

Development of innovative biotechnological protocols for the valorisation of by-products, waste and agri-food surpluses as a strategy for the sustainability of systems in marginal areas

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Introduction

In order to re-use by-products of marginal areas, the activities of the PhD project focused on valorization of almond skin. Following spontaneous fermentations of by-product under uncontrolled and in strict anaerobic condition, autochthons lactic acid bacteria (LAB) were isolated. LAB have been identified and characterized in order to select the best performing starter to be used for a fermentation of almond skin. The mixture of fermented almond skin and tap water has been used as an ingredient for the production of gluten-free muffins.

This poster reports the main results of the first activities:

- (A1) Microbial and chemical characterization of almond skin;
- (A2) Isolation and identification of LAB from fermented almond skin;
- (A3) Inoculum of lab identified in almond skin mixture to select the most performing through acidification kinetics and exopolysaccharide (EPS) production tests;
- (A4) Development of the fermentation protocol for almond skin mixtures and production of high-fiber gluten-free muffin.

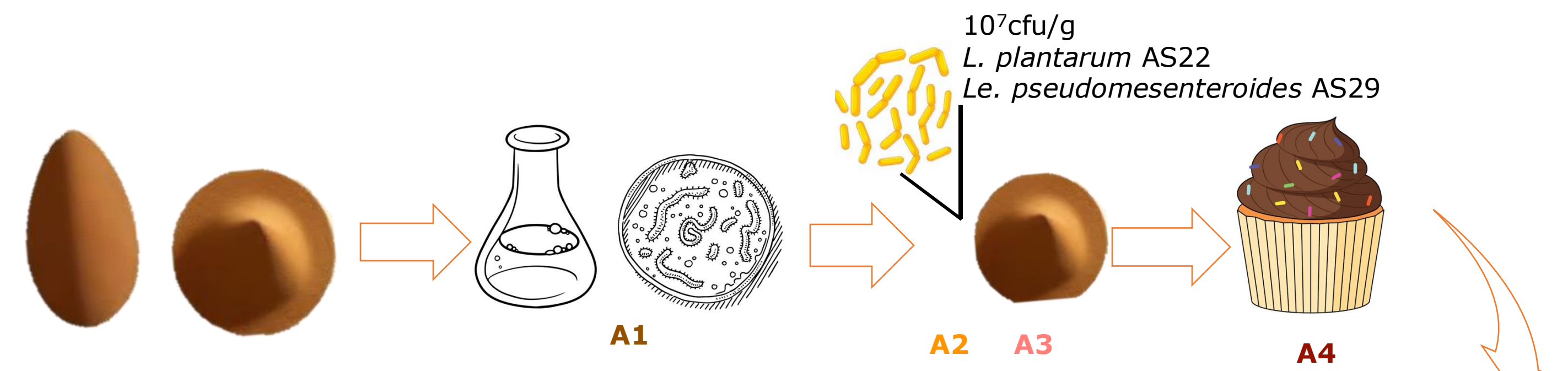


Table 1. Muffin ingredients

	LB	LBMD	LN25	LNMD25	LN80	LNMD80
Rice Flour	100	93.4	100	93.4	100	93.4
Sugar	6	6	4.75	4.75	2.00	2.00
Stevia	4	4	4	4	4	4
Deoiled almond	-	6.6	-	6.6	-	6.6
Improvement of structure	3.3	3.3	3.3	3.3	3.3	3.3
Vanilla flavor	1.1	1.1	1.1	1.1	1.1	1.1
Sunflower seed oil	45	45	45	45	45	45
Milk	100	100	43	43	43	43
Brewer's Yeast	1.65	1.65	1.65	1.65	1.65	1.65
Mixture of fermented almond skin	-	-	25	25	80	80

Materials and methods

(A2) Spontaneous fermentation was carried out on almond skin mixtures and sterile tap water (1:3) incubated at 30 °C for 8h under uncontrolled growing conditions and under strict anaerobic conditions. At the end of the incubation hours, 6 refreshments were carried out at 25%.

(A3) Microorganisms were inoculated individually on sterile almond skin powder mixtures and incubated at 30°C for 24h. The acidification kinetics were achieved by measuring the pH every 2h. In addition, in order to verify the ability to produce EPS, the above-mentioned microorganisms were inoculated on mixtures with 5% (w/w) of sucrose added and incubated at 25 and 30 °C for 24h. The production of EPS was evaluated, by plate observation, as follows : - no production; low production (low presence of mucoid colonies with a diameter <1mm and no filament); + high production (presence of mucoid colonies greater than 5mm in diameter and presence of filament).

(A4) Pre- and post-fermentation mixtures were tested for antioxidant activity with DPPH assay. The fermented almond skin mixture was used to produce four experimental gluten-free muffin theses. Specifically, the mixture was added at 25% and 80% (w/w) (Table 1).

Results

Table 2. Values (%) of the biochemical measurements of almond skin powder

Protein	Fat	Total carbs	Dietary fiber	Ash
10.21%	15.26%	2.80%	50.64%	3.95%

Almond skin powder is mainly composed of total dietary fiber, fat and protein.

Table 3. EPS production by isolates

Isolates	EPS
<i>L. plantarum</i> AS12	±
<i>L. plantarum</i> AS22	±
<i>Le. pseudomesenteroides</i> AS25	+
<i>Le. pseudomesenteroides</i> AS29	+
<i>Le. mesenteroides</i> AS30	-
<i>Le. mesenteroides</i> AS31	-
<i>Le. mesenteroides</i> AS39	-
<i>Le. mesenteroides</i> AS44	-

The highest EPS production occurred when the strains were incubated at 30°C compared to 20°C. Moreover, EPS production was different depending on the isolate.

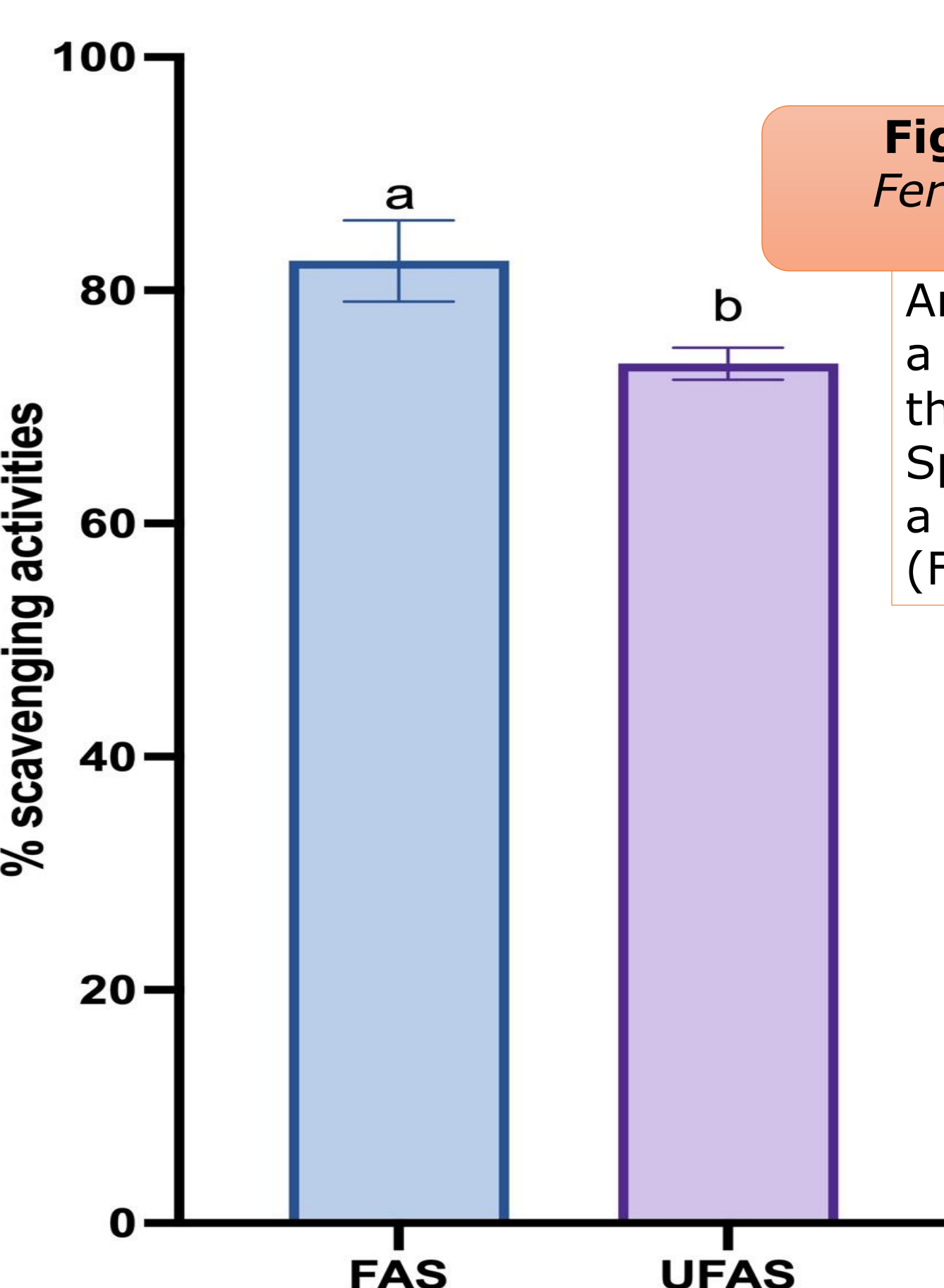


Figure 1. Antioxidant activities of Fermented (FAS) and unfermented mixture (UFAS)

Antioxidant activity increased in a statistically significant way in the fermented mixture. Specifically, the samples showed a % scavenging activity of 82% (FAS) and 73%.

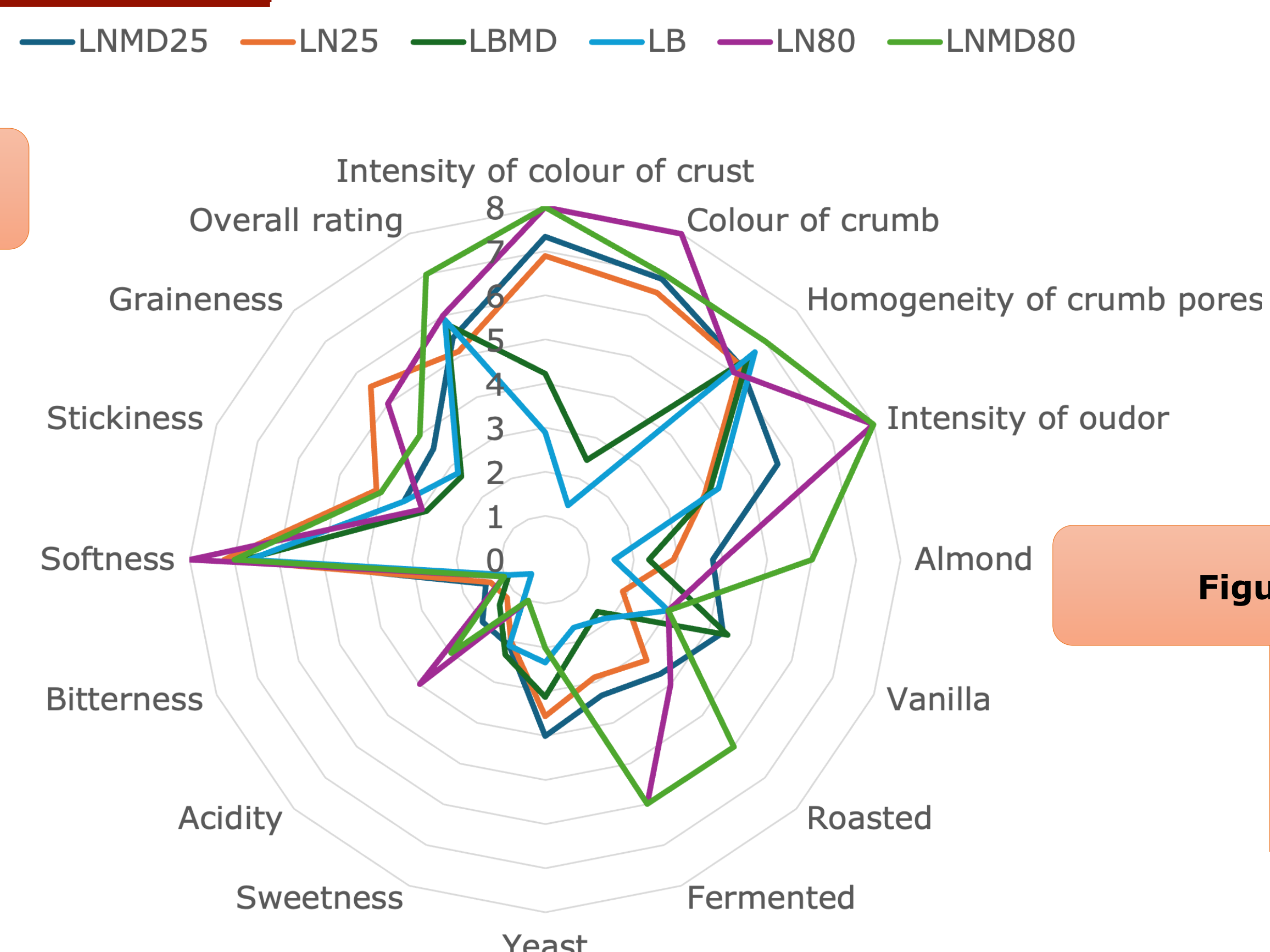


Figure 2. Sensory Analysis

The addition of the mixture of fermented almond skin and deoiled almond flour changed the sensory profile of the muffins.