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Effect of Repeated Use of Frying Media on Free Fatty Acids Content of Oils

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ABSTRACT By using the same frying media for repeated fryings, the free fatty acid content increased gradually and showed a significant increase from an average of 0.200% in fresh samples to 0.885% after sixth frying of potato chips. The decomposition of the oil started after the free fatty acid content increased beyond 0.5% level due to the formation of more unsaturated peroxides, which were less stable at higher temperatures. The resultant effect was the formation of saturated fatty acids which are not considered good for human health.

INTRODUCTION

Deep frying is one of the important methods of food preparation and preservation. Different oils and fats are used, most often repeatedly in the household and commercial ventures for the sake of convenience and/or economy. Repeated fryings result in the burning of the residues of the food ingredients as well as of the medium itself particularly in the deep and intermittent fryings, where it undergoes many physical and chemical changes and many deteriorative changes are evident. Although the deep fat fried foods are accepted almost universally nevertheless, the susceptibility of frying fat to deteriorative changes and the transfer of undesirable flavour to the food cooked in the degraded medium results in poor quality of fried food.

MATERIALS AND METHODS

Four different oils (rapeseed, mustard, cotton seed, and groundnut) and a shortening (hydrogenated vegetable ghee) were used for frying the Potato chips (Var. *Kufri Jyoti*) of uniform size and thickness. An effort was made to keep the temperature and other variables constant. Regular fryings were made in the same media for a period of six weeks at a weekly interval, without any oil replenishment. In one set chips were actually fried to conform to the Standard of Identity of the product. However, in the other set the oils were simply boiled to the frying temperature (210°C± 3°C). The samples of the chips and oils were marked for the analytical purpose. The FFA contents were calculated according to the method of AOAC (1990). The statistical analysis was done as suggested by Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

The oils showed a gradual increase in viscosity which may be due to the thermal deterioration during frying operations. Arya et al. (1972) found that during frying, oils/fats were subjected to very high temperatures ranging from 180° to 240°C resulting in thermal deterioration of media accompanied by increased viscosity and off flavour. In the study, a little difference in the odour of oil was found even after sixth frying of chips. Only rapeseed and mustard oils exhibited some rancid smell after fifth and sixth frying. It was observed that the free fatty acid content of the oils/fats which were only heated showed lower free fatty-acid content as compared to those in which chips were fried. The oils used in fryings showed an increase in free fatty acids probably resulting from the addition of water from the chips into the frying media. The process could release the fatty acids from the triglycerides.

Table 1: Weekly changes in mean free fatty acid content (per cent) of frying media (without frying chips)

S. No.	Name of frying media	Week of heating						
		1	2	3	4	5	6	Oil's mean
1.	Rapeseed oil	0.067	0.130	0.160	0.200	0.300	0.470	0.221
2.	Mustard oil	0.130	0.130	0.300	0.300	0.530	0.667	0.342
3.	Cottonseed oil	0.100	0.130	0.230	0.230	0.267	0.330	0.214
4.	Groundnut oil	0.670	0.100	0.130	0.160	0.336	0.467	0.310
5.	Ghee(shortening)	0.033	0.110	0.145	0.160	0.267	0.267	0.163
6.	Week's mean	0.200	0.120	0.193	0.210	0.340	0.440	

1. CD at 5% level for the difference of two oil's means at same week or for the differences of two week's means for the same oil = 0.112
2. CD at 5% level for the difference of two oil's means = 0.046
3. CD at 5% for the difference of two week's means = 0.050

On an average the free fatty acid content of ghee (shortening) was found to be significantly lower from that of the oils. Among oils, mustard oil showed highest free fatty acid content (0.344%) in heated samples only and was found significantly different from all other oils which were nonsignificantly different from each other (Table1). In case of chips being fried (Table 2), the comparison showed the FFA during the first, second and third fryings to be non-significantly different, whereas, in the fourth attempt, mustard oil and ghee (shortening) were found to be different from each other.

Average weekly comparison in free fatty acid contents showed that increased number of fryings increased the free fatty acid contents irrespective of the frying media. However, use of the same media resulted in FFA being increased from an average of 0.200 of fresh samples to 0.885 per cent after sixth frying (Table 2). These findings are in conformity with those reported by Thompson et al. (1967). It has been observed that with the increase in storage period and fryings, the free fatty acid contents increased in all the samples. It has also been observed that oils under unfavourable storage conditions like that of high temperature or excessive moisture developed high free fatty acids. The decomposition of the oil started after the FFA content increased beyond the 0.5 per cent level due to the formation of more unsaturated peroxides. Such peroxides are less stable at higher temperatures like that of frying.

Table 2: Weekly changes in mean free fatty acid content (per cent) of frying media (with frying chips)

S. No.	Name of frying media	Week of frying						
		1	2	3	4	5	6	Oil's mean
1.	Rapeseed oil	0.187	0.252	0.341	0.541	0.584	0.923	0.390
2.	Mustard oil	0.246	0.341	0.467	0.686	0.859	0.934	0.588
3.	Cottonseed oil	0.233	0.380	0.327	0.485	0.697	0.966	0.519
4.	Groundnut oil	0.182	0.215	0.369	0.420	0.560	0.728	0.412
5.	Ghee(shortening)	0.176	0.233	0.359	0.420	0.467	0.874	0.421
6.	Week's mean	0.205	0.284	0.372	0.511	0.633	0.885	

1. CD at 5% level for the difference of two oil's means at same week or for the differences of two week's means for the same oil=0.201
2. CD at 5% level for the difference of two oil's means =0.082
3. CD at 5% for the difference of two week's means=0.090.

It is, therefore, evident that fats and oils used in intermittent frying readily exhibited oxidative and hydrolytic rancidity and deteriorative changes. Rancidity as such does not significantly affect the nutritional value of the food because the only change is the cleavage of fatty acids from the glycerol. Its main effect is the objectionable flavour imparted by the free fatty acids, resulting in lower consumption of the affected food. An increase in viscosity and excessive foaming during cooking was observed which also resulted in the poor quality of fried food. The physical and chemical analysis have indicated that the degree of deterioration was independent of the degree of saturation, but rather depended upon how they are used.

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