INTERPROFESIONAL DEL ACEITE DE ORUJO DE OLIVA

Functionality of Puff Pastry Olive Pomace Oil-Based Margarines and Their Baking Performance.

ICTAN - CSIC

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Summary of the ICTAN - CSIC research study report on the use of olive pomace oil as a fat substitute in the production of margarines for puff pastry.

1. RESEARCH DESCRIPTION

Study
"Functionality of Puff Pastry Olive Pomace Oil-Based Margarines and Their Baking Performance."

Research center
Institute of Food Science and Technology and Nutrition (ICTAN) of the Spanish National Research Council (CSIC).

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Objective of the study
The general objective of this project was to investigate the potential functionality of olive pomace oil (OPO) as an ingredient in the preparation of margarines for subsequent use in puff pastry. The study developed two lines of action to address this aim:

First, it **assessed the technological functionality of OPO in the formulation of margarines** as a substitute for saturated solid fat present in butter and commercial fatty preparations commonly used in puff pastry production.

Second, it **assessed the technological applicability of margarines made with OPO** and selected, according to the results obtained, for the preparation of puff pastry.

Methodology
The following tasks have been conducted to accomplish the **first action:**

1) Study of the **composition factors of** the oily phase (OP) (type and proportion of lipid ingredients and organogelifying agents) and aqueous phase (AP) (type and proportion of ingredients), as well as the processing conditions (type of homogenizer, emulsification temperature and time, cooling speed, etc.) involved in the formulation and development of margarines with OPO, and with characteristics suitable for their use in puff pastry production.

   Margarine is a **water-in-oil** (W/O) **emulsion** mainly composed of a variable percentage OP. Margarines with application in puff pastry require a higher solids content than table margarines to ensure good baking properties and high plasticity for repeated spreading. Therefore, in this study, all margarines were formulated using an OP:AP ratio of 80:20.

   In this task, numerous formulations of margarines for puff pastry were developed (~ 40), depending on composition and processing factors, to find formulations with characteristics close to those presented by a commercial butter and fat preparation, and commonly used in puff pastry production.

2) **Preparation of margarines** containing OPO with optimal composition and processing conditions selected based on the previous point.

Ingredients and concentrations in the final margarines	
MARGARINE (M1, M2)	**MARGARINE (M3, M4)**
OILY PHASE (80%) Olive Pomace Oil (40.75%) - Palm stearin (23.5%) - Butter (7.5%) - Soybean lecithin (1.5%) - Palsgaard 1311 (1.17%) - Verol N90 (0.83%) - Verol P-Flakes (1.75%) - Beeswax (3%) Cocoa butter (x)	OILY PHASE (80%) Olive Pomace Oil (30.75%) - Palm stearin (23.5%) - Butter (7.5%) - Soybean lecithin (1.5%) - Palsgaard 1311 (1,17%) - Verol N90 (0.83%) - Verol P-Flakes (1.75%) - Beeswax (3%) Cocoa butter (10%)
AQUEOUS PHASE (20%) - Water (17.785%) - Cream of tartar (0.25%) - Flavor (0.375%) - Salt (1%) - Gelatin (0.5%) - Citric acid (0.0025%)	AQUEOUS PHASE (20%) - Water (17.785%) - Cream of tartar (0.25%) - Flavor (0.375%) - Salt (1%) - Gelatin (0.5%) - Citric acid (0.0025%)

3) Characterization of the **physicochemical** (rheological, textural, color, oil retention capacity), thermal, structural, and nutritional (lipid profile) **properties** of margarines developed with OPO. In addition, a commercial butter (CB) and a commercial fat preparation (CFP), commonly used in puff pastry production are characterized, which were used as controls throughout the process.
4) Study of **preservation under refrigeration conditions** of margarines with OPO with the most suitable physicochemical and nutritional characteristics obtained in the previous tasks. Evaluation of physicochemical and thermal properties and oxidative stability.

The following tasks have been implemented as part of the **second line of action:**

1) Study of the **compositional factors** (type and concentration of dough constituent ingredients) and processing conditions (number and type of folds, dough resting times, etc.) involved in puff pastry production. Study of the baking conditions (times and temperatures) of margarine-based puff pastry made with OPO and commercial controls.

2) **Characterization of puff pastries** made with commercial butter (CB) and fat preparation (CFP), and with four margarines with OPO selected from the

previous tasks. Study of **baking behavior** (texture, color, weight loss, percentage growth, shrinkage, etc.), lipid profile and sensory evaluation.

Preparation and baking of puff pastry dough
Ingredients Mix Dough resting Flour Margarin in Flour 1st Petal 2nd Petal 3rd Petal 4th Petal Stretched pastry 2 simple folds Double fold Dough ready for baking Half baked Final pastry

3) Assessment of the effect of **refrigerated storage** of margarines formulated with OPO on the behavior of puff pastry. Study of the response to baking (texture, weight loss, percentage growth, puff pastry height, etc.).

2. RESULTS

Related to the study of margarines

- From a **technological point of view**, it is feasible to formulate margarines for puff pastry with significant amounts of Olive Pomace Oil (OPO), using a specific mixture of lipid materials in terms of type and proportion (organogelifying/emulsifying agents/solid fats) which is necessary to structure the liquid oil, as well as certain processing conditions (emulsification time and temperature and initial cooling speed).

  Based on this premise, we optimized the formulation of two margarines, one containing 41% OPO and the other containing 31% OPO and 10% cocoa butter, which were cooled using two initial crystallization speeds. The four margarines produced (different composition and cooling speed) showed rheological (plasticity), textural, thermal, structural, and organoleptic (odor, color, appearance) properties very close to those of commercially available butter and fatty puff pastry preparations.

- From a **nutritional point of view**, the stand-out feature is the improvement of the lipid profile of margarines containing OPO, based on a lower content in saturated fatty acids (37% - without cocoa butter and 28% - with cocoa butter) and higher in monounsaturated fatty acids (58% - without cocoa butter and 54% - with cocoa butter), compared to commercial butter for puff pastry.

	Lipid profile			
Fatty acids (mg GA/g sample)	CFP	CB	M1/M2	M3/M4
Σ AGS	278	593	354	403
Σ AGM	408	180	429	387
Σ AGP	80.5	16.8	78.7	68.2
Σ AGM + Σ AGP	488	197	508	455

CFP: commercial fatty preparation
CB: commercial butter
M1/M2: margarines formulated with 41% OPO
M3/M4: margarines formulated with 31% OPO and 10% cocoa butter

- During the **refrigeration storage period (60 days),** margarines containing 41% OPO were very stable at the technological, organoleptic, and oxidative levels. However, margarines containing a lower amount of OPO and with cocoa butter were less stable, exhibited significant changes in their structure due to the formation of fat crystal aggregates, which led to a deterioration of their physicochemical properties and, subsequently, to a loss of their functionality. However, these technological changes did not affect their lipid profile.

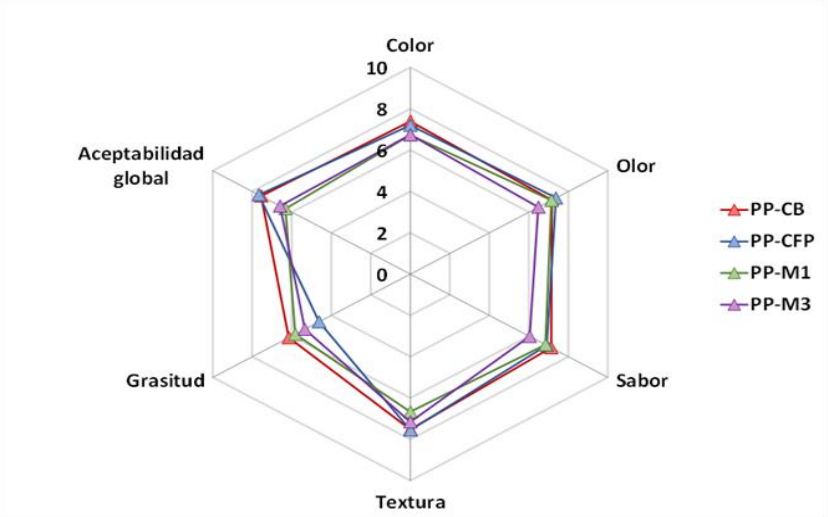
Related to study of puff pastry

- **At the technological level**, the puff pastry produced with the freshly prepared margarines, containing both 41% and 31% OPO and 10% cocoa butter, showed **excellent baking performance** (percentage of growth, height of the puff pastry, number of layers, color, etc.). However, because of the structural modifications undergone by the margarines containing cocoa butter after 18 days of refrigeration, the puff pastries made with these margarines showed a poorer response when baked (greater weight loss and shrinkage, lower number of layers, etc.).

- From a **nutritional point of view**, the puff pastry made with both margarines containing different amounts of OPO had a better lipid profile than those made with commercial butter. Compared to the latter, the puff pastries prepared with the margarines with OPO (41 and 31%) presented a reduction in saturated fatty acid content of 37 and 25%, respectively, and with a much higher oleic acid content. Therefore, these puff pastries are a healthier option for all consumers.

- At the **sensory level**, the 30 panelists (untrained but familiar with the various attributes of the four puff pastries assessed) gave high mean scores for color, odor, flavor, texture, and overall acceptability, ranging from 6 to 8 on a scale of 10. However, the fatty sensation scores were lower and ranged from 4 to 6. However, there were no significant differences in the sensory attributes or overall acceptability of the four puff pastries assessed by the panelists, suggesting that commercial butter and fat preparation could be replaced by the margarines developed with OPO without affecting the overall acceptability of the final puff pastry.

Sensory analysis of puff pastry



PP-CB: puff pastry made with commercial butter
PP-CFP: puff pastry made with commercial fat preparation
PP-M1: puff pastry made with margarine formulated with 41% OPO
PP-M3: puff pastry made with margarine formulated with 31% OPO and 10% cocoa butter.

3. CONCLUSIONS

- The results of this project have shown the **technological functionality of olive pomace oil (OPO) in preparing margarines to replace saturated fats present in commercial fatty preparations**, and to be incorporated in laminated dough to obtain different final baked products (puff pastry, vol-au-vents, croissants, crodots, palmiers, etc.).

- From the technological point of view, when freshly prepared, the four margarines formulated showed **plasticity, textural, thermal, structural, and organoleptic properties very close to those of** commercial butters and fatty puff formulations. However, in relation to the processing conditions, it is advisable to test production at pilot plant and industrial scale to optimize crystallization. The puff pastry showed **excellent baking performance** (percentage growth, puff pastry height, number of layers, color, etc.). However, the response shown by margarines with cocoa butter after 18 days of storage under refrigeration was poorer.

- From the nutritional point of view, the most noteworthy aspect is the improvement in the lipid profile of the margarines containing OPO. The puff pastry produced with OPO margarines showed a **reduction in the saturated fatty acid content of between 25% and 37%.**

At the sensory level, the panelists found no differences between the sensory attributes and overall acceptability of the puff pastries prepared with the two OPO margarines and those of the puff pastry prepared with the commercial butter and fat preparation.