USE OF GRAPE SKIN FLOUR FOR NOVEL FOOD DEVELOPMENT: SENSORY CHARACTERIZATION AND ACCEPTABILITY OF SOFT CHEESES

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INTRODUCTION

Grape skin flours (GSF) have been recently proposed as functional ingredient in order to create novel foods with enhanced nutritional value and minimize the volume of agricultural wastes (1). Despite their interesting nutritional properties (i.e. for fiber and antioxidants content), new developed products are often critical in terms of sensory acceptability and their success by consumers is therefore under risk (2).

AIM

The aims of this study were to:

1. investigate the sensory properties for new cheese prototypes obtained by addition of GSF
2. investigate consumers' responses for the innovative cheeses

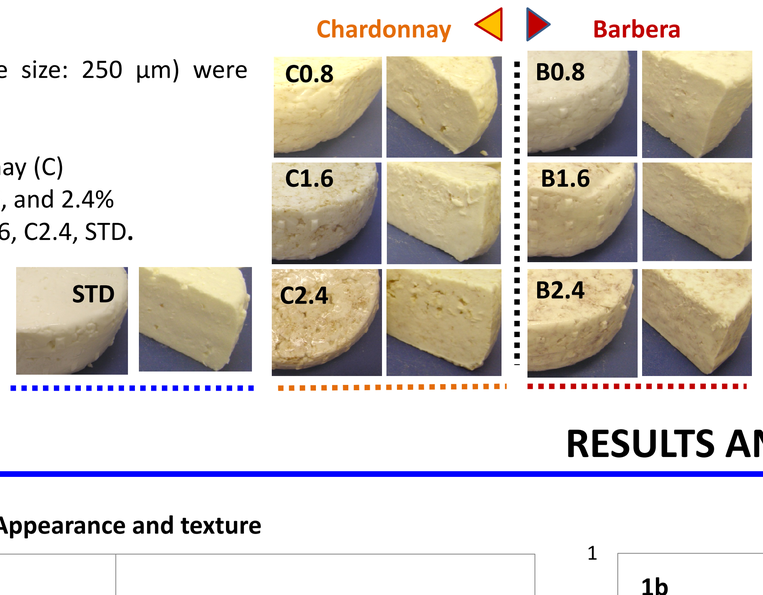
The effects of the **grape variety** and different **percentages** of GSF addition were studied.

SAMPLES

- **Grape skin flours** (average particle size: 250 µm) were added to cow's milk curd.

Soft cheeses were aged 1 week.

- **Grape variety**: Barbera (B), Chardonnay (C)
- **Percentages of GSF addition**: 0.8, 1.6, and 2.4%
- 7 samples: B0.8, B1.6, B2.4, C0.8, C1.6, C2.4, STD.



METHODS

1 Free Choice Profile

- 22 expert cheese tasters (M=14; aged from 24 to 70, mean age=55) from the Italian National Cheese Taster Association (ONAF, Organizzazione Nazionale Assaggiatori Formaggio).
- One evaluation session (around 120 minutes).
- Two sample sets were provided:
  1st set -> Free generation of attributes.
  2ndset -> Intensity quantification of selected attributes (9-point scale: 1=extremely weak, 9=extremely intense).

Data Analysis: Generalized Procrustes Analysis (GPA) (Senstools v. 1.2x OP&P Product Research BV, Utrecht, Netherlands).

2 Consumer test

- 90 consumers (M=43; aged from 8 to 70, mean age=43)
- Central Location Test at the International Cheese Exhibition (Cheese 2013, Bra - Italy).
- Liking test: appearance, odour, taste, flavour, texture, overall liking (1=extremely dislike, 9=extremely like).
- Questionnaire

Data Analysis: were analyzed by 2-way mixed ANOVA models followed by LSD Fisher's post–hoc test (SYSTAT vers 13.1, Systat Software Inc, San José, USA)

RESULTS AND DISCUSSION

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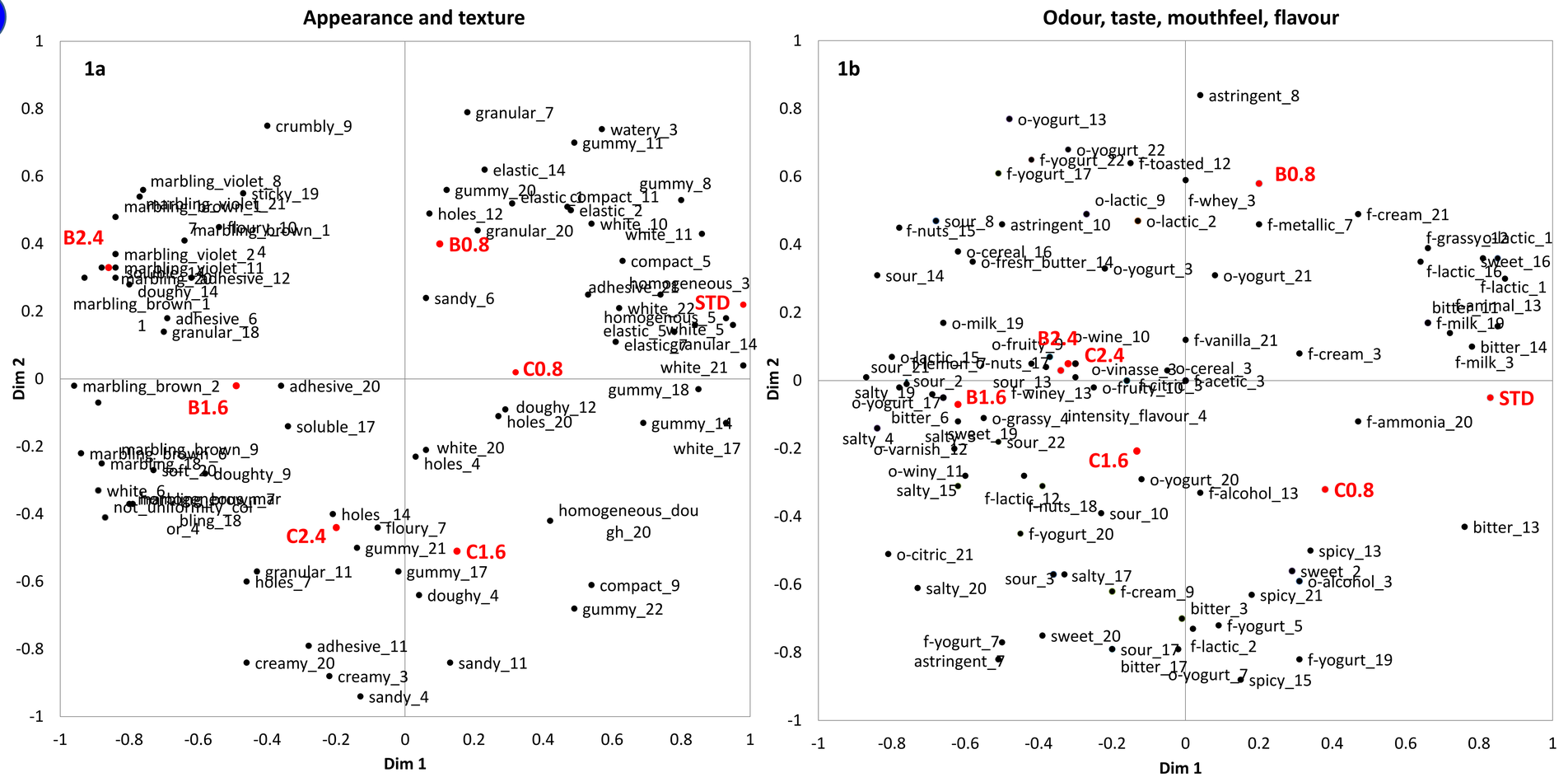

Fig. 1 Consensus maps obtained from General Procrustes Analysis (GPA) considering two matrices appearance and texture (1a) and odour, taste and flavour (1b). Individual configurations and sample's positioning are depicted. Letters o- and f- : odour and flavour.

SENSORY PROPERTIES

New developed cheeses were freely described by experts considering appearance, odour, taste, flavour and texture.

Attributes: 64 from free generation, 56 after the vocabulary harmonization.

The individual configurations were submitted to Generalized Procrustes Analysis (GPA) applied to two separate matrices: **appearance-texture** (Fig. 1a) and **odour-taste-flavour** (Fig. 1b).

Permutation Tests indicated the significance of the GPA results ($p < 0.05$) for both matrices.

- Samples were mainly **discriminated according to the % of GSF** on PC1 **and to grape variety** on PC2.
- The increase of % was generally associated to an increase in perceived sourness, saltiness, astringency, marbling aspect, granularity and adhesiveness. Furthermore it contributed to generate several vegetable sensations **(o-winy, o-fruity, o-citric, o-grassy, o-vinasse, o-spicy, f-whey, f-nuts and f-spicy)**.
- Appearance: **violet and brown marbling** were generally characteristic attributes for samples prepared with Barbera GSF.

2 CONSUMER PREFERENCES

- **Factor grape variety ->** no significant effect on overall liking of 90 consumers.
- **Factor GSF percentage ->** a significant effect on overall liking:
  - the lowest amount of GSF (0.8%) -> the most liked
  - liking proportionally decreased with the increase of the amount of GSF.
- **Factor product** (7 samples) -> a significant effect on liking for appearance, odour, taste, flavour, texture and the overall liking.

  The control sample was the significantly most liked sample (6.39±0.17).

A K-means Cluster Analysis was conducted on overall liking of 90 consumers:
- Un-paired t-test indicated significant differences between clusters for all samples ($p<0.01$) -> Cl1: higher preference for all prototypes.

- **Cluster 1** (n=54, 60%): a significant effect of product on liking was found for the appearance, the taste, the flavour and the overall liking → **high discrimination**
- **Cluster 2** (n=36, 40%): a significant effect of product was just found for the appearance and the overall liking → **low discrimination**

Cluster characterization:
A significant cluster*product effect was found, with Cl1 rating the overall liking for the products higher than Cl2. This difference in liking could be partially influenced by the higher frequency of cheese consumption declared by Cl1.
No differences for gender, educational qualification and profession was found between clusters.

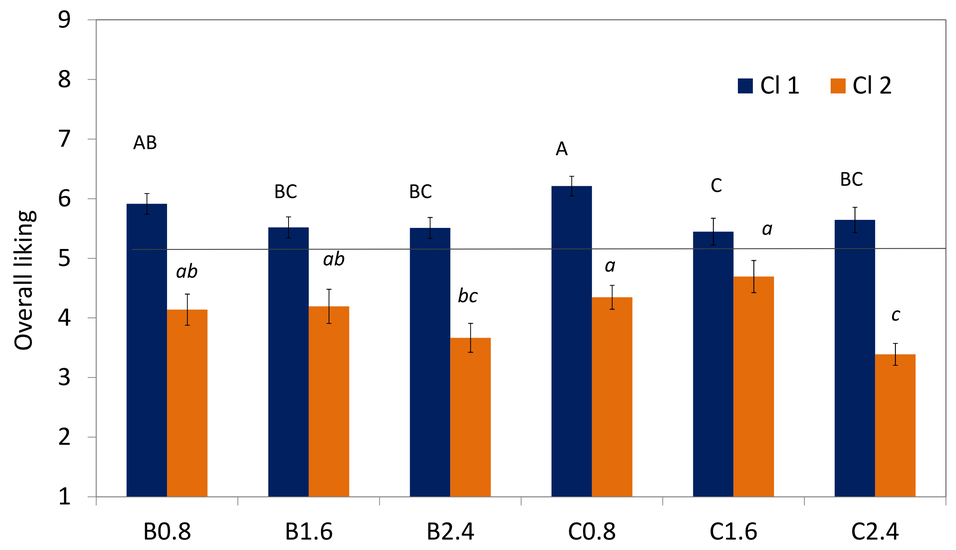

Fig. 2. Mean values and standard errors for overall liking of Cl1 and Cl2. Two-way mixed ANOVA models were separately conducted on liking data of clusters. LSD ($p<0.05$) letters: block letters for Cl1, Italic letters for Cl2.

3 RELATIONSHIP BETWEEN SENSORY PROPERTIES AND CONSUMER RESPONSES

- The key sensory drivers resulted: **white colour, homogeneity of appearance and texture, lactic flavours (o-milk, o-lactic, f-lactic, f-cream), sweetness, gummy, compact and elastic texture**.
- The most preferred samples showed a less intense sourness, astringency and bitterness.
- Results highlighted the importance of reducing sandiness and granular sensations. Violet and brown marbling, characteristic for B2.4 and B1.6 samples, resulted not particularly appreciated.

CONCLUSIONS

- The use of GSF in developing soft cheeses provided satisfactory results.
- A future use in dairy product seems possible. Nevertheless, an optimization of the innovative product is required, especially aimed to reduce the flour particle size below the perception threshold and to improve the flour dispersion.
- Furthermore, investigating the effect of information (GSF enrichment) on consumer's perception could represent a future issue.

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AKNOWLEDGEMENTS

This research was supported by AGER (contract number 2010-2222).