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Influence of roasting and conching conditions on aroma volatiles of chocolate

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Introduction

Roasting of cocoa beans and conching are two important processes in the manufacture of chocolate that influences its flavor. Both the temperature and duration of these two processes are reported to be important in determining the aroma of the final product (1, 2, 3). During roasting, aroma precursors formed during fermentation/drying are developed into aroma compounds via the Maillard reaction. It is not yet clear whether new compounds are formed during conching. Whilst roasting and conching ensures the evaporation of water and undesirable flavor compounds from cocoa/chocolate, the loss of some desirable compounds through evaporation and degradation during these processes is also a possiblity since high temperatures are involved.

The experiment was aimed at determining the effect of roasting and conching conditíons on the aroma volatile profile of chocolate produced from heap-fermented Ghanaian cocoa beans.

Materials and methods

Nine samples of chocolate were prepared using the same recipe but varying roasting and conching conditions. The roasting conditions used were 100ºC for 100 min, 120ºC for 45 min and 150ºC for 30 min with conching at 80ºC for 6, 8 and 10 h. Two control samples were also produced; the first (conh1) was produced with unroasted cocoa nibs and conching for 8 h whilst the second (conh2) was produced from nibs roasted at 120ºC for 45 min but with no conching. Table 1 shows the combinations of roasting conditions and conching durations used in producing the samples.
Aroma volatiles were isolated onto tenax traps by Dynamic Headspace Sampling and identified by GC-MS. All samples were analysed in triplicate.

Table 1. Combinations of roasting and conching conditions used in producing chocolate with sample codes.

Roasting condition	Conching duration/hr (at 80ºC)		
	6	8	10
100ºC/100 min	hr1c1	hr1c2	hr1c3
120ºC/45 min	hr2c1	hr2c2	hr2c3
150ºC/30 min	hr3c1	hr3c2	hr3c3

Results and discussion

Table 2. Number of compounds identified in chocolate produced under different roasting and conching conditions.

Compound group	Number of compounds										
	conh1[a]	conh2[b]	hr1c1	hr1c2	hr1c3	hr2c1	hr2c2	hr2c3	hr3c1	hr3c2	hr3c3
Acids	6	6	5	5	6	5	5	5	5	5	6
Alcohols	11	10	12	10	12	10	9	12	11	10	10
Aldehydes	12	10	10	8	9	9	9	8	11	11	10
Esters	6	7	8	8	7	6	4	6	7	6	6
Furans	5	6	3	4	4	4	4	5	7	4	5
Hydrocarbons	2	2	2	2	2	2	2	2	2	2	2
Ketones	8	9	8	7	8	10	8	9	10	9	9
Phenols	1	1	1	1	1	1	1	1	1	1	1
Pyrans	1	1	1	1	1	1	1	1	1	1	1
Pyrazines	4	13	5	4	6	10	5	10	14	12	7
Pyrroles	1	2	1	1	1	1	2	1	2	1	1
Sulfur compounds	3	4	1	2	2	3	3	2	4	3	4
TOTAL	**60**	**71**	**57**	**53**	**59**	**62**	**53**	**62**	**75**	**65**	**62**

[a]unroasted, conched control (conching at 80ºC for 8 h); [b]roasted, unconched control (roasting at 120ºC for 45 min).

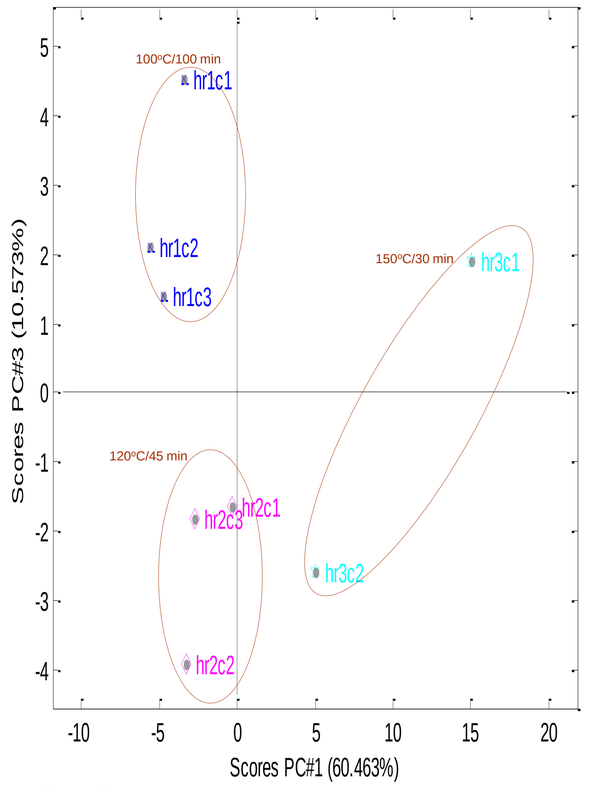

Fig.1. PCA score plot showing distribution of chocolate samples according to roasting conditions. Data is based on GC-MS peak areas of aroma volatiles .

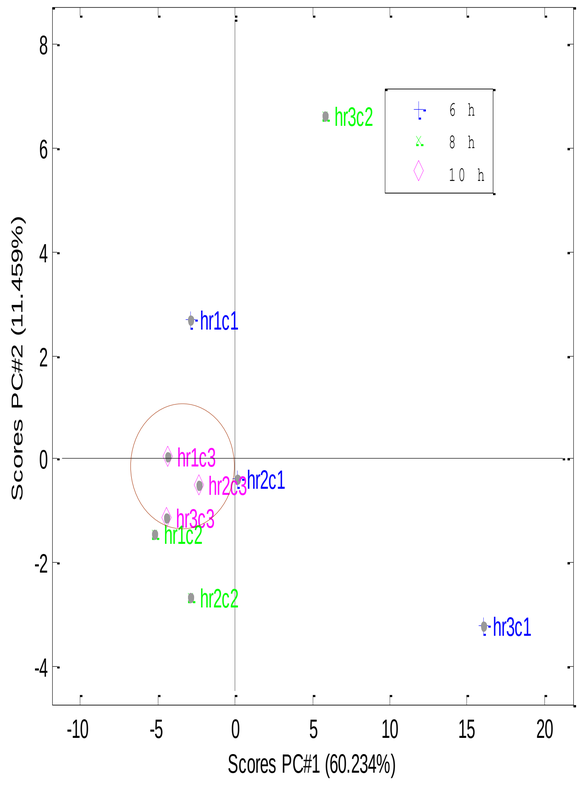

Fig. 2. PCA score plot showing distribution of chocolate samples according to conching duration. Data is based on GC-MS peak areas of aroma volatiles.

The number of aroma volatiles identified varied depending on the roasting and conching conditions. The number of the different compound groups and the total number of aroma volatiles of the chocolate samples are shown in Table 2. Chocolate produced from cocoa nibs roasted at 150ºC/30 min and conched for 6 h (hr3c1) had the highest number of aroma volatiles of seventy-five. This was followed by the roasted, unconched control (conh2) with seventy-one aroma volatiles. Samples roasted at 100ºC /100 min and conched for 10 h (hr1c3) as well as that roasted for 120ºC/45 min and conched for 10 h (hr2c3) both had the lowest number of aroma volatiles of fifty-three. Generally, it appears more aroma compounds were formed at higher roasting temperatures but these were also lost through long conching durations. The number of pyrazines, the most important products of the roasting process, were lowest in the unroasted control sample and highest in sample roasted at 150ºC/30 min and conched for 8 h. Pyrazines obtained in the unroasted control may have been mostly formed during fermentation of the beans. It was observed that long conching duration also seem to affect the number of pyrazines identified. In essence a high temperature roasting coupled with a long period of conching is almost synonymous with a low temperature roasting. Apparently some aroma volatiles are lost through evaporation, combinations or degradation into other compounds. The presence of furanic compounds and a pyrrole in the unroasted control sample suggest the formation of such temperature-generated compounds during the high conching temperature of 80ºC.

A PCA score plot of GC-MS peak areas of aroma volatiles (Fig 1) showed a clear separation of the samples according to the roasting conditions with PC1 and PC3 explaining more than 70% of the variation in the samples. PC1 separated the chocolate samples into those roasted at 150ºC/30 min on one side and those roasted at 120ºC/45 min and 100ºC/100 min on the the other side. Samples roasted at high temperatures were closely related to higher levels of most aroma compounds identified. Samples conched for 10 h grouped together but there was no clear separation of the other samples based on the conching duration (Fig. 2).

Conclusion

Both roasting and conching conditions had some effect on the type and number of aroma volatiles produced during chocolate production. Roasting at a higher temperature resulted in the production of the most aroma compounds but some of these are lost through long durations of conching. Long conching duration is synonymous with low temperature roasting as far as the total number of aroma volatiles is concerned.

References

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