



REPORT ABOUT CONSUMERS' PREFERENCE OF DIFFERENT PUMPKIN FRUIT PULP FORMULATIONS

DELIVERABLE 4.4

Pulping

Developing of Pumpkin Pulp Formulation using a Sustainable Integrated Strategy



UNIVERSITY OF THESSALY





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Document information

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1 Summary

The PulpIng project aims to develop a high-quality pumpkin pulp product enriched with value-added compounds from pumpkin by-products. This initiative promotes sustainability and an integrative approach. The main objective of WP4 is to develop a pumpkin pulp formulation ready to use and incorporated with natural preservatives that ensure stability over the product shelf-life. The present report concerns WP4 deliverable D4.4 “Report about consumers’ preference of different pumpkin fruit pulp formulations”, where the results of the evaluation of pumpkin pulp formulations by consumers are presented and discussed.

2 Description

In Task 4.2, the optimized preservative extract obtained in the previous Task 2.2 was incorporated into the pumpkin pulp formulation. The extract obtained from the Butternut squash peels in the optimal global condition of heat-assisted extraction was incorporated in the pumpkin pulp, to partially replace the artificial preservative potassium sorbate. The final formulation described in Deliverable 4.7 was tested for consumer acceptance along with the traditional formulation adding potassium sorbate as a preservative. Both formulations were evaluated regarding its colour, taste, aroma and texture pleasantness, on a scale from 1 to 5.

The following formulation, previously described in Deliverable 4.3 were tested for consumer acceptance:

- Traditional formulation (SP): potassium sorbate.
- Pumpkin peel extract at a concentration of 10 g/kg + 50% of the amount of potassium sorbate concentration in the traditional formulation (PE10SP).

The test involved 106 untrained participants at the premises of the Polytechnic Institute of Bragança, Bragança, Portugal. Participants were asked to evaluate colour, taste, aroma and texture pleasantness, on a scale from 1 to 5 (1-very dissatisfactory, 2-dissatisfactory, 3-neutral, 4-satisfactory, 5-very satisfactory). Colour was also assessed for its intensity from more yellow to more orange on a 5-point scale. **Annex 1** presents the evaluation form used. Each participant received portions of both samples, with one being the PE10SP formulation and the other SP as control, coded discreetly, as shown in **Figure 1**.



Figure 1. Presentation of pumpkin pulp formulations for acceptance assessment testing.

Figure 2 displays photographs taken during the sensory analysis activity, showcasing the tasting room, the assistance provided, and the project dissemination materials.



Figure 2. Photographic documentation of sensory analysis of pumpkin formulations.

Among the 106 participants, 77 were female with ages ranging from 19 to 66 years, and 29 were male with ages ranging from 19 to 55 years.

Figure 3 presents the number of responses for each formulation, reflecting consumers' perception of colour intensity, on a scale that goes from the most yellow to the most orange.

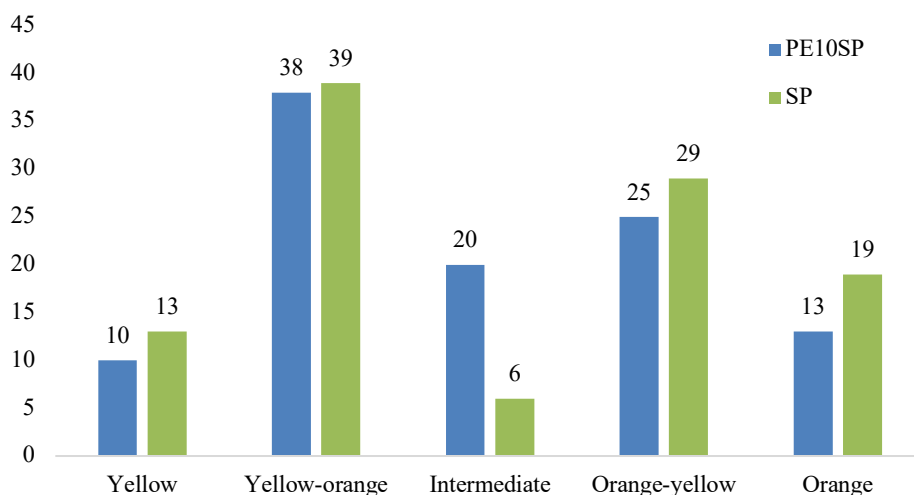


Figure 3. Comparison of colour intensity preferences between PE10SP and SP formulations.

The analysis of colour intensity data between the PE10SP and SP formulations reveals a relatively uniform distribution in participant preferences. The majority of participants rated both formulations within the “yellow-orange” and “orange-yellow” intensities, with 38 and 39 responses for “yellow-orange” and 25 and 29 responses for “orange-yellow”, respectively. Minor variations observed in other categories, such as “intermediate” and “orange”, also do not indicate significant discrepancies that could compromise the comparability of the samples. Additionally, it is noteworthy that 40 out of the 106 participants gave the same rating for both samples. Therefore, we can conclude that there are no substantial differences in the colour perceptions between the PE10SP and SP samples, suggesting that both formulations are comparable in terms of perceived colour intensity by the participants.

In **Tables 1** and **2**, the number of consumers who reported each perception for formulations PE10SP and SP, respectively, across the criteria of colour, aroma, taste, and texture, is presented. To facilitate comparison, the total score for each criterion was calculated by summing the number of responses for each perception level, according to their respective rating.

Table 1. Number of responses per grade of perception for each criterion, and respective total score and mean \pm standard deviation for each criterion, for PE10SP formulation.

Perception (P)	Equivalent grade (EG)	Criterion			
		Colour	Aroma	Taste	Texture
Very dissatisfactory	1	4	2	5	5
Dissatisfactory	2	12	18	33	12
Neutral	3	19	27	16	15

Satisfactory	4	48	43	43	51
Very satisfactory	5	23	16	9	23
Total grade ($\Sigma P \times EG$)		392	371	336	393
Mean \pm SD		3.70 \pm 1.05	3.50 \pm 1.01	3.17 \pm 1.11	3.71 \pm 1.08

Table 2. Number of responses per grade of perception for each criterion, and respective total score and mean \pm standard deviation for each criterion, for SP formulation.

Perception (P)	Equivalent grade (EG)	Criterion			
		Colour	Aroma	Taste	Texture
Very dissatisfactory	1	8	5	7	6
Dissatisfactory	2	2	8	16	11
Neutral	3	9	28	21	15
Satisfactory	4	29	40	44	49
Very satisfactory	5	58	25	18	25
Total grade ($\Sigma P \times EG$)		445	390	368	394
Mean \pm SD		4.20 \pm 1.17	3.68 \pm 1.07	3.47 \pm 1.14	3.72 \pm 1.11

Moreover, **Figure 4** presents a comparison of consumer perceptions for formulations PE10SP and SP based on the criteria of colour, aroma, taste, and texture. This visualization facilitates the comparison of the two formulations across different sensory attributes.

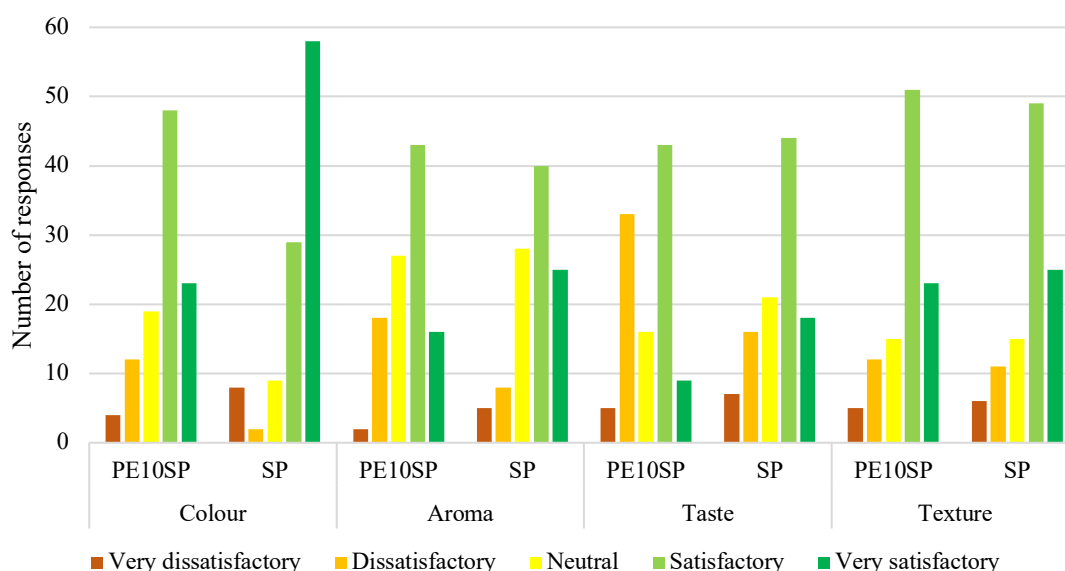


Figure 4. Comparative sensory evaluation of formulations PE10SP and SP.

In both the aroma and texture criteria, there is a noticeable similarity in the distribution of perception categories. For texture, there is a concentration of distribution in the “satisfactory” and “very satisfactory” categories, followed by lower counts in the other categories, for both

formulations. In terms of aroma, the distribution is concentrated in the “satisfactory” and “neutral” categories for both samples. However, for the SP formulation, the next most common category is “very satisfactory”, while for the PE10SP, “very satisfactory” and “dissatisfactory” are represented in similar proportions. Overall, both formulations exhibit positive trends in consumer perception of these attributes. While there are some differences in the distribution of responses, the similarities suggest that both formulations are generally well-received in these sensory attributes.

On the other hand, for the colour and taste criteria, consumers exhibited stronger criticality. Regarding taste, there is a predominance of “satisfactory” responses, followed by a trend towards “dissatisfactory” for PE10SP, and a balance between “dissatisfactory”, “neutral” and “very satisfactory” for SP. For colour, despite the predominance of responses in the “satisfactory” and “very satisfactory” categories, there is a distribution between “neutral” and “dissatisfactory” for PE10SP, contrasted by eight “very dissatisfactory” responses for SP. It is noteworthy that 49 and 47 out of the 106 participants gave the same rating for both formulations for colour and taste respectively, which demonstrates similarity in the perception of the formulations. This could be due to the fact, that this pulp is not sweet nor salty, is more neutral in order to be applied in both flavours.

In general, based on the bar graph in **Figure 4** and the analysis of means and standard deviations in **Tables 1** and **2**, it’s possible to conclude that there are no substantial differences in consumer perception between the PE10SP and SP formulations. Both showed a distribution of similar preferences and perceptions regarding colour, aroma, taste, and texture attributes. This suggests that the formulations can be considered comparable from a consumer preference perspective.

4. Prospection

Since the formulations can be considered comparable and the partial replacement of potassium sorbate by pumpkin peel extract is feasible, in Deliverable 4.6 the global acceptability of the formulations was evaluated as well as their quality.

Annex 1

19/06/24, 22:23

Prova Sensorial - PulpIng

Prova Sensorial - PulpIng

Prova sensorial para avaliação de polpa de abóbora com conservante natural de casca de abóbora em comparação com a formulação tradicional com sorbato de potássio .

Instruções:

Estão a ser entregues duas amostras de formulação de polpa de abóbora para si. Por favor, avalie-as atentamente conforme indicado em cada questão.

Observações:

Por favor, limpe seu paladar entre as amostras com água;
Não discuta suas opiniões com outros participantes durante a avaliação.

* Indica uma pergunta obrigatória

1. Nome *

2. Idade *

Exemplo: 7 de janeiro de 2019

3. Sexo *

Marcar apenas uma oval.

Feminino

Masculino

Prefiro não dizer

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4. **Cor** *

Avalie a cor com relação a sua intensidade amarelo/laranja

Marcar apenas uma oval por linha.

	Amarelo	Amarelo-alaranjado	Intermédio	Alaranjado-amarelo	Laranja
Amostra 256	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amostra 875	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. **Cor** *

Avalie a cor conforme a atratividade visual

Marcar apenas uma oval por linha.

	Muito insatisfatório	Insatisfatório	Indiferente	Satisfatório	Muito satisfatório
Amostra 256	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amostra 875	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. **Aroma** *

Avalie a atratividade do aroma, ou seja, o quanto este é agradável e característico.

Marcar apenas uma oval por linha.

	Muito insatisfatório	Insatisfatório	Indiferente	Satisfatório	Muito satisfatório
Amostra 256	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amostra 875	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. **Sabor** *

Avalie a agradabilidade do sabor, ou seja, o quanto é atrativo e característico.

Marcar apenas uma oval por linha.

	Muito insatisfatório	Insatisfatório	Indiferente	Satisfatório	Muito satisfatório
Amostra 256	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amostra 875	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. **Textura** *

Avalie a agradabilidade da textura dos produtos

Marcar apenas uma oval por linha.

	Muito insatisfatório	Insatisfatório	Indiferente	Satisfatório	Muito satisfatório
Amostra 256	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amostra 875	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. **Avaliação Global** *

Avalie os produtos considerando o aspecto global

Marcar apenas uma oval por linha.

	Muito insatisfatório	Insatisfatório	Indiferente	Satisfatório	Muito satisfatório
Amostra 256	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amostra 875	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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10. **Comentários adicionais**

Deixo seu comentário sobre o que achou dos produtos

11. **Você prefere consumir produtos naturais e livres de conservantes artificiais? ***

Marque todas que se aplicam.

- Sim, prefiro produtos naturais sem conservantes artificiais
- Sim, mas não é um fator determinante na minha escolha
- Não, não tenho preferência por produtos naturais
- Não tenho opinião formada sobre o assunto
- Outro: _____

12. **Qual a principal razão para sua escolha acima? ***

Por favor, selecione a opção que mais se aplica a você

Marque todas que se aplicam.

- Preocupação com a saúde e segurança alimentar
- Preocupação com o meio ambiente e sustentabilidade
- Melhor sabor e qualidade dos produtos naturais
- Influência de informações e campanhas publicitárias
- Não tenho opinião formada sobre o assunto
- Outro: _____

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