

VOLATILE AROMA COMPOUNDS OF KAJMAK

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Kajmak is a traditional dairy product of the Balkan region, valued for its creamy texture, mildly acidic taste, and characteristic aroma of boiled milk. Beyond the Balkans, a closely related product, often called *kaymak*, is also manufactured in Turkey, while similar clotted cream-type products are found in the Middle East, Central Asia, Iran, Afghanistan, and India, where they are known as *kaymak*, *qeymak*, or *sarshir*, depending on the region and production method.

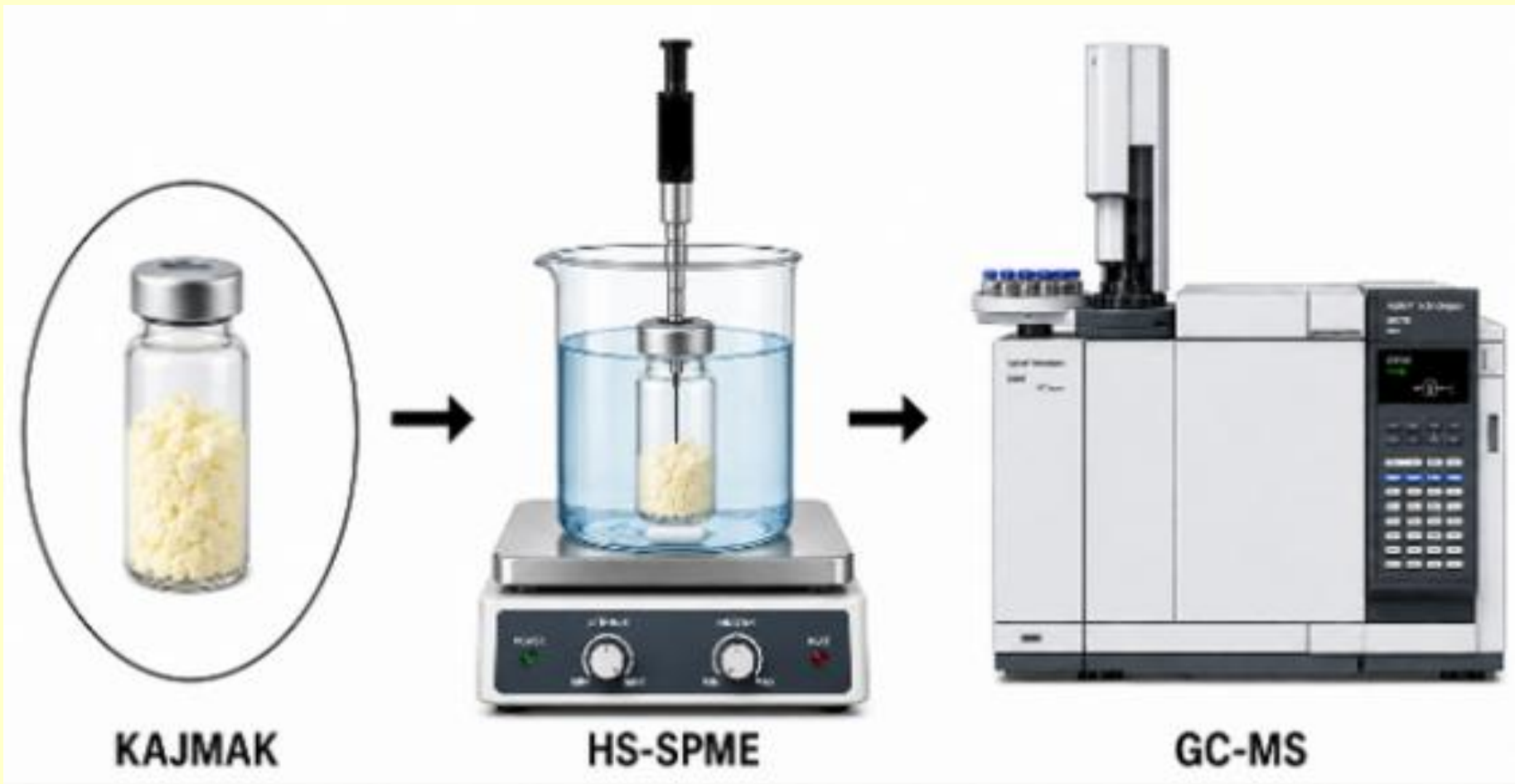
Introduction:



Kajmak is classified as a full-fat fermented dairy product, positioned between butter and soft cheese in composition, with a high milk fat content and a layered microstructure that distinguishes it from other spreadable dairy products. National regulations in Bosnia and Herzegovina distinguish fresh and mature kajmak based on ripening duration, specifying maximum moisture content and minimum fat levels. During ripening, the aroma of kajmak changes from butter-like to cheese-like, while the texture shifts in the opposite direction, becoming more butter-like and less cheese-like.

Experimental:

Two commercial kajmak samples from Bosnia and Herzegovina, one fresh and one mature, both purchased in Croatia, were investigated. Volatile aroma compounds were isolated by headspace solid-phase microextraction (HS-SPME) using two fibers of different composition and analyzed by gas chromatography-mass spectrometry (GC-MS).



Volatile aroma compounds of kajmak isolated by HS-SPME

COMPOUND NAME		RI HP-5MS	PEAK AREA% grey/blue		COMPOUND NAME	RI HP-5MS	PEAK AREA% grey/blue	
			FRESH	MATURE			FRESH	MATURE
CARBOXYLIC ACIDS					KETONES			
1. acetic acid		<800	21.21/19.35	24.06/42.64	18. acetoin	<800	8.34/13.59	-/-
2. butanoic acid		<800	4.41/2.88	5.11/5.51	19. pentan-2-one	<800	-/-	7.51/10.64
3. 3-methylbutanoic acid		835	6.28/-	0.67/-	20. heptan-2-one	892	14.76/3.28	10.41/7.35
4. hexanoic acid		980	3.10/-	5.76/2.06	21. octan-2-one	994	0.91/-	-/-
5. octanoic acid		1174	1.47/-	0.62/-	22. non-8-en-2-one	1086	1.81/-	1.22/0.73
6. tetradecanoic acid		1762	-/2.17	-/-	23. nonan-2-one	1093	20.61/0.93	5.64/2.66
7. pentadecanoic acid		1859	-/0.50	-/-	24. undecane-2-one	1294	1.97/0.61	-/-
8. hexadec-9-enoic acid		1938	-/1.53	-/-	25. tridecan-2-one	1495	-/1.11	-/-
9. hexadecanoic acid		1961	-/9.0	-/-	26. pentadecane-2-one	1696	-/1.13	-/-
10. (Z)-octadec-6-enoic acid		2128	-/1.68	-/-			48.40/20.65	24.78/21.38
11. (Z)-octadec-9-enoic acid		2152	-/0.71	-/-	ESTERS			
			36.47/37.82	36.22/50.21	27. ethyl butanoate	805	-/-	4.48/2.80
ALCOHOLS					28. ethyl hexanoate	1002	-/-	7.09/1.48
12. ethanol		<800	13.27/21.48	15.27/20.70	29. 3-hydroxy-γ-butyrolactone	1160	-/2.47	-/-
13. 3-methylbutan-1-ol		<800	-/-	1.64/-	30. ethyl octanoate	1199	-/-	2.09/0.62
14. butane-2,3-diol		<800	-/-	1.38/-	31. ethyl decanoate	1396	-/-	1.01/0.49
15. furan-2-ylmethanol		860	-/0.83	-/-	32. α-decalactone	1493	0.83/-	0.23/-
16. 3-methylbutan-2-ol		871	-/3.58	2.27/2.31	33. Δ-dodecalactone	1704	-/0.67	-/-
17. 2-phenylethanol		1116	-/-	0.40/-			0.83/3.14	14.9/5.39
			13.27/25.89	20.96/23.01				
OTHERS								
34. 2,2,4,6,6-pentamethylheptane		995	-/-	2.32/-				
35. hydroxydihydromaltol		1146	-/2.17	-/-				
36. 5-hydroxymethylfurfural		1229	-/2.24	-/-				
			-/4.41	2.32/-				

RI: retention index determined relative to a homologous series of n-alkanes (C₈ - C₂₀) on a HP-5MS column; grey: DVB/CAR/PDMS fiber; blue:

CAR/PDMS fiber; -: not detected; tr.: traces < 0.1%

Results:

A total of 36 compounds were identified in the kajmak samples: 11 carboxylic acids, 9 ketones, 7 esters, 6 alcohols, and 3 other compounds. In both fresh and mature kajmak samples, regardless of fibre type, carboxylic acids and ketones were the most abundant, followed by alcohols.