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IMPACT OF REPLACING COCOA WITH CAROB AND ROSEHIP POWDER ON THE **SENSORY PERCEPTION OF CHOCOLATE**

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INTRODUCTION

A key challenge in today's food industry is the formulation of innovative chocolate products that improve nutritional properties and attractive sensory attributes

by incorporating unconventional plant materials rich in high-value phytochemicals, while remaining economically sustainable. This study investigates changes in the proximate composition and sensory perception of chocolate by partially replacing cocoa with carob powder (CP) and rosehip powder (RP) as unconventional plant-derived materials rich in high-value phytochemicals. For this purpose, cocoa was replaced (w/w) by 10%, 20%, 30% and 40% CP, then by a mixture of 30% CP and 10% RP, 20% CP and 20% RP, 10% CP and 30% RP, and 40% RP, respectively.. Rosehip, particularly Rosa canina L., is rich in vitamin C, phenolics, and carotenoids, with proven anti-inflammatory, antioxidant, and potential anti-diabetic and anticancer benefits. Carob is a natural sweetener high in dietary fiber, polyphenols, and essential minerals, commonly used as a cocoa substitute. The addition of carob and rosehip powders in chocolate formulations offers a promising approach to creating healthier chocolate formulations.

MATERIALS AND METHODS

Chocolate formulas were produced by mixing sugar and water, boiling until thickened, then incorporating butter, milk powder, and cocoa powder or substitutes like carob and rosehip powders. The mixtures were molded, cooled, and refrigerated. The resulted formulation were investigated in terms of proximate composition, energy value and sensory properties. The proximate composition of chocolate formulations was evaluated in accordance with the standard method described by the Association of Official Analytical Chemists (AOAC, 2000). The designed products were rated by twenty (20) trained assessors for sensory characteristics, including appearance, texture (mouthfeel), taste, flavor and overall acceptability on a 5-point hedonic scale where 1 indicated "dislike extremely" and 5 indicated "like extremely".

RESULTS AND DISCUSSIONS

The developed chocolate formulas are shown in Figure 1. Changes in proximate composition and sensory attributes of enriched chocolate formulas were assessed in relation to a control sample containing unsubstituted cocoa, Table 1. Replacing cocoa powder with CP and RP in chocolate formulations significantly increased moisture content, especially with higher RP concentrations. Protein and fat content decreased slightly with increasing CP and RP proportions, while carbohydrate content (CRB) showed a minimal increase. The energy value was not strongly influenced by substitution of cocoa with CP and RP. The average scores for the sensory attributes (appearance, aroma, texture, taste and overall acceptability) of the samples are summarised in Figures 2 and 3. Results showed that changes in the sensory perception of chocolate, in particular in terms of appearance, taste and texture, are influenced by both the materials used as cocoa substitute and the level of substitution. The highest overall acceptability was recorded for chocolate formula fortified with 30% CP and 10% RP.

40RP

Figure 1. Chocolate formulas obtained by partially replacing cocoa powder with CP and RP



Table 1. Frominate composition of chocolate formulations						
Sample	Protein (%)	Lipids (%)	Ash (%)	Moisture (%)	CRB (%)	Energy Value (kcal/100g)
С	8.37 ± 0.01ª	16.42 ± 0.02ª	1.91 ± 0.03 ^a	5.42 ± 0.03 ⁱ	67.88	452.78
10CP	8.21 ± 0.02 ^b	16.19 ± 0.03 [♭]	1.84 ± 0.01 ^b	5.51 ± 0.02 ^h	68.25	451.55
20CP	8.06 ± 0.01 ^c	16.02 ± 0.04 ^c	1.76 ± 0.01 ^c	5.62 ± 0.01 ^g	68.54	450.58
30CP	7.92 ± 0.03 ^d	15.81 ± 0.03 ^d	1.68 ± 0.02 ^d	5.75 ± 0.02 ^f	68.84	449.33
40CP	7.79 ± 0.01 ^e	15.60 ± 0.02 ^e	1.61 ± 0.01 ^e	5.86 ± 0.01 ^e	69.14	448.12
30CP10RP	7.71 ± 0.01 ^e	15.66 ± 0.04 ^e	1.66 ± 0.02 ^d	5.92 ± 0.02 ^d	69.05	447.98
20CP20RP	7.65 ± 0.02°	15.73 ± 0.03°	1.72 ± 0.02 ^d	6.03 ± 0.03 ^c	68.87	447.65
10CP30RP	7.58 ± 0.01 ^d	15.81 ± 0.02 ^d	1.77 ± 0.01 ^c	6.12 ± 0.02 ^b	68.72	445.09

Table 1 Provimate composition of chocolate formulations

Values are reported as the mean of three independent analyses ± standard deviation (SD). Values in a column having different superscripts are statistically different (one-way ANOVA, p < 0.05).

1.83 ± 0.02^b

6.25 ± 0.04^a

68.56

447.03

Appearance

——Overall acceptability

-Flavour

— Texture

-----Taste

15.87 ± 0.05^b

7.49 ± 0.03^b



Figure 2. Sensory profile of chocolate formulas obtained by rreplacing cocoa powder with CP

Figure 3. Sensory profile of chocolate formulas btained by replacing cocoa powder with CP and RP

CONCLUSIONS

Our research suggests that the partial replacement of cocoa with unconventional plant-derived materials, such as CP and RP, is a technological option for diversifying the range of chocolate products. This approach could also be an attractive sustainable solution to obtain chocolate formulations with sensory properties appreciated by consumers as well as with added nutritional value. Theit inclusion in the chocolate fomulation not only improved the sensory attributes of the final product but also enriched its nutritional profile, reinforcing their viability as cocoa powder substitutes in chocolate manufacturing.