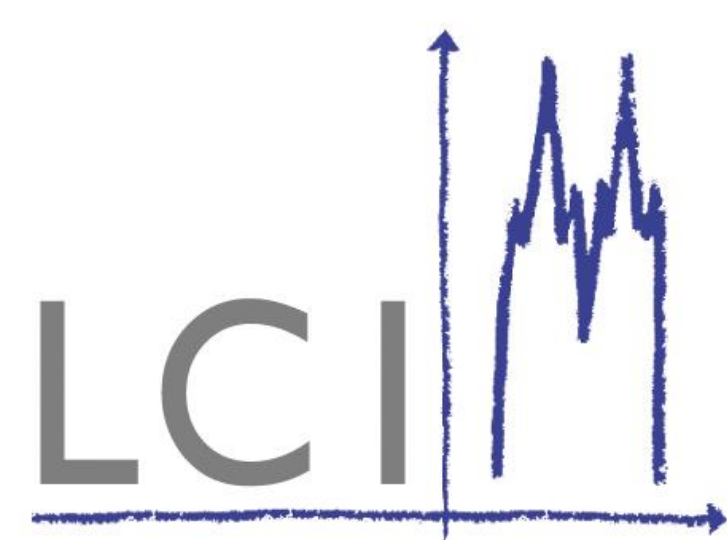


FINE FLAVOUR OR BULK COCOA?

A Classification on the basis of the T/C Ratio

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Background

The last few years have seen a rise in market offerings of single-variety fine flavour chocolate, i.e. chocolate with a cocoa content level of over 50%. Since the market share of expensive fine flavour cocoa is only 5%, it is of great interest to establish whether the cocoa used for such products consists exclusively of fine flavour cocoa or has been mixed with bulk varieties.

In two research projects conducted within the scope of producing the Cocoa Atlas and in an LCI project, a total of 451 cocoa kernels of various origin were tested for their methylxanthine (MeX) content levels. Differences in MeX content levels were shown to depend on the region of origin. In examining the individual methylxanthine content levels of theobromine (T) and caffeine (C) as well as the T/C ratio, differences depending on region of origin again became visible, allowing conclusions to be drawn about the quality of the cocoa.



Fine Flavour Cocoa – Legal Definition



“Cocoa recognized for its unique flavour and colour, and produced in countries designated in annex C of this Agreement.” [1]

Growing regions for fine flavour cocoa (shown in yellow):

Costa Rica, Dominica, Dominican Republic, Ecuador, Grenada, Indonesia, Jamaica, Colombia, Madagascar, Papua New Guinea, Peru, Saint Lucia, Sao Tomé & Príncipe, Trinidad & Tobago, Venezuela

To allow for a better comparison, the growing regions for bulk cocoa are shown in brown.

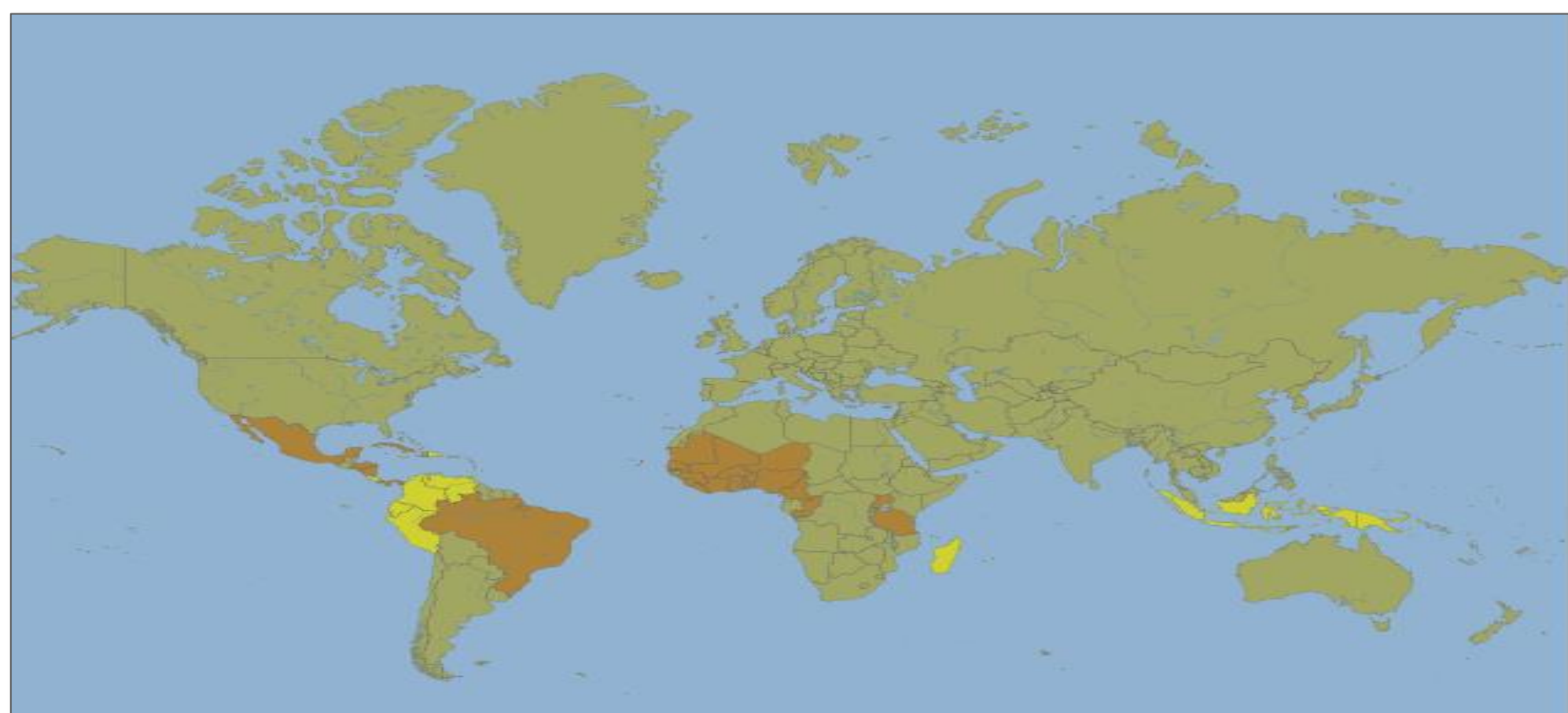


Fig. 1: growing regions for fine flavour and bulk cocoa

Fine Flavour Cocoa and Chocolate

The Criollo, Nacional, and Trinitario varieties are termed **fine flavour cocoas**. Criollo (of local origin) is cocoa in its most original and unadulterated form, whereas Trinitario is a hybrid of Criollo and the widely grown bulk cocoa Forastero. Diagram 2 shows the diverse external differences of the individual cocoa varieties.

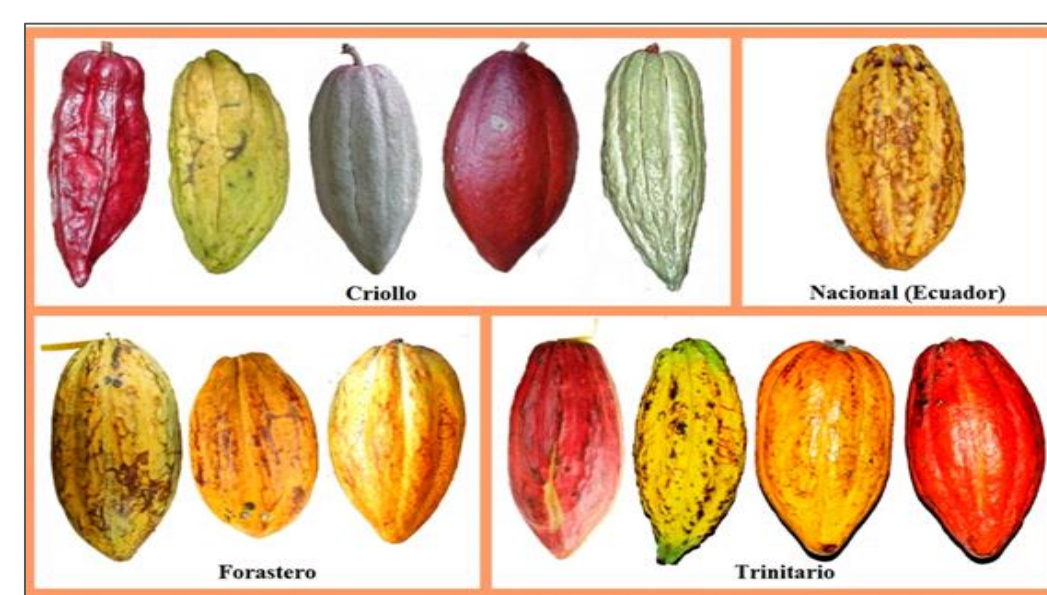


Fig. 2: cocoa varieties (Cocoa Atlas 2010)

Fine flavour chocolate is understood to be chocolate whose cocoa mass contains at least 40% of fine flavour cocoa. Basically speaking, chocolate containing 100% fine flavour cocoa is seldom produced. Fine flavour cocoas are frequently mixed with bulk cocoa varieties during the manufacture of chocolate [1].

Conclusion

Within the scope of our research work (LCI 2010), the T/C ratios of a total of 203 cocoa kernel samples (150 bulk cocoa varieties, 53 fine flavour cocoa varieties) were established and plotted against the corresponding caffeine content levels. As expected and as known from previous literature [8], our calculations showed significant differences in the T/C ratios of fine flavour and bulk cocoa varieties. The bulk cocoas had a median T/C ratio of 9.86 (range: 3.44-30.72) whereas the fine flavour cocoas had a ratio of 4.98 (range: 2.20-11.05). The ratios calculated in the Cocoa Atlas projects 2002 and 2010 lay within a similar and very comparable range.

Hence it can be said that the T/C ratio only really says anything about the origin of a cocoa if the cocoa in question was produced from only a single cocoa variety. If the chocolate in question is a mixed product, its origin cannot be clearly determined. Nevertheless the T/C ratio provides a good way of estimating whether “fine flavour or bulk cocoa” has been used.

Results

In comparison to bulk cocoas, fine flavour cocoas tend to have lower theobromine levels yet higher caffeine levels [2-5]. A possible explanation of this is the permeation of theobromine within the course of fermentation. Since Criollos usually undergo fermentation for only 3 days, compared to 7 days for bulk cocoas, this results in higher theobromine content levels in Forasteros [6]. The assays for determining the content levels of MeX, fat, and water conducted within the course of the LCI project and the analyses made within the course of producing the Cocoa Atlas for 2002 and 2010 were carried out using the same methods for the purpose of improving the reproducibility of the analysis results [7]. The MeX content levels were standardised to the dry non-fat cocoa solids (Table 1).

Calculation of the **theobromine/caffeine ratio** (T/C ratio) (Table 1) produces a lower ratio for fine flavour cocoas and a higher one for Forasteros. Trinitario cocoa, a hybrid, lies in the middle range.

Table 1: analysis results and calculated T/C ratios

	Cocoa type	Number n	Theobromine in dry non-fat cocoa solids Mean [g/100g]	Caffeine in dry non-fat cocoa solids Mean [g/100g]	T/C Ratio	Range of T/C Ratios
LCI 2010	Fine flavour cocoa	53	2.44	0.49	4.98	2.20-11.05
	Bulk cocoa	150	2.86	0.29	9.86	3.44-30.72
Cocoa Atlas 2002	Fine flavour cocoa	46	2.47	0.5	5.69	2.64-9.45
	Bulk cocoa	70	3.01	0.25	13.53	6.39-26.67
Cocoa Atlas 2010	Fine flavour cocoa	60	2.65	0.54	5.93	2.61-10.77
	Bulk cocoa	72	2.96	0.35	9.76	3.14-23.48
Total	Fine flavour cocoa	186	2.57	0.51	5.69	2.48-10.42
	Bulk cocoa	266	2.93	0.29	11.77	4.32-26.96
Sum total		451				

If the T/C ratios are plotted against the usually relatively constant caffeine content levels, this produces the characteristically hyperbolic curves we see in diagrams 3 and 4. The fine flavour cocoas (yellow) are plotted more in the upper area of the hyperbolic curve whereas the bulk cocoas (brown) are plotted more in the lower area.

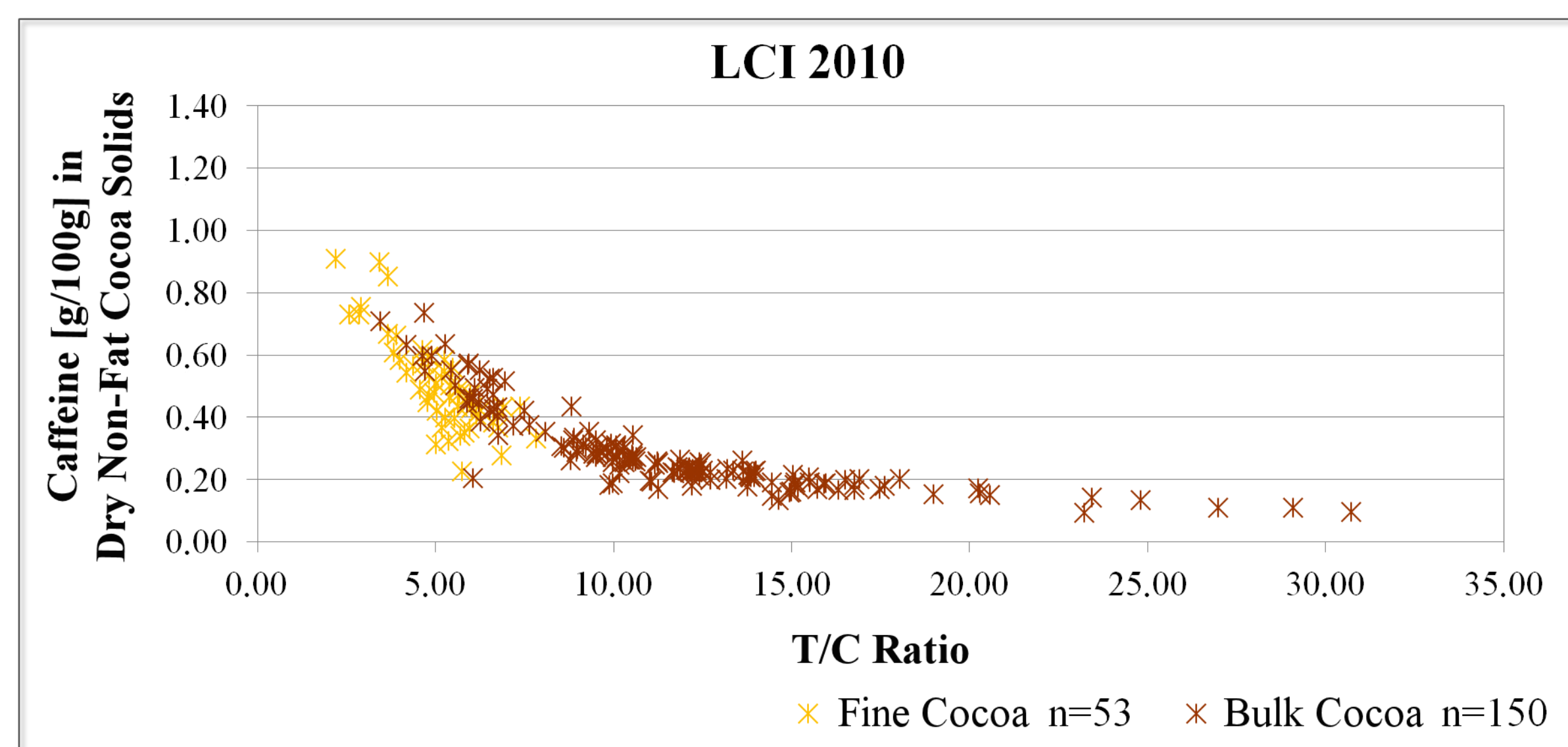


Fig. 3: T/C ratios calculated from the LCI results

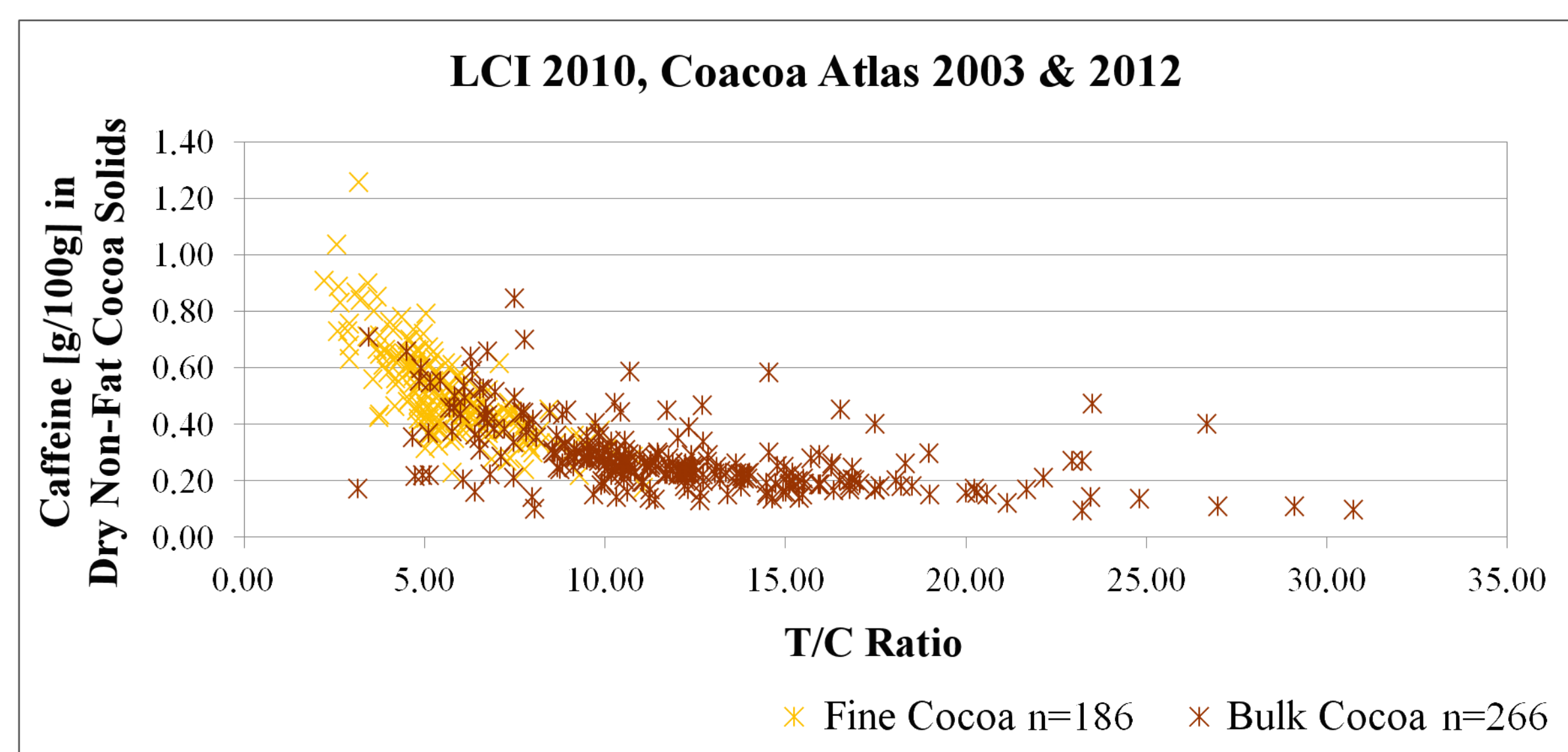


Fig. 4: T/C ratios calculated from the LCI results and the Cocoa Atlas results for 2002 & 2010

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