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Comparative analysis of flavor characterization in duck meat prepared by sous vide and conventional cooking methods

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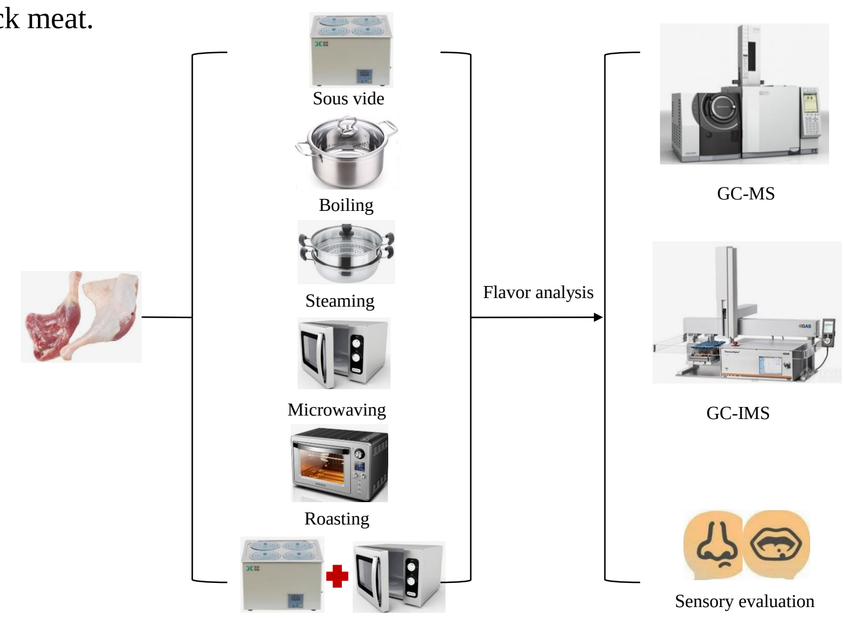
INTRODUCTION & AIM

Introduction

Duck meat is a popular and important food commodity in Asia especially in China, which contained high quantities of health-promoting components including protein, vitamins, iron, selenium, niacin and low content of fat and cholesterol. Cooking is the most significant process that promotes food quality. Different cooking methods can impart distinct effects on the aroma of food due to differences in temperature, heat transfer and heating medium.

Aim & Purpose

The aim of this study was to evaluate the differences in flavor characteristics of duck meat prepared in different thermal methods (sous vide, steaming, boiling, microwaving, roasting, sous vide-microwaving). GC-IMS and GC-MS combined with OAVs, and sensory evaluation were used to identify the flavor fingerprints and investigate the flavor changes in duck meat from different cooking methods. Our research would provide useful information for the further production in duck meat.



Sous vide combined with microwaving

METHOD

Sous vide cooking (SV): the marinated duck legs were put in vacuum-sealed bags and submerged in water at 70 ℃ to cook for 10 h.

Steaming (ST): the marinated duck legs were placed on the steamer for steaming for 40 min with boiling water (4 times the weight of the samples) which was heated on an induction cooker (800 W).

Boiling (BT): the marinated duck legs were added into boiling water (4 times the weight of the samples) for boiling for 40 min on an induction cooker (800 W).

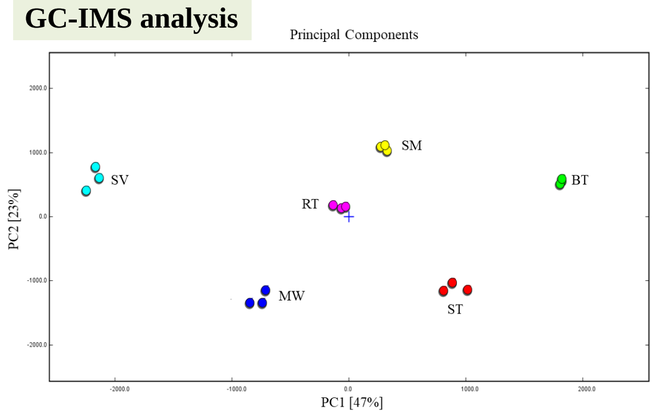
Microwaving (MW): the marinated duck legs were cooked in a microwave oven for 14 min at 1000W.

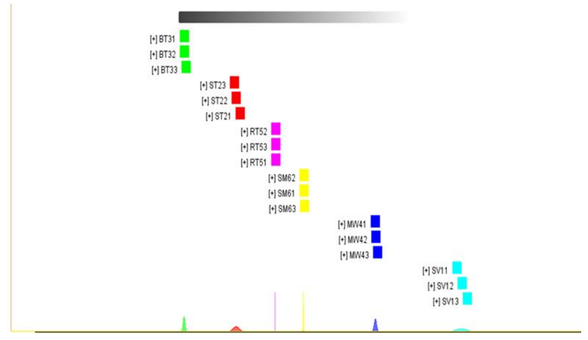
Roasting (RT): the oven was preheated to 210 ℃, and the marinated duck legs were roasted in the oven for 40 min.

Sous vide combined with microwaving (SM): the marinated duck legs were placed in vacuum-sealed bags and submerged in water at 70 ℃ to cook for 4 h. Then the samples were taken out and heated in a microwave oven for 3.5 min at 1000W.

RESULTS & DISCUSSION

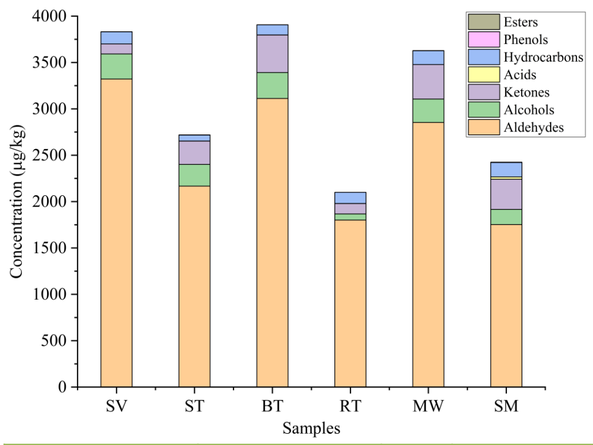
GC-IMS analysis

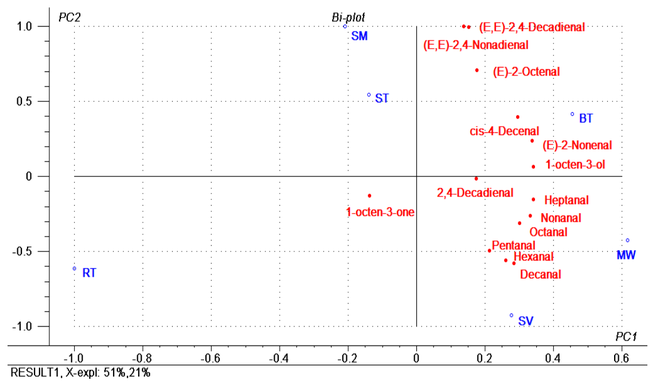




GC-IMS identified 48 flavor compounds, including their monomers, dimers and trimer. The esters and furan content in SV samples were higher than other samples, while the aldehydes and hydrocarbons content in ST were relatively higher. Principal component analysis (PCA) of GC-IMS data indicated that there were significant flavor distinctions among duck meat processed in different cooking methods.

GC-MS combined with OAV analysis



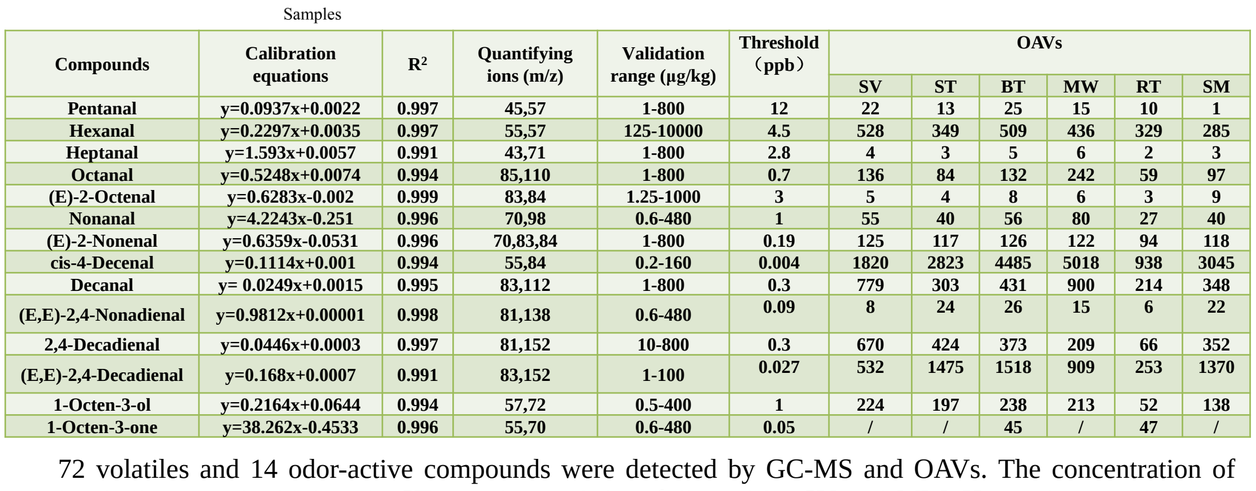


Samples

Compounds	Calibration equations	R^2	Quantifying ions (m/z)	Validation range (μg/kg)	Threshold（ppb）	OAVs					
						SV	ST	BT	MW	RT	SM
Pentanal	y=0.0937x+0.0022	0.997	45,57	1-800	12	22	13	25	15	10	1
Hexanal	y=0.2297x+0.0035	0.997	55,57	125-10000	4.5	528	349	509	436	329	285
Heptanal	y=1.593x+0.0057	0.991	43,71	1-800	2.8	4	3	5	6	2	3
Octanal	y=0.5248x+0.0074	0.994	85,110	1-800	0.7	136	84	132	242	59	97
(E)-2-Octenal	y=0.6283x-0.002	0.999	83,84	1.25-1000	3	5	4	8	6	3	9
Nonanal	y=4.2243x-0.251	0.996	70,98	0.6-480	1	55	40	56	80	27	40
(E)-2-Nonenal	y=0.6359x-0.0531	0.996	70,83,84	1-800	0.19	125	117	126	122	94	118
cis-4-Decenal	y=0.1114x+0.001	0.994	55,84	0.2-160	0.004	1820	2823	4485	5018	938	3045
Decanal	y= 0.0249x+0.0015	0.995	83,112	1-800	0.3	779	303	431	900	214	348
(E,E)-2,4-Nonadienal	y=0.9812x+0.00001	0.998	81,138	0.6-480	0.09	8	24	26	15	6	22
2,4-Decadienal	y=0.0446x+0.0003	0.997	81,152	10-800	0.3	670	424	373	209	66	352
(E,E)-2,4-Decadienal	y=0.168x+0.0007	0.991	83,152	1-100	0.027	532	1475	1518	909	253	1370
1-Octen-3-ol	y=0.2164x+0.0644	0.994	57,72	0.5-400	1	224	197	238	213	52	138
1-Octen-3-one	y=38.262x-0.4533	0.996	55,70	0.6-480	0.05	/	/	45	/	47	/

72 volatiles and 14 odor-active compounds were detected by GC-MS and OAVs. The concentration of total volatiles was the highest in ST samples, and then followed by SV and MW. Hexanal, octanal, (E)-2-octenal, nonanal, (E)-2-nonenal, cis-4-decenal, decanal, 2,4-decadienal, (E,E)-2,4-decadienal, 1-octen-3-ol and 1-octen-3-one were the key aroma contributors to duck meat in different cooking methods. PCA analysis revealed that there were significant differences among duck meat prepared in various cooking methods.

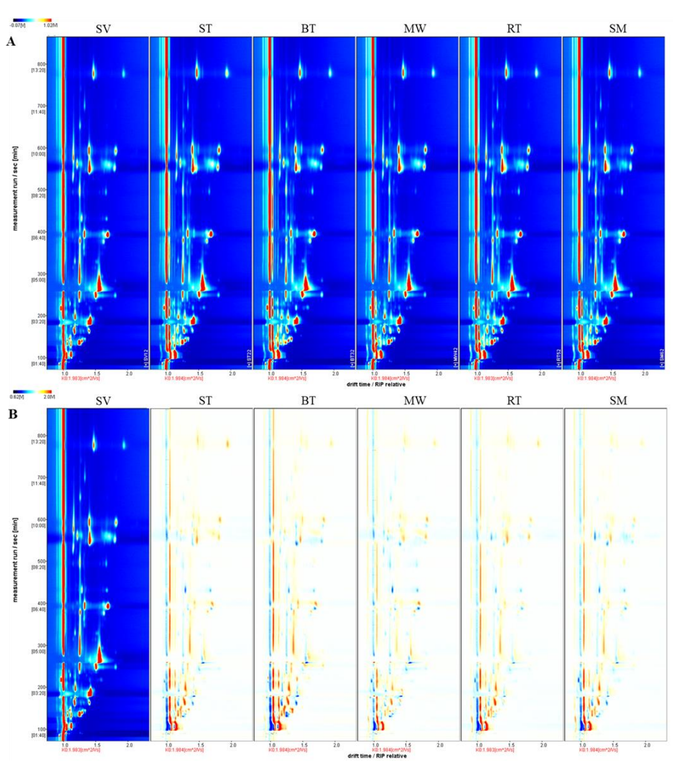
Sensory analysis

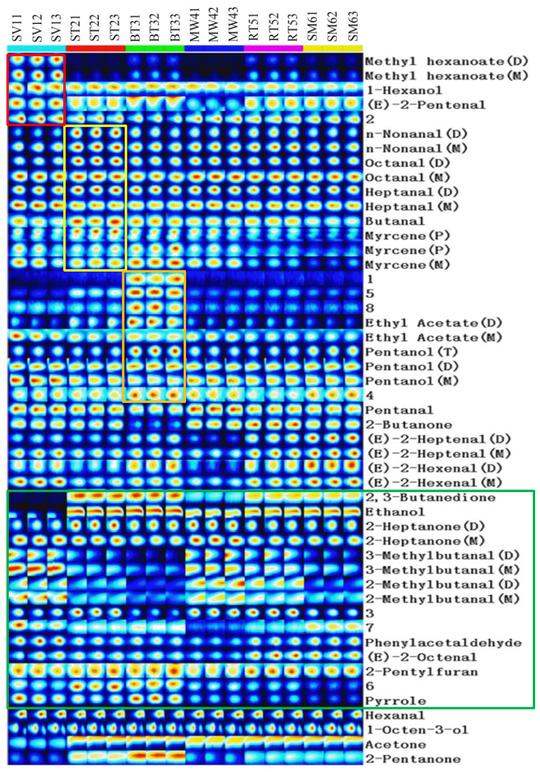


Sensory evaluation revealed that the scores of overall acceptability were relatively higher in BT, SV and MW samples than other samples, and the umami value was the highest in MW.

RESULTS & DISCUSSION

GC-IMS analysis





CONCLUSION

GC-IMS data showed that SV samples had higher esters content, while ST had higher aldehydes contents. 14 odor-active compounds were detected by GC-MS combined with OAVs. The key odor-active compounds in different cooked duck meat included hexanal, octanal, (E)-2-octenal, nonanal, (E)-2-nonenal, cis-4-decenal, decanal, 2,4-decadienal, (E,E)-2,4-decadienal, 1-octen-3-ol and 1-octen-3-one. PCA analysis indicated that the six cooked duck meat had significant flavor distinctions. The scores of overall acceptability were relatively higher in BT, SV and MW samples than other samples, and the umami value was the highest in MW. Thus, ST, SV and MW could be used to better maintain the flavor quality of duck meat.