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The Relation Between Protein-Protein and Polysaccharide-Protein Interactions on Aroma Release from Brined Cheese Model

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Abstract. The relation between textural parameters and casein network on release of aromatic compounds was investigated over 90-days of ripening. Low DE (Dextrose Equivalent) maltodextrin and WPI (Whey Protein Isolate) were used to modify the textural properties of low fat brined cheese. Hardness and compaction of casein network were affected by addition of maltodextrin and WPI. Textural properties and aroma release from cheese texture were affected by interaction of WPI protein-cheese protein and maltodexterin-cheese protein.

Keywords: maltodexterin, WPI, brined cheese, aroma release

1. Introduction

Flavour and texture of low fat brined cheese is significantly different from full fat cheese. Several researchers have proposed the addition of polysaccharides and whey protein concentrate (WPC) to modify the rheological properties of low fat cheese [1]. The effect of k- and λ-carrageenans on the low fat Oaxaca characterization was previously studied [2]. Textural properties of reduced fat Cheddar cheese were improved in the presence of Xanthan gum and sodium caseinate as fat replacers [3]. Other researchers reported that some of the compositional properties of reduced fat Oxaca cheese were improved by the addition of skim milk or dry milk protein [4]. One of the defect occurred during fat reducing of cheese is fail to produce a balance intense flavour. Rate of aroma release from products was affected by volatility of the aroma compounds in the product base (thermodynamic factor) and the resistance to mass transfer from product to air (kinetic factor) [5]. Aroma volatile diffusion coefficient in dairy matrices with different composition and microstructure were calculated by other researchers [6]. Since polysaccharides added to modify textural properties of low fat cheese change kinetic factor of aromatic compounds play an important role in aroma release from cheese texture. In this research, the effect of low DE maltodexterin (DE=20) and WPI on texture and aroma release of low fat brined cheese was investigated.

2. Material and Method

2.1. Iranian White Brined Cheese Production

Full fat and low fat cheeses were produced from milk containing 3% and 0.4% fat, respectively. For production of low fat cheese containing fat replacer, 0.02% maltodextrin or WPI were added to milk. Iranian white brined cheese was produced according to method proposed by [1]. For cheese flavoring, 0.1% Ethyl acetate, Ethyl butyrate, Ethyl hexanoate and 3-methyl butanol (Sigma-Aldrich, Germany) were added to pasteurized and cooled milk.

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2.2. Evaluation of Cheese Hardness

Hardness of brined cheese during ripening was determined by texture analyzer (Testometric M350-10CT, England) fitted with a 0-50 kg load cell according to the method proposed by other researchers [7]. Cheese cube samples (20×20×20 mm) adjusted to 12±5℃ were compressed to 70% of their initial height with a plunger, 40 mm in diameter and 30 mm/min speed.

2.3. Microstructure

Cheese samples were prepared for microstructure study with scanning electron microscopy (SEM) after 90 days of ripening, according to [8] method with some modifications suggested by [9]. This method is based on fixation of microstructure in gluteraldehyde, dehydration with ethanol and de fatting in chloroform.

2.4. Determination of Aroma Compounds by SPME-GC-MS

Aroma release from cheese texture after 90 days of ripening was assessed with [10] method. DVB/CAR/PDMS [divinylbenzene/carboxen/polydimethylsiloxane] fiber, 50/30 μm film thickness bonded to a flexible fused silica core (Supelco), was selected for all extractions.

2.5. Statistical Analysis

SPSS version 15 was applied for all statistical analyses. All experiments were done in triplicate and Duncan test was used to investigate the effect of ripening on hardness and comparison between area peaks of aromatic compounds.

3. Result and Discussion

3.1. Evaluation of Cheese Hardness

Changes in hardness of different types of white brined cheese were shown in Figure 1. During the first month of ripening, hardness of all types of brined cheese increased due to water expel from cheese texture as a result of osmotic pressure of salt in brine. After one month of ripening, hardness of cheese samples did not change significantly which could be related to the equilibrium between water desorption resulted from osmotic pressure and water adsorption due to proteolysis. Hardness of white brined cheese increased when its fat content decreased. Hardness of low fat white brined cheese decreased when Low maltodexterin and WPI were added to low fat milk which could be related to water binding capacity of maltodexterin and caseinomacropeptide (CMP) in the WPI [11]. Our results were in agreement with the results of other researchers who reported that textural properties of low fat Oxaca cheese were improved by protein addition [4].

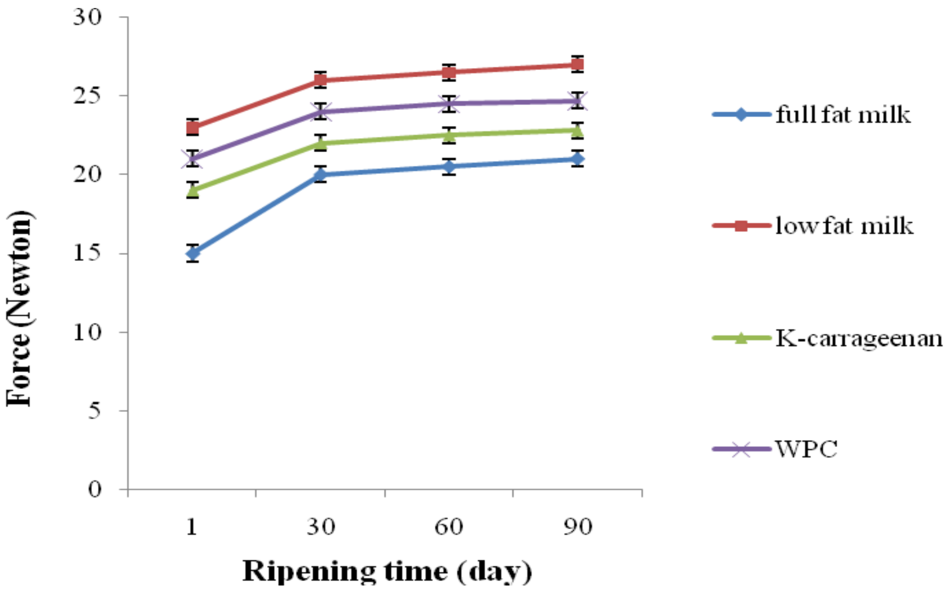

Fig. 1: Changes in hardness of low fat cheese, low fat cheese containing WPI and maltodexterin during ripening ($P<0.05$).

3.2. Microstructure

Figure 2 shows that the microstructure of low fat cheese was affected by addition of protein and polysaccharide. The Compaction of low fat cheese decreased when maltodexterin and WPI were added to it due to their water binding capacity. Other researchers reported that the density of acidified dairy matrices was affected by protein content [6]. Addition of maltodexterin leades to network formation and water was entrapped in the network voidages. Caseinomacropeptide (CMP) of WPI is responsible for water adsorption and more open structure. Similar results were reported by Rahimi *et al.* (2007), who demonstrated that the increase in tragacanth concentration led to more open matrix in Iranian white cheese [1].

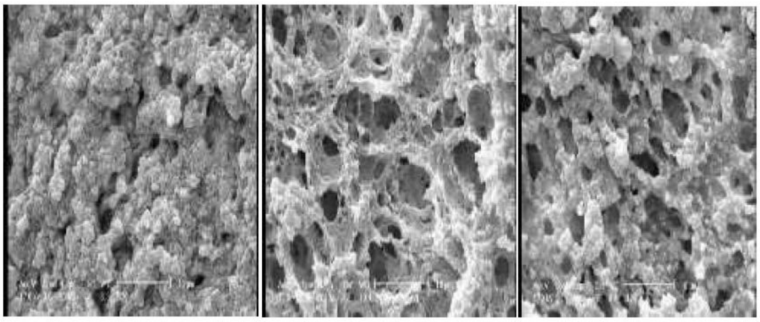

Fig. 2: Microstructure of low fat cheese, low fat cheese containing WPI and maltodexterin.

3.3. Aroma Release Determination

Table I showed that aroma release from full fat cheese is lower than low fat cheese. This difference could be related to the solubility of hydrophobic aromatic compounds in fat and softer texture of full fat cheese. Other researchers reported that hardness of cheese texture plays an important role in aroma release in in-mouth process during both mastication and post-swallowing steps. According to [11], harder casein gel induced a greater and a faster release of all aroma compounds. As shown in Table I, although the hardness of low fat cheese decreased in the presence of WPI, area peak of WPI containing cheese was significantly lower than low fat cheese which could be related to the presence of *B*-lactoglobulin. Since *B*-lactoglobulin contains several binding site [5], plays an important role in aroma retention. Other researchers [12] showed that increase in protein density (by addition of 4% protein) did not affect the diffusivity of aromatic compounds. Their results are not in agreement with our results. This difference could be related to the difference between the types of the protein. When maltodexterin was added to low fat brined cheese, aroma release from cheese texture decreased significantly. This decrease could be attributed to entrapment of aromatic compounds in gel network formed as a result of water binding capacity of polysaccharide.

Table I: Area peak of aromatic compounds released from different types of brined cheese.

Aromatic compounds	Type of cheese			
	Full fat	*Low fat*	*WPI*	*Maltodexterin*
Ethyl acetate	9.2^{b}	11.1^{a}	7.2^{c}	9.4^{b}
Ethyl butyrate	6.5^{c}	9.5^{a}	6.8^{c}	8.1^{b}
Ethyl hexanoate	6.9^{b}	8.2^{a}	5.5^{c}	7.1^{b}
3-mathyl butanol	7.3^{b}	8.5^{a}	5.2^{c}	5.9^{c}

a-c. Different letters in each row are significantly different (P<0.05)

4. Conclusion

Release of aromatic compounds from Iranian white brined cheese was affected by many factors such as hardness, the amount fat, the presence of *B*-lactoglobulin and polysaccharide compounds. Decrease in release of aromatic compounds from low fat cheese in the presence of maltodexterin and WPI - although decrease in cheese hardness- could be related to the network which is formed in the presence of maltodexterin and the presence of *B*-lactoglobulin in WPI.

5. Acknowledgements

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