

# Aroma of chocolate produced from tray-fermented cocoa beans at different stages of fermentation

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## INTRODUCTION

Tray fermentation is a method of fermenting cocoa beans in wooden trays to ensure more even fermentation than the traditional heap method practised by most cocoa farmers in Ghana (Baker et al., 1994). Chocolate produced from tray-fermented cocoa beans is widely perceived to have a flowery/fruity note.

The investigation was to find key odorants in chocolate produced from tray-cocoa fermentation at different stages of fermentation as a means of optimizing the process for good quality chocolate.

## MATERIALS AND METHODS

Four types of dark chocolate (2D, 3D, 4D and 5D) were produced from two, three, four and five-day tray-fermented Ghanaian cocoa beans, using the same recipe.

Volatile compounds were sampled by dynamic headspace sampling, separated and identified using GC-MS. Key compounds important to the aroma of the chocolates were identified by GC-O (detection frequency method) using a trained panel of five assessors.

## RESULTS AND DISCUSSION

Fifty-five aroma compounds consisting mainly of pyrazines, esters, organic acids and alcohols were isolated and identified by GC-MS from the chocolate samples. 2,6-dimethylpyrazine, 2,5-dimethyl-3-ethylpyrazine, 2,3,5-trimethyl-6-ethylpyrazine and octenal were only identified in chocolate produced from 5-day fermented cocoa but not in the other chocolate samples (Fig. 1). Proper cocoa fermentation is essential for the formation of precursors for these Maillard reaction compounds. Chocolate from 3 days fermented beans had relatively high GC-MS peak areas for mostly alcohols, esters and organic acids. These compounds are mainly produced during cocoa fermentation through microbial activity and may have been at their peaks at this time (3 days).

A number of peaks with sweet/fruity/flowery notes were detected by judges in all the four samples of chocolate. These odorants may be responsible for the perceived flavor attribute of 'tray chocolate'. The GC-O results (Table 1) shows, however, that at least five days of fermentation is required to obtain some of the Maillard reaction products which are known to be important for the chocolate aroma.

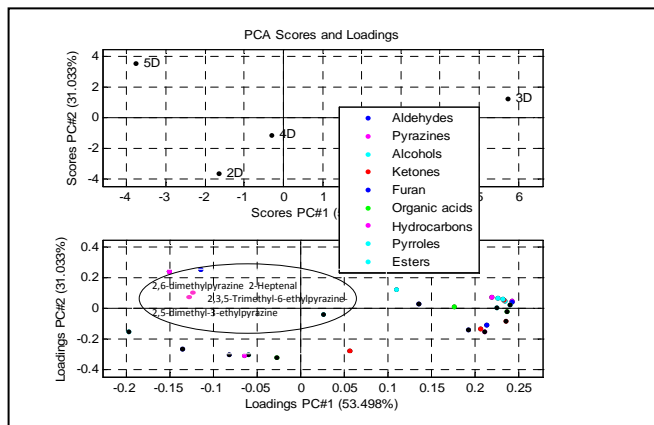


Fig. 1. PCA scores and loadings of GC-MS peak areas of key odorants detected in the chocolate samples by GC-O. Odorants associated with 5D chocolate: 2-Heptenal; 2,6-Dimethylpyrazine; 2,5-Dimethyl-3-ethylpyrazine; 2,3,5-Trimethyl-6-ethylpyrazine.

Table 1. Key odorants detected by GC-O and identified by GC-MS in four different chocolates produced from tray-fermented cocoa at 2 days (2D), 3 days (3D), 4 days (4D) and 5 days (5) of fermentation.

Odorant	Description by judges	Chocolate samples			
		2D	3D	4D	5D
3-Methylbutanal	Cocoa, chocolate	X	X	X	X
Pentanal	Fruity, strawberry		X	X	
Ethyl propanoate	Sweet, fruity	X			
Isoamylacetate	Sweet, rose	X		X	X
Limonene	sweet			X	
2-Butanone, 3-hydroxy	Bread			X	X
2-Heptenal	Orange, citric	X	X	X	X
2,3-Octanedione	Earthy, mushroom	X	X	X	X
2,6-Dimethylpyrazine					X
Unknown 1		X			
2,3-Dimethylpyrazine	Baked potato, popcorn	X	X	X	X
2,3,5-Trimethylpyrazine	Earthy, potato	X	X	X	X
Unknown 2		X			
Acetic acid	Sharp, vinegar	X	X	X	X
2,5-Dimethyl-3-ethylpyrazine	grassy, green vegetable				X
Linalool oxide	Fresh grass, sweet	X	X		X
Isomenthol	Minty, liquorice	X	X	X	
Tetramethylpyrazine	Green, grass	X	X	X	X
Decanone			X		
Decanal				X	X
Benzaldehyde	Earthy, green, nutty	X	X	X	X
2,3,5-Trimethyl-6-ethylpyrazine	sweet				X
2-Nonenal	Sweet, fresh leaves	X			X
Linalool	Sweet, flowery	X	X	X	X
2-Methylpropanoic acid,	Unpleasant, bad odor			X	X
Unknown 3		X			
1-phenyl-ethanone					X
Unknown 4	Baked potato			X	X
Pentanoic acid/3-Methylbutanoic acid	Unpleasant, sweaty, blue cheese	X	X	X	X
Epoxylnalol	Spicy, liquorice	X	X	X	X
Unknown 5	Sweet, candy		X		X
Ethylphenyl acetate	sweet	X	X		
Propanoic acid, 2-methyl, 3-hydroxy-2,4,4-trimethylpentyl ester	Fruity, flowery			X	
Phenylethyl alcohol	Flowery, rose	X	X	X	X
Benzeneacetaldehyde, alpha.ethylidene		X	X	X	X
2-Acetylpyrrole		X	X	X	X
Unknown 6	Sweet, flowery			X	X

## CONCLUSION

A number of key odorants described as sweet/ fruity/flowery may be responsible for the perceived flavor note of 'tray chocolate' but investigation is on-going to find how these impact on the sensory flavor attributes of this chocolate.

At least five days of fermentation may be required to ensure the formation of precursors that will develop into known odorants important for good chocolate aroma.

## REFERENCE

Baker, D. M. et al. (1994). Food Chemistry 51, 425-431.