

Effect of Post-harvest Treatments On The Occurrence of Polycyclic Aromatic Hydrocarbon (PAHs) In Cocoa Beans Sourced From Côte d'Ivoire



Didier-Axel Sess-Tchotch^a, Tagro Simplicie Guehi^a, Maï Koumba Koné^a, Angélique Fontana-Tachon^b, Noël Durand^b, Joël Grabulos^b, Renaud Boulanger^b, Didier Montet^b

^a Department of Food Science and Technology, University of Nangui Abrogoua, 02 Bp 801 Abidjan 02, Côte d'Ivoire ^b UMR Qualisud, CIRAD - TA-B 95/16, 73 rue JF Breton, 34398 Montpellier Cedex 5, France

Corresponding author: didaxel@yahoo.fr



PAH occurrence in raw cocoa and derivative products is more and more worrying for the health of chocolate consumers. Consequently, European Union has fixed PAH maximal content in cocoa products by EU Standards 835/2011 and 2015/1933. Present research dealt with the impact of post-harvest treatments on PAHs formation in raw cocoa.

Material and Methods

Raw cocoa sampling

Ivorian first generation of hybrids (Amelonado × West African Trinitario) variety cocoa pods harvested at Akoupe (Côte d'Ivoire) from traditional plantation in 2014 and 2015 (Figure 1) were used to constitute 370 cocoa samples in controlled conditions: health state of pods, fermentation methods, drying supports, storage conditions and time (Figure 2).



Figure 1. Cocoa producing and sampling

PAHs contents measurement

PAHs contents of cocoa were determined using an optimized and validated method based on stirred saponification of 1 g of cocoa butter for 1 hour in 6 mL of KOH, 1 M at 80°C. Benzo (a) anthracene (BaA); Chrysene (Chr), Benzo (a) Pyrene (BaP), Benzo (b) Fluoranthene (BbF) were then identified and quantified by HPLC-Fluorescence and content of sum of the four PAHs (PHA4).

Results

- PAH4 content of raw cocoa resulted from good post-harvest treatments and drying practices is about 5 - 6 $\mu\text{g.kg}^{-1}$ of cocoa butter (Figure 3).
- PAH4 content of raw cocoa stored for 28 days (Figure 3):
 - Traditional warehouse is ranged 5.6 - 8 $\mu\text{g.kg}^{-1}$ of cocoa butter.
 - Traditional kitchen (with wood smoke) reaches 35-39 $\mu\text{g.kg}^{-1}$ of cocoa butter slightly up EU standard 835/2011.
- Artificial dried cocoa in the presence of wood smoke recorded the highest PAH4 content reaching 142.05 $\mu\text{g.kg}^{-1}$ of cocoa butter while natural dried cocoa presented the lowest content (Figure 4).
- Sun or natural drying cocoa method is appropriated to limit PAH occurrence, however artificial drying method specifically in the presence of wood smoke promotes contamination 3 to 4 times higher than the European standard (30 $\mu\text{g.kg}^{-1}$ of cocoa butter) (Figure 4).

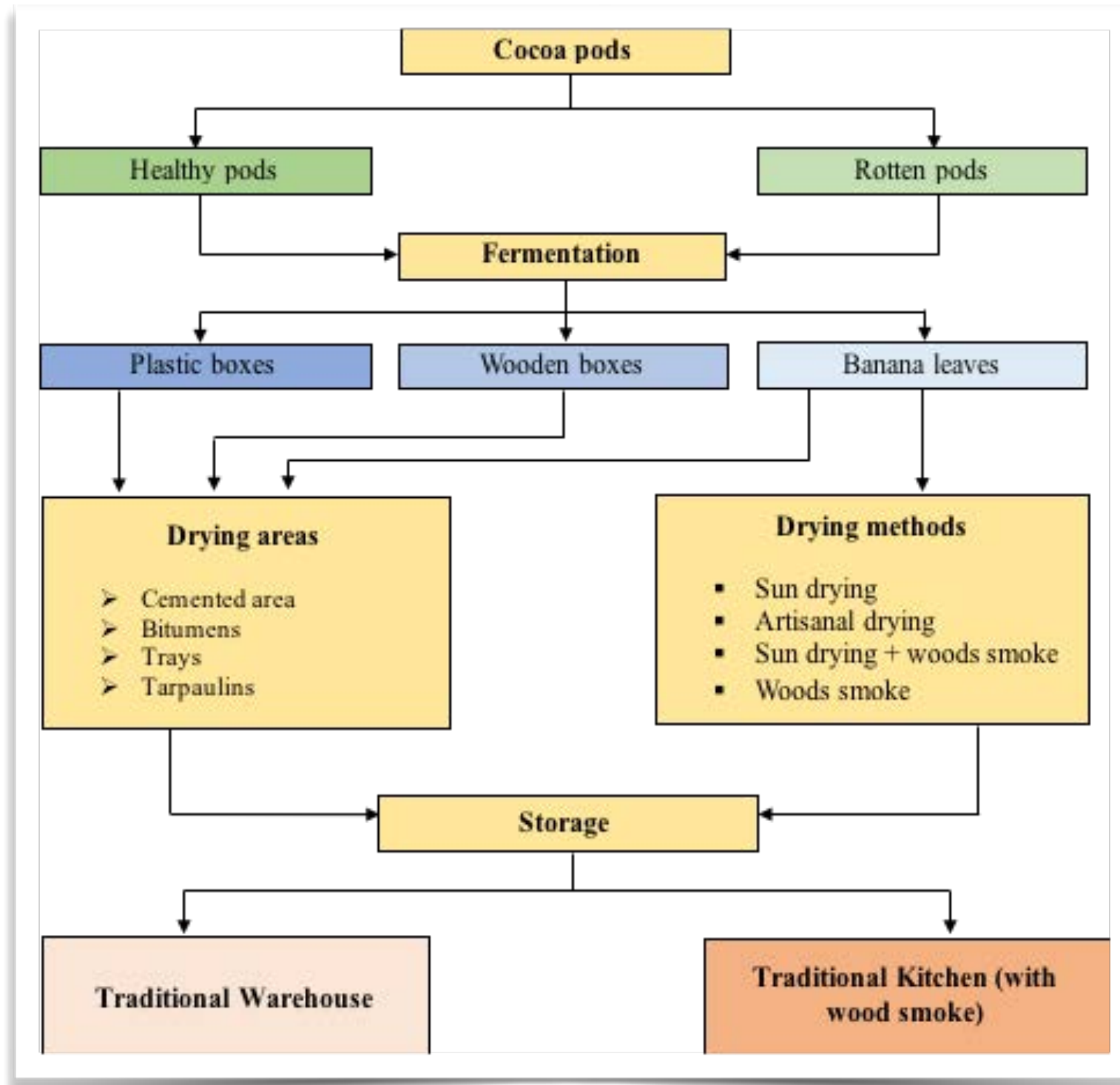


Figure 2. Diagram of cocoa beans sampling

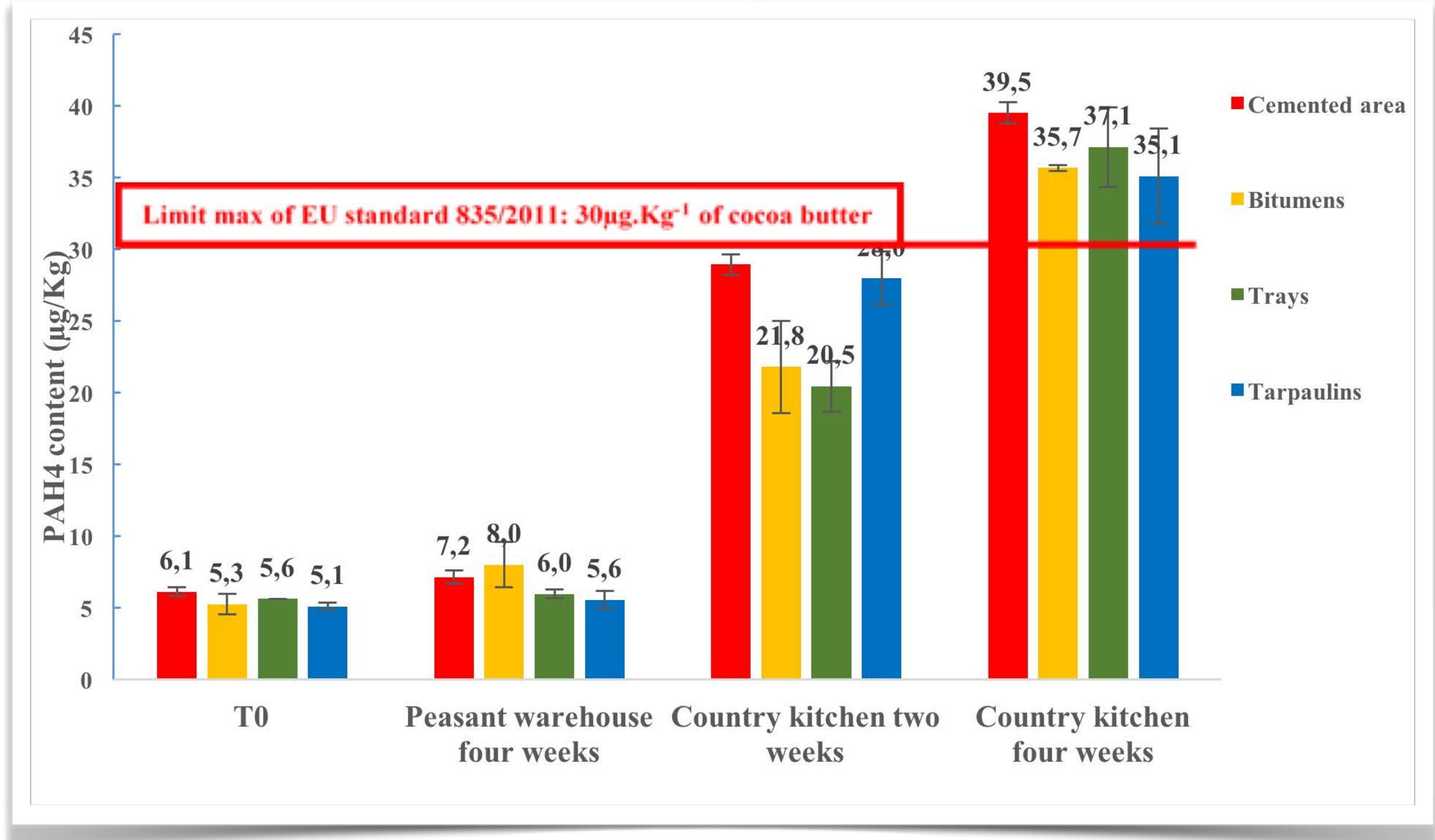


Figure 3. Changes in PAH4 contents during various storage conditions of raw cocoa samples

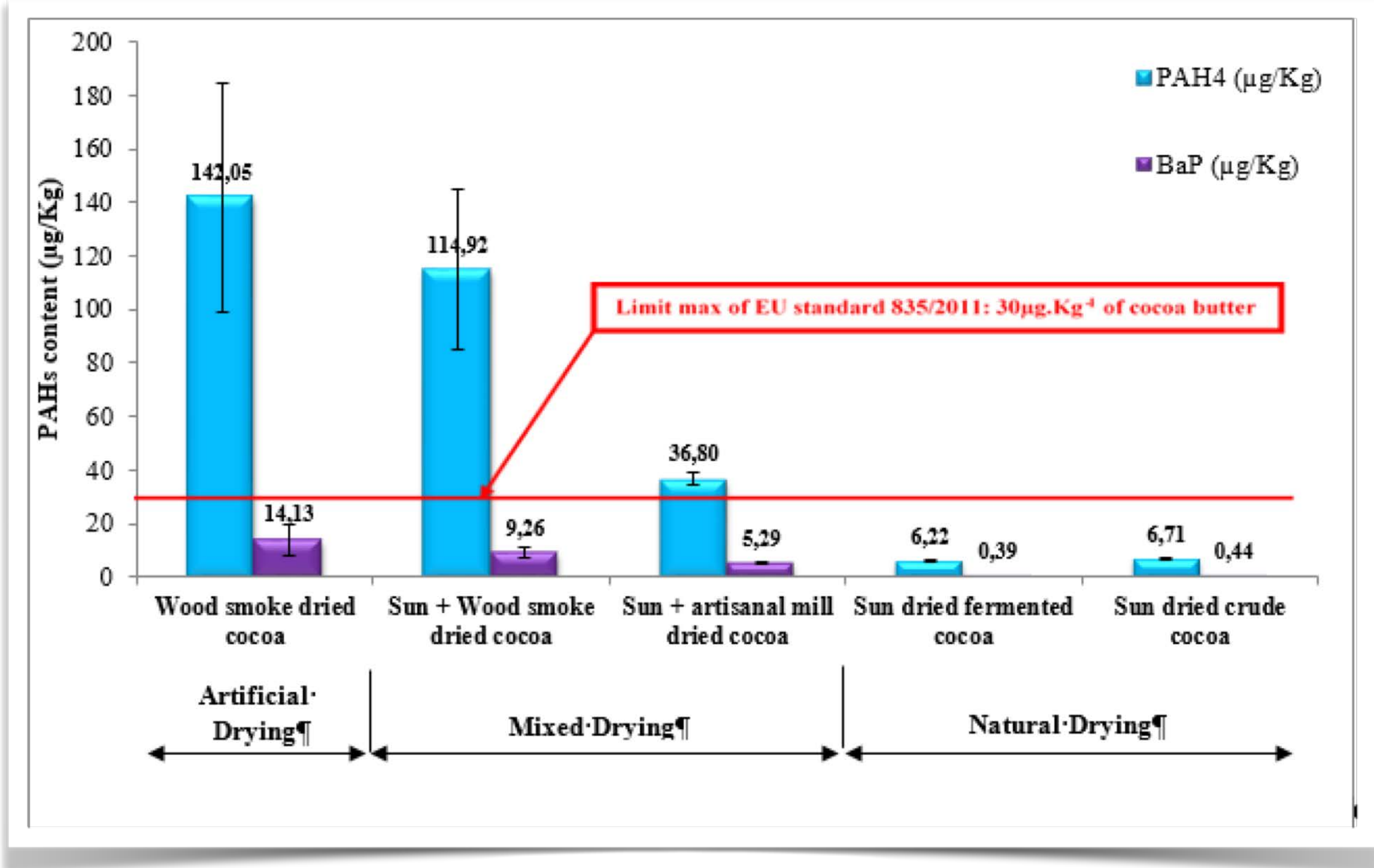


Figure 4. PAHs contents in raw cocoa according to the drying methods

Conclusion and recommendations

Controlled cocoa post-harvest treatments and sun drying method induce low PAHs content in raw cocoa. Artificial drying method and storage of cocoa in the presence of wood smoke provoke alarming levels of PAHs very higher than international standards. They must be avoided. Occurrence of PAHs in raw cocoa could be greatly reduced by using smokeless drying and storage methods.

