Impact of vine shoots xylooligosaccharides on the nutritional, technological, and sensory properties of spreadable goat cheese

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A spreadable goat milk cheese fortified with a rich-xylooligosaccharides extract (XE) was developed. The experimental samples were analysed for proximate composition, colorimetric and textural properties. Finally, the sensory features were evaluated.

Impatto di xilooligosaccaridi estratti da tralci di vite sulle proprietà nutrizionali, tecnologiche e sensoriali di formaggio spalmabile di capra

Le attività del progetto di tesi di dottorato hanno previsto la produzione di formaggio spalmabile di capra fortificato con estratto ricco in xilooligosaccaridi (XOS). Successivamente i campioni ottenuti sono stati caratterizzati valutando la composizione centesimale, il colore e le caratteristiche strutturali. È stata inoltre effettuata la valutazione del profilo sensoriale.

**Keywords**: spreadable goat cheese; vine shoot; xylooligosaccharide extract.

# **1. Introduction**

This poster reports the main results of the activities concerning the manufacturing and characterization of a spreadable goat cheese fortified with XE obtained from vine shoots by steam explosion.

# **2. Materials and Methods**

**2.1.Preparation of the XE and spreadable goat cheese production**

The XE was extracted from vine shoots with the steam explosion technique, operating at 210 °C for 5 minutes. XOS concentration in the extract was 34 g/L. The XOS syrup was freeze-dried and stored at -20 °C. Raw goat milk was pasteurized at 65 °C for 30 minutes in a thermostatic bath. After lowering the temperature to 30 °C, a mixed starter culture (*Lactobacillus delbrueckii subsp. bulgaricus* and *Streptococcus thermophilus*) and a small amount of rennet were added (75 µL/L). Coagulation occurred at 30 °C overnight, then the curd obtained was cut into fragments of about 3 centimetres to allow a slight whey draining. The curd obtained was added with 5.5 g of XE per 100 g of product and homogenized, after that the cheese was placed in hermetically sealed jar, pasteurized at 65 °C for 30 minutes, and stored at 4 °C. A cheese sample prepared without XE was used as control (FC).

**2.2. Characterization of FC and FX**

Protein, ash, lipid, and total fiber content were determined using the AOAC methods 979.09, 923.03, 945.38, and 991.43, respectively. Lactose, galactose, and organic acids were determined by high-performance liquid chromatography (HPLC) (Trani et al., 2017; Buffa et al., 2004). Moisture was determined by a moisture analyser MAC 110/NP. The pH was measured with a pH-meter. Water activity (aw) was determined by using the water activity meter Aqua Lab 4TE. The CM-600d colorimeter (Konica Minolta, Tokyo, Japan) and SpectraMagic NX software were used for the color analysis. Brightness (*L\**), red index (*a\**), and yellow index (*b\**) are considered in accordance with the International Commission on Illumination. Back extrusion was evaluated according to De Angelis et al. (2022). Sensory analysis of cheeses was performed by a semi-trained sensory panel composed of ten members. The descriptors were selected considering the ONAF (Italian Organization of Cheese Tasters) vocabulary (Gambera, 2008) were rated on a 1-5 score range. Minitab19 (Minitab Inc., State College, PA, USA) was used for the statistical analysis of all results, reported as mean ± standard deviation (SD) of three replications. To evaluate the differences between samples, one-way ANOVA followed by Tukey’s HSD test was applied.

# **3. Results and Discussion**

The addition of XOS caused a slight increase in pH, as the pH value of the extract was 4.40. The addition of XE in FX led to about 5% decrease in moisture, probably due to a higher syneresis during the homogenization process. In addition, non-digestible oligosaccharides such as XOS contribute to an increase in soluble solids in cheese formulation with a consequence on product moisture. No significant differences were found for water activity, lipid, lactose, galactose, and organic acids. An opposite trend occurred for proteins that were found to be greater in FX. The addition of plant extracts may promote the fixation of soluble proteins to the para-casein network or the formation of small protein aggregates, resulting in an increase in the protein content of cheeses (da Silva et al., 2015). The results of the total dietary fibers highlight the high concentration of fibers in FX. One of the objectives of this study was the enrichment of spreadable goat cheese with xylooligosaccharides for the attribution of the claim “*Source of fiber*” (at least 3 g of fiber per 100 g of product in accordance with EC Regulation No. 1924/2006). The results show that the amount of fiber found in functional cheese was 3.56 g/100g of cheese.

***Table 1.*** Proximate composition (g/100g) of FC and FX.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Moisture** | **aw** | **pH** | **Lipid** | **Total fiber** | **Protein** | **Lactose** | **Galactose** | **Lactic acid** | **Acetic acid** | **Ash** |
| *FC* | 74.6±0.84A | 0.99±0.00 A | 4.12±0.01 B | 11.89±0.26 A | nd | 8.88±0.04 B | 1.63±0.18 A | 0.60±0.12 A | 0.67±0.27 A | 0.31±0.14 A | 0.63±0.03 B |
| *FX* | 71.17±0.91B | 0.99±0.00 A | 4.22±0.01A | 11.40±0.10 A | 3.56±0.09  | 9.42±0.10 A | 1.60±0.20 A | 0.56±0.06 A | 0.61±0.10 A | 0.35±0.17 A | 0.99±0.05 A |
| FC, spreadable goat cheese; FX, spreadable goat cheese with xylooligosaccharides extract; aw, water activity.Results are expressed as mean±standard deviation. Analysis performed in triplicate. Different letters indicate statistical differences according to Tukey’s test (p < 0.05). |

***Table 2***. Colorimetric and textural properties of FC and FX.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **L\*** | **a\*** | **b\*** | **Firmness** | **Consistency** | **Cohesiveness** | **Viscosity** |
| *FC* | 82.17± 0.04A | -1.51±0.00B | 10.47±0.06B | 2.38±0.30A | 19.54±1.09A | -0.87±0.10A | 8.54±0.91A |
| *FX* | 50.78± 0.44B | 7.93±0.22A | 26.11±0.51A | 1.74±0.07B | 12.34±1.06B | -0.66±0.22A | 5.53±0.63B |
| FC, spreadable goat cheese; FX, spreadable goat cheese with xylooligosaccharides extract; L\*, brightness; a\*, red index; b\*, yellow index.Results are expressed as mean±standard deviation. Analysis performed in triplicate. Different letters indicate statistical differences according to Tukey’s test (p < 0.05). |

***Figure 1***. Sensory analysis of FC and FX. \*, statistically different values (p < 0.05).

***Figure 2.*** Appearance of FC (***A***) and FX (***B***).

***A***)

***B***)



Concerning color analysis, the addition of XE determined a decrease in *L\** for FX and an increase of *a\** and *b\** values. FX showed a browning effect (***Figure 2B***), caused by dark pigments in XE. In general, the addition of by-product extracts or flours in the cheese formulation leads to a tendency to decrease the brightness in the final product and to increase the red and yellow parameters depending on the type of extract added (Difonzo et al., 2023). Significant differences between the two samples were also found for back extrusion analysis. In FX was found a decrease in firmness, related to an increase in pH, as mentioned above. The homogenization process for incorporating XE in the cheese may be the cause of a reduction in cheese consistency. This phase of the production process subjected the cheese to greater mechanical stress that was reflected in the consistency parameter. The addition of XOS extract also caused a decrease in cheese viscosity, and an increase in cohesiveness. Textural features may depend on the particle size of the extract and the interaction between the insoluble fibres and the protein gel created during cheesemaking (Xue et al., 2020). The addition of XE significantly affected the cheese’s sensory features (***Figure 1***). The results of the visual analysis confirmed the instrumental color analysis. Maillard compounds present in XE thus influenced the final color of FX. The flavor, which includes sweet, salty, acid, bitter, and astringent was similar in FC and FX. Thus, it can be stated that the addition of XE resulted in a limited change in the perception of basic tastes. The same trend was found for the texture attributes. The taste-olfactory attributes showed strong differences between the two samples. The odor intensity increased significantly in FX. No significant differences were found for vegetable and buttermilk descriptors. The significantly higher attributes in FX were roasted coffee and caramel. The hazelnut, chocolate, and woody odors showed a significant increase in FX and were absent in CT. The overall acceptability was not significantly different (3.6 FC and 3.5 FX). In general, the experimental cheese showed a greater complexity of smells and flavors that was appreciated by the group of tasters.

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