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Rancidity of Butter Fat

by

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Introduction : Butter is the substance containing practically the whole of the fat of the milk from which it is prepared, produced by the continual shaking or beating of cream or of the milk itself. When butter is freshly produced it consists of a nodular mass which is then worked in order to remove excess of water and make the whole a visibly homogeneous mass. With a view to find out the agencies responsible for increasing the rancidity of butter fat an experiment was conducted in the State Ghee Grading Laboratory, Madras.

The development of an acrid taste and unpleasant aroma in fats makes the butter fat unfit for edible purposes. A freshly prepared sample of butter fat free from water content reads the following value, on physico chemical examination.

Physical State	...	Fully developed and characteristic butter aroma and taste
Specific gravity @ 15°C	...	0.9358
Solidifying point °C	...	20.6
Saponification value	...	235.00
Iodine value	...	26.54
Polenske value	...	0.7
Reichert-Meissl value	...	28.0
Butyro-refractometer	...	42.6
Acid value	...	0.82

Materials and Methods : A sample of fat was kept in a sterilised porcelain dish which was placed in a vacuum desiccator and finally kept open to diffused light for 92 days. Another sample of the same lot was kept for 115 days. A third sample was kept for 167 days under similar conditions. The samples show the following chemical variation. The effect of moisture and light was common to all the samples.

	Aroma practically unaffected; taste acrid	Aroma unaffected taste very acrid	Aroma unaffected very strong acrid taste
Physical state	Sample of 92 days	Sample of 115 days	Sample of 167 days
Specific gravity @ 15°C	0.94	0.94	0.94
Solidifying point °C	19.8	19.6	19.3
Saponification value	236.0	236.5	237.6
Iodine value	25.9	25.4	25.0
Polenske value	0.61	0.58	0.54
R. M. Value	28.95	29.1	29.95
Butyro-refractometer @ 40°C	43.2	43.35	43.8
Acid value	9.30	9.85	11.65

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Results : It is seen that moisture and light together lower the solidifying point, Iodine value and Polenske value. They increase the acid value, Saponification value, R. M. value with refractive index. Taste gets acrid on keeping. On keeping the sample for longer periods the effects are strongly exhibited. Air and light together lower the Iodine value and Polenske value, but increase the specific gravity, Saponification value, R. M. value and refractive index. Presence of light has positively augmented the action of air. Air and moisture together increase the specific gravity, Saponification value, R. M. value and Acid value. Light acts as a positive catalyst to accelerate the effect of air and moisture on butter fat.

In the rancid samples of butter fat the acetyl values at various level is determined.

	Acid value	Acetyl value
Original fresh sample	—	—
Direct sunlight	5.2	5.5
Moisture alone present	8.9	7.8
Moisture and light present for 92 days	9.3	8.3
115 days	9.85	8.5
167 days	11.67	8.8
Air, moisture and light present without sterilisation	15.1	9.6

Discussion : The causes responsible for the development of rancidity in butter fat can be arrived by analysing the individual factors. The action of light destroys the minute traces of chromogenetic substances. Wagner *et al.* (cited by Godbole and Sadagopal, 1939) found that oxygen is necessary to produce rancidity. Light alone has no part in the production of rancidity. In the experiment it is revealed that light acts as a positive catalyst in the production of rancid fats. Diffused sun light alone is not sufficient to produce rancidity. The action of air alone shows that the two values affected appreciably are the specific gravity and iodine value. Air has acted in absence of other factors as an oxidising agent giving rise to oxy-acids which lower the iodine value and thicken the fat, giving a higher specific gravity. There is no change in aroma and taste to any appreciable extent. Air alone does not produce any rancidity effect. Lewkowitsch (1899) has proved that linseed oil kept for 13 years in bulk did not produce any rancidity effects.

The action of moisture affects the physico chemical constants and imparts to the fat a clear acrid taste, which is always characteristic of rancid butter fat. This action is enhanced in the presence of light which acts as a positive catalyst. No trace of rancidity is noticeable in the case of fat kept for a long time in the absence of air, light and moisture. Rancidity, both of taste and odour is very prominent in the case of sample exposed to the

combined action of air and moisture together. This action is further activated by the presence of light acting as positive catalyst.

During rancidification the decomposition of the fat takes place in two stages.

1. Hydrolysis of the glycerides and consequent formation of free fatty acids and glycerol due to the action of moisture and
2. Oxidation of the acids and glycerol and inter-action of the oxidation products under the influence of air.

Light and bacteria appear to play the part of positive activating catalyst. The effect is more pronounced in the presence of non-fatty matter. Action of micro-organisms or the enzymes resulting from their development is responsible for causing rancidity. The process of rancidification is accelerated very much by the presence of free fatty acids and also traces of the previously rancid fat.

According to Scala (cited by Godbole and Sadagopal, 1939) oleic acid is primarily set free in rancid fats. He also isolated the decomposition products of rancid fats and by oxidation got acids like pelargonic, butyric, caprylic and capric acids. Free fatty acids are always present in case of rancid fats. It is seen that rancidity and acidity are not co-terminous. During rancidification the glycerol content of the fat is lowered showing thereby that it positively takes part in the process (Godbole and Sadagopal, 1939).

Summary: (1) The fundamental and primary cause of rancidity in butter fat is the action of moisture, liberating free fatty acids and glycerol. Air comes next to complete the process of rancidification. (2) The rancid behaviour of butter fat is revealed by the development of the characteristic aroma, taste, and increase in acid value.

REFERENCE

Godbole N. N. and Sadgopal. 1939. "Butter fat" published by Hindu University, Banaras.

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