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ASSESSMENT OF VARIOUS FAT COMPONENT OF SAUCES FORMULATED FOR USE IN MUSCLE BASED CONVENIENT FOODS WITH RESPECT TO PRODUCT QUALITY AND STABILITY

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Introduction

There are general trends in the food industry, which indicate that the sector is in transition, with shifts in consumer expenditure from fresh to frozen products and from basic products to more prepared convenient products such as ready meals[1]. Total consumption of all ready meal products grew from 1.9 million tonnes in 1996 to over 2.1 million tonnes in 2001. Average per person consumption for all ready meals within the EU stands at 5.8 kilos, having grown from 5.4 kilos in 1996, with forecasts suggesting an increase to over 6 kilos per person by 2006[2]. Ready meals usually consist of a portion of carbohydrates such as potatoes, a portion of vegetables and a portion of meat. The meat forms the core of the meal and ultimately its presentation and more importantly its quality, will result in the consumer repurchasing the product. Sauce, whether it is a tomato sauce, white sauce, gravy or marinade is used to complement a meal, and serves to improve the presentation of the meat. Sauce can be used to mask the off flavours of lower quality meat, prevent product dehydration, tenderise the meat and can also be used for adding desired flavours[3]. In the production of convenience foods, the quality of the raw materials, particularly that of the sauce and meat components, will ultimately determine the quality of the final product. The task for the food technologist is to determine the degree of interactions, which occur between these raw materials.

Objectives

The objective of this study was to evaluate the stability of a tomato-based sauce, manufactured from a range of commercial oils, for application in muscle-based convenience-style food products.

Methodology

The commercial oils tested were: corn oil (CO), grape seed oil (GSO), olive oil (OO), sunflower oil (SFO) soya bean oil (SBO) rape seed oil (RSO), vegetable oil (VO), linseed oil (LO) and tallow (T). Tomato sauces (water (56.25%), oil (15%), tomato paste (13.5%), sun-dried tomatoes (1.5%), skim milk powder (5%), cheese (5%), starch (2.5%), salt (1%), pepper (0.25%)) were processed (80˚C x 15 min) in a Limitech mixer (Limitech, Denmark), modified atmosphere packaged (65% CO_2: 35% N_2) and held in refrigerated display, under light, for 30 days. Oxidative stability was measured using four methods, anisidine value, peroxide value, totox value and 2-thiobarbituric acid method. The peroxide value (PV) was measured (meq O_2 kg^{-1} oil) according to a modification of the method of the American Oil Chemist's Society[4]. The anisidine value (AV) was determined according to the British Standard method[5]. The Totox value (TV) was calculated from PV and AV values (Totox= 2PV+AV)[6]. The extent of lipid oxidation was also assessed by measuring thiobarbituric acid reacting substances (TBARS)[7] and expressed as mg malonaldehyde per kg sample. CIE 'L', 'a', 'b' colour analysis (Minolta chromameter CR-300), and microbiological analysis (standard plate counts) were assessed throughout storage. Syneresis was assessed by measuring graduated change over the storage period.

Results & Discussion

Peroxide, anisidine, totox and TBARS analysis of all sauces revealed that in general, sauces made with OO, CO, SBO, and RSO were less susceptible to lipid oxidation in comparison to sauces made with LO, VO and SFO (Table 1). This is most likely due to the degree of unsaturation of these oils. LO, VO and SFO have higher levels of unsaturated fatty acids in comparison to the other test oils, which would make them more vulnerable to lipid oxidation. SFO has a high level of linoleic acid (approx 68%) and LSO has a high level of linolenic acid (approx 58%), which may be responsible for the higher degree of lipid oxidation in these sauces. The fatty acid profile of the VO used was unknown, however, results of lipid oxidation indicate that it may contain high levels of unsaturated fatty acids. Tallow fat contains a low level of unsaturated fatty acids, and as expected lipid oxidation results indicated that the sauce manufactured using tallow, remained stable during storage. TBARS analysis indicated that all sauces except LO sauce, (TBARS value greater than 1mg malonaldehyde per kg sample) were sensorially acceptable following 30 days of storage (Table 1). CIE 'L' value of all sauces ranged between 62 and 69, the CIE 'a' values, an indicator of redness, ranged between 19 and 24 and the CIE 'b' values ranged between 47 and 58. Results showed that all sauces prepared using the selected oils were microbiologically safe and free from syneresis over a 30-day storage period.

Conclusions

Oxidative stability of sauces formulated using different oil sources decreased over a 30-day storage period in the general order of: SBO sauce > CO sauce > RSO sauce > OO sauce > T sauce > GSO sauce > SFO sauce > VO sauce > LO sauce. Results showed all sauces prepared using the test oils were microbiologically safe and free from syneresis over the assessment period. Analysis showed that OO, CO, RSO and SBO were most acceptable for tomato sauce manufacture based on the test parameters assessed.

References

Teagasc (2002) Factors Shaping Expenditure on Meat and Prepared Meals, Project Armis No. 4607, pp2.

Sanco (2001). European Commission Directorate-General for Agriculture: Prospects For Agriculture Markets 2001–2008, Brussels. Journal of Food Technology, Jan 1996, Savoury Fruit Based Salsas.

AOCS. Method Cd 8-53. (4th ed.). In: Official methods and recommended practices of the American il Chemists' Society,1990. Champaign: American Oil Chemists' Society.

British Standard Method. Determination of peroxide value. BS 684-2.14: 1998, ISO 3960:1998, 12.

Baur, F. Analytical methods for oils and fats. In: “Food Oils and Fats: Technology, Utilization and Nutrition”. Lawson, H. (Ed), 1995. Chapman & Hall, London. Chapter 14, 291.

Ke PJ, Ackman RJ, Linke BH, Nash DM. 1977. Differential lipid oxidation in various parts of frozen mackerel. J Food Tech, 12(1):37–47.

Tables and Figure

Table 1: Lipid Oxidation of sauce using method: (a) (TBARS) Thiobarbituric acid, (b) PV (Perovide value), (c) Anisidine value, (d) Totox value

Test	Oil	Time					
		1	4	7	10	20	30
TBARS	***CO***	0.218[a]	0.274[a]	0.346[a]	0.56[ab]	0.491[ab]	0.237[ab]
	GSO	0.296[a]	0.213[a]	0.345[a]	0.277[a]	0.308[ab]	0.238[ab]
	OO	0.301[a]	0.398[ab]	0.33[a]	0.384[a]	0.426[ab]	0.357[ab]
	SFO	0.448[ab]	0.562[ab]	0.42[a]	0.337[a]	0.439[ab]	0.387[ab]
	VO	0.759[b]	0.552[ab]	0.485[a]	0.569[ab]	0.648[b]	0.642[ab]
	SBO	0.35[a]	0.249[a]	0.286[a]	0.481[ab]	0.338[ab]	0.168[a]
	RSO	0.342[a]	0.474[ab]	0.326[a]	0.502[ab]	0.259[a]	0.483[ab]
	LO	0.569[ab]	0.931[b]	0.73[a]	0.735[b]	0.54[ab]	1.133[c]
	T	0.306[a]	0.407[ab]	0.292[a]	0.332[a]	0.474[ab]	0.306[ab]
PV	*CO*	0.65[a]	2.07[b]	0.83[a]	3.93[bcd]	1.78[ab]	1.33[a]
	GSO	0.850[a]	1.100[a]	3.070[a]	5.670[d]	3.110[c]	2.210[a]
	OO	0.85[a]	2.2[b]	7.33[ab]	3.43[abcd]	2.67[bc]	2.21[a]
	SFO	3.17[b]	5[cd]	6.04[ab]	2.17[abc]	1[a]	2.67[a]
	VO	4[b]	3.857[bcd]	11.5[b]	1.551[ab]	0.944[a]	1.556[a]
	SBO	0.789[a]	1.667[b]	0.722[a]	2.273[abc]	1.17[a]	1.435[a]
	RSO	0.944[a]	3.125[abcd]	3.333[a]	1.068[a]	1.846[ab]	0.659[a]
	LO	13.00[c]	5.36[d]	7.83[ab]	10.67[e]	6.22[d]	5.08[b]
	T	3.00[b]	4.06[abc]	2.93[a]	5.44[cd]	6.83[d]	2.67[a]
AV	***CO***	7.06[b]	9.13[b]	8.54[b]	7.86[b]	10.23[d]	8.77[cd]
	GSO	23.280[c]	22.680[d]	25.480[d]	21.580[d]	nd	10.960[de]
	OO	5.89[b]	5.5[ab]	8.72[b]	5.17[ab]	nd	nd
	SFO	52.08[d]	22.3[cd]	19.36[cd]	16.06[cd]	17.9[f]	15.82[ef]
	VO	53.23[d]	21.222[cd]	23.038[cd]	17.355[d]	16.705[ef]	18.182[ef]
	SBO	nd	1.437[a]	nd	nd	1.49[c]	5.545[bcd]
	RSO	nd	2.648[a]	7.003[b]	8.182[b]	nd	4.512[bc]
	LO	nd	18.48[c]	17.79[c]	10.53[bc]	11.19[de]	20.52[f]
	T	5.06[b]	6.06[b]	6.47[b]	8.29[b]	nd	0.92[ab]
TV	**CO**	8.36[bc]	13.27[b]	10.2[ab]	15.72[bc]	13.79[de]	11.43[bc]
	GSO	24.98[d]	24.88[c]	31.62[cd]	32.92[d]	nd	15.38[cd]
	OO	7.59[b]	9.9[ab]	23.38[bc]	12.03[abc]	nd	0.89[a]
	SFO	58.42[e]	32.3[d]	31.44[cd]	20.4[c]	19.9[ef]	21.16[d]
	VO	61.23[e]	28.936[cd]	46.038[d]	20.457[c]	18.593[ef]	21.294[d]
	SBO	nd	4.771[a]	nd	3.964[a]	3.83[c]	8.415[bc]
	RSO	nd	8.898[ab]	13.669[b]	10.318[ab]	2.289[c]	5.83[ab]
	LO	20.773[d]	29.201[cd]	33.459[cd]	31.866[d]	23.637[f]	30.688[e]
	T	11.06[c]	14.167[b]	12.317[b]	19.173[bc]	12.933[d]	6.249[ab]

[a,b,c,d,e,f]refer to tests of significance within test parameter, between oil types and within days of storage. Means bearing different superscripts are significantly different ($P< 0.05$).

Table 2: Results of Minolta CIE 'L', 'a' and 'b' for test tomato sauce prepared using selected oils as a function of time (days)

Test	Oil	Time					
		1	4	7	10	20	30
CIE L	CO	66.23 [c]	66.97 [ab]	66.85 [b]	67.20 [cd]	66.16 [c]	65.66 [ab]
	GSO	63.73 [abc]	65.81 [ab]	66.08 [b]	65.82 [b]	66.49 [c]	63.98 [b]
	OO	62.38 [a]	64.38 [a]	63.59 [a]	63.46 [a]	63.70 [ab]	63.18 [a]
	SFO	64.68 [bc]	65.32 [b]	65.35 [b]	64.61 [cd]	65.96 [bc]	64.55 [b]
	VO	64.79 [abc]	64.15 [ab]	64.72 [b]	65.25 [bc]	65.40 [c]	63.76 [ab]
	SBO	65.42 [bc]	64.71 [ab]	65.61 [b]	65.58 [bc]	64.98 [bc]	65.65 [ab]
	RSO	63.29 [ab]	64.31 [a]	64.80 [ab]	64.72 [ab]	63.87 [bc]	64.69 [a]
	LO	69.65 [d]	68.52 [c]	68.23 [c]	68.17 [de]	68.53 [d]	68.08 [c]
	T	60.06 [d]	64.68 [c]	65.59 [c]	66.00 [e]	65.18 [a]	65.29 [c]
CIE a	CO	19.60 [a]	20.42 [b]	20.51 [a]	19.50 [ab]	20.41 [bcd]	22.93 [bc]
	GSO	21.20 [a]	21.24 [ab]	20.23 [ab]	22.39 [ab]	20.22 [abc]	20.27 [abc]
	OO	20.88 [a]	20.46 [a]	20.69 [a]	22.69 [ab]	20.72 [ab]	18.74 [a]
	SFO	20.11 [a]	19.14 [ab]	20.23 [ab]	22.23 [a]	20.42 [ab]	20.18 [ab]
	VO	21.93 [a]	21.88 [a]	22.56 [a]	21.81 [a]	21.53 [a]	22.81 [ab]
	SBO	20.53 [a]	19.38 [b]	20.68 [a]	19.62 [b]	20.59 [d]	20.19 [abc]
	RSO	19.85 [a]	19.78 [b]	20.49 [b]	20.28 [b]	20.39 [cd]	21.89 [c]
	LO	22.33 [a]	21.64 [a]	22.50 [a]	23.40 [ab]	22.64 [abcd]	21.95 [a]
	T	23.34 [a]	19.55 [a]	19.84 [a]	19.72 [a]	19.53 [a]	19.40 [a]
CIE b	CO	57.96 [a]	53.14 [bc]	53.76 [ab]	52.90 [a]	52.83 [bc]	50.17 [a]
	GSO	55.35 [a]	52.79 [ab]	52.63 [c]	47.65 [a]	50.35 [bc]	49.58 [a]
	OO	54.45 [a]	51.07 [a]	52.19 [c]	48.68 [a]	53.52 [bc]	57.06 [a]
	SFO	53.13 [a]	49.80 [abc]	52.42 [bc]	48.33 [a]	52.18 [b]	49.40 [a]
	VO	49.74 [a]	48.96 [abc]	47.53 [abc]	49.36 [a]	47.77 [bc]	49.30 [a]
	SBO	52.34 [a]	49.30 [bc]	51.70 [a]	50.74 [a]	51.94 [b]	51.61 [a]
	RSO	55.39 [a]	51.29 [c]	52.52 [c]	52.40 [a]	50.12 [c]	48.07 [a]
	LO	53.72 [a]	51.45 [bc]	52.44 [c]	53.24 [a]	52.12 [c]	49.49 [a]
	T	50.78 [a]	50.69 [abc]	49.89 [c]	48.89 [a]	46.30 [a]	47.53 [a]

[a,b,c,d,e]refer to tests of significance within test parameter, between oil types and within days of storage. Means bearing different superscripts are significantly different ($P < 0.05$).