An assessment of the effect of cinnamon spice on cocoa nibs (*Theobroma cacao L.*) - An approach to change flavour in stored roasted cocoa nibs

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Abstract

Fine flavours in chocolate are influenced by factors such as cacao variety, growing environment, post-harvest processing and chocolate manufacturing processes. The objective of this experiment was to develop a method to enhance the flavour of cocoa nibs without affecting their inherent fine flavours. Concentration of cinnamon, method of packaging, and exposure time were manipulated to obtain a unique ancillary spice note as detected via descriptive sensory evaluation of cocoa liquor processed from the cinnamon infused cocoa nibs. Increased concentration enhanced the detection of cinnamon flavour, more so under vacuum packaging, while simultaneously reducing the perception of an undesirable note. This study shows that addition of ancillary spices to a mass of nibs can enhance the taste experience, allowing for novel favourable and unique liquor products. This method has particular potential for small to medium size chocolate makers and chefs.

Introduction

Cocoa beans are categorized globally into two groups, “fine or flavour” cocoa and bulk cocoa. Fine or flavour cocoa beans are generally obtained from cocoa trees of Criollo or Trinitario ancestry. They are characterized by desirable ancillary flavour notes such as floral and fruity, with a robust chocolate flavour. In contrast, bulk cocoa has a robust chocolate note with no significant ancillary notes. Cocoa nibs are fermented, dried, roasted and crushed cocoa beans [1]. Currently, there is an increase in demand for “fine or flavour” cocoa beans and nibs largely due to the buoyant craft chocolate and culinary industry that uses it to produce exclusive chocolates and chocolate products.

This craft industry uses innovations through the transference of novel flavours into cocoa and therefore can provide a competitive advantage in an increasingly competitive marketplace. Cocoa or chocolate flavours can be enhanced through the addition of direct spices and flavouring during conching but this may give negative mouthfeel properties.

Desirable flavours can result in unique flavour notes and thus further enhance the quality of cocoa and the potential price it can fetch in the market. Bio-generated atmospheres or vacuum storage demonstrated a positive impact on stored cocoa beans [2]. Little work has been done to show the significance of vacuum storage or its influence on flavour infusion on “fine or flavour” roasted cocoa nibs. Aromas could potentially be transferred onto cocoa by a process known as mass transfer [3]. By manipulating concentration and distance one should be able to affect a flavour change in stored roasted cocoa nibs validated through descriptive sensory evaluation.

Descriptive sensory evaluation of cocoa liquor has been used as a tool to judge cocoa bean quality. A major strength of descriptive sensory evaluation is that it can link instrumental measurements of quality with consumer acceptance [4]. An optimised

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protocol for descriptive sensory evaluation was developed to quantify different flavour attributes of cocoa liquors in Trinidad and Tobago [1].

The overall objective of this work is, therefore, to develop a standardised method for cocoa nib infusion with cinnamon spice aroma to be used by small to medium size chocolate makers and chefs.

Experimental

Nib and cocoa liquor preparation

Cocoa beans from the International Cocoa Gene Bank Trinidad (ICGT) were selected and used for the experiment. Roasting of beans was done according to Sakha et al. [1]. After roasting, beans were cooled to room temperature on cooling racks for further processing. Cocoa beans were broken using a cocoa breaker to an average size of 0.2-0.5 cm and collected into neutral and non-odorous plastic containers. The broken beans were then winnowed and winnowed nibs were manually fine cleaned using stainless steel forceps. Cocoa nibs were packaged based on the experiment design below and stored at 22°C room temperature.

Table 1: Overview of the experimental set-up and design.

Experiment Replication	*Treatments of ingredient infusion*	*Storage method*	*Levels of infused ingredient in 100 grams of nibs*	*Sampling days*
Two replicates (0 grams cinnamon was not repeated in experiment)	Cinnamon sticks (placed in the bags with nibs)	Vacuum (1) sealable bags Aerated (2) sealable bags	• 2 grams • 10 grams • 25 grams • 0 grams	3, 7, 14, 28, 56

Each vacuum sealed and aerated sample bag was opened and 50 g of nibs were removed and used to make liquor. Bags with the remainder of the nibs were resealed. Nibs were broken down using a Magic Bullet®USA blender. The blender was pulsed 9 times for one second and 3 times more for 3 seconds. The ground sample was placed in a Cocoa Town® USA mini 500g bowl to be milled for one and a half hours in a Cocoa Town® ECGC-12SLTA Melanger. The cocoa paste or liquor was then transferred to a sterile plastic cup, which was labelled with the date and sample information. The cups were then sealed with tape and placed in a freezer at -4 °C.

Sensory evaluation

Frozen samples were thawed and one ounce of each liquor sample was placed in one-ounce cups. Each cup was given a random code [1]. A sensory panel, consisting of 6 people, was trained for four days to taste cocoa liquors prior to the actual sensory evaluation of the infused nibs. Each person was trained to taste 46 different descriptors and to use the extended sensory sheet called “Cocoa and Chocolate Flavour Evaluation” [5]. Panellists were also asked to provide comments, an overall score and assessment of ‘uniqueness’. Sensory evaluation was done in an air conditioned room at 23°C. Each panellist was given samples in random order. Seventy-four coded liquors were tasted over a period of 10 days; 70 from the experiment and four samples of Ghana liquor as additional controls. The latter was used to test consistency of the panellists in scoring. Liquors were placed on a VWE Analog 2 block heater (USA) prior to tasting. Each panellist was given a jar of warm water, a jar of room temperature water and Carr's table water crackers to clear their palate. A tasting spoon and a small plate were also provided.

The method for cleaning the palate and tasting liquor were as described by "ESSeguine-DASukha Cocoa and Chocolate Flavour Evaluation method 2017" [5].

Panellist scored each flavour note perceived on a 10 point hedonic scale. The data was subjected to analysis of variance (ANOVA) to determine the significance of the major effects and interactions. Data were subsequently used in statistical analysis to determine the effects of cinnamon concentration, storage methods (aerated or vacuum stored), and storage time.

Results and discussion

The average mean scores for "Spice other", "Wood resin" and "overripe fruit" were significantly affected by the infusion of cinnamon. The average mean scores are calculated based on all samples tested for time, concentrations and aerated and vacuum packaging. Not all sensory evaluation results are recorded on this paper.

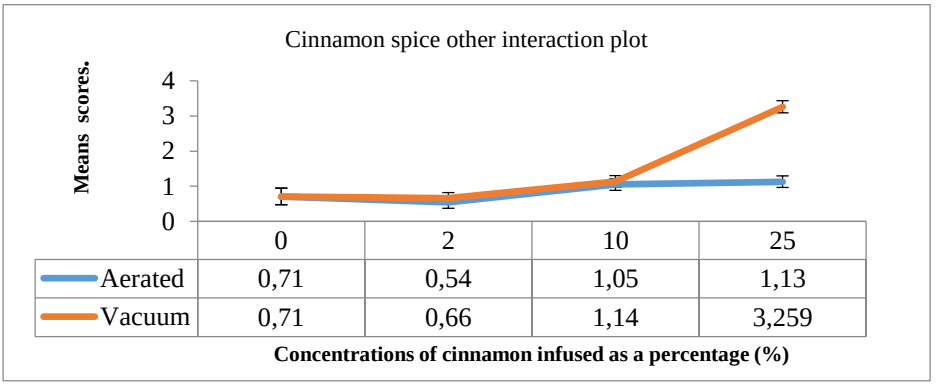

Figure 1: The effect of increasing concentration of cinnamon spice on vacuum and aerated packaging for the infusion of "spice other" flavour note on cocoa nibs.

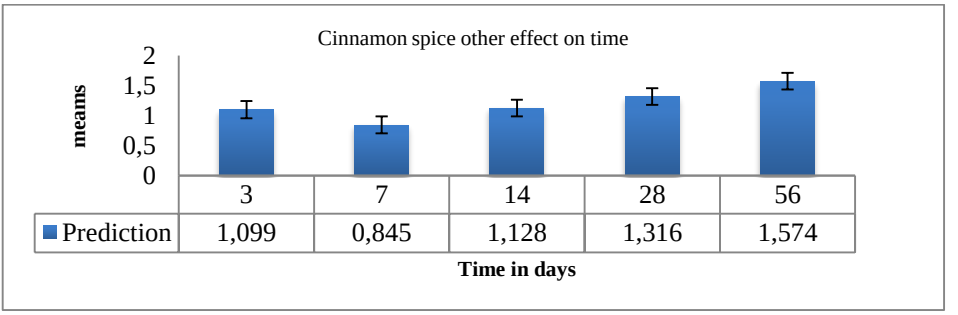

Figure 2: Evaluation of the spice other flavour note of cocoa nibs after selected days of infusion.

"Spice other": "Spice other" flavour was the note that the sensory panellists determined as the cinnamon flavour in the liquors. Interaction between concentration and packaging method was significant ($P < 0.001$) and least significant difference (LSD) 0.3846 indicating that the effect of vacuum packaging was more evident at the 25% cinnamon concentration than at the lower concentrations. In general, the intensity of the spice note increased with increasing time of exposure to the spice ($P < 0.05$).

"Cinnamon spice" aroma is perceived by two main volatile compounds: cinnamon aldehyde (cinnamon), and 2-propenoic acid, 3-phenyl ester (cinnamon) [7]. This experiment showed that with increased percentages of cinnamon bark, and increased storage time, especially under vacuum storage, a spice note can be effectively transferred to cacao nibs.

Overall score: This is a score that rates how good or bad the cocoa liquor samples are. The panellists significantly ($P < 0.001$) preferred vacuum over aerated storage. The overall score was significantly ($P < 0.05$) higher for nibs stored with 25% cinnamon. Thus, infusing the nibs with 25% cinnamon under vacuum storage, improve the general quality of the nibs.

Conclusion

The objective of this experiment was to develop a novel method to change cocoa nib flavour. Here this method was tested using cinnamon. Vacuum storage and higher cinnamon concentration allowed for superior intensity of cinnamon flavour. Length of exposure also enhanced the spice flavour in cocoa nibs. Given the positive results of this study, this method can be recommended for the infusion of flavour to nibs.

Nonetheless more research using other spices remains necessary to show the general usefulness of the methods. Moreover, quantifying the mass transfer of volatiles from spice to nibs and the inclusion of analytical data such as solid phase micro extraction (SPME)-gas chromatography (GC)-and mass spectroscopy (MS), will help to identify relationships or linkages between the panel's sensory analysis and instrumental quantitative data [7].

References

1. Sukha D.A., Butler D.R., Umaharan P. and Boult E. (2008) European Food Research and Technology 226(3): 405-413.
2. Navarro S., de Bruin T., Montemayor A.R., Finkelman S., Rindner M. and Dias R. (2007) IOBC Bulletin Volume 30: 20-23.
3. Fair J. R. (2009) In: Chap 8 Mass transfer. Albright's Chemical Engineering Handbook (Lyle, F., ed.) Albright CRC Press.
4. Murray J. M., Delahunty C. M., and Baxter I. A. (2001) In: Descriptive sensory analysis: past, present and future. Food research international 34(6): 461-471.
5. ESSeguine-DASuhka Cocoa and Chocolate Flavour Evaluation, by ESSeguine and DA Sukha (2017) Licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.
6. VSN International (2011) GenStat for Windows 14th Edition. VSN International, Hemel Hempstead, UK. Web page: GenStat.co.uk
7. Albak F. and Tekin A.R. (2015) Journal of Food Science and Technology 52(4): 1960.