CXXXIII. FAT CONTENT OF BREADS AND CEREALS.

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(Received August 24th, 1926.)

UP to the present there has been some doubt as to the absolute fat content of the different cereals and breads. Smedley MacLean [1922, 1923] states that by first hydrolysing yeast by boiling with *N* HCl for 2 hours, filtering, drying the residue and subjecting it to ether extraction in a Soxhlet apparatus, she obtained much larger quantities of fat than by direct extraction of the dried yeast with ether. Sharpe (unpublished results), working in this Institute, found that in the case of breads much larger quantities of fat could be obtained by first digesting the bread.

His results were so striking that it was felt that further investigation should be made.

It was decided to extend the study to the flours prepared from the chief cereals and from soya bean.

A. Breads.

The breads were dried, finely ground in a mortar, dried to a constant weight and a weighed sample extracted with ether in a Soxhlet apparatus for 9–12 hours.

Another sample was digested with 0.2 % HCl and 0.05 % pepsin, 25 cc. being used; the digest was repeatedly extracted with ether in a separation funnel, the ether evaporated off and the residue dried and weighed.

Results.

	Fat	
	Soxhlet %	Ether extraction after preliminary digestion %
Scotch white wheaten	0.29	0.93
English white wheaten	0.27	0.61
Scotch pan loaf	0.96	1.6
Scotch brown bread	1.4	2.8

In the Scotch white wheaten bread, Soxhlet's extraction gave 0.29 %, whilst the digestion method gave 0.93 %. Plimmer [1921] attributed the higher fat content in Scotch bread to the practice of adding milk to the dough. This is not the case.

B. *Cereal flours and soya bean flour.*

The meals were finely ground in a mortar and all were passed through a fine sieve so that they were in the same state of subdivision. The powder was then dried to constant weight.

A weighed sample was extracted by Soxhlet's method and another digested with hydrochloric acid and pepsin, and the digest extracted in the same way as in the case of breads. Three analyses were made in every case.

The results (I and IV) show that, when cereal flours were treated in these two ways, the marked differences observed in breads did not occur, and that digestion does not greatly increase the yield of fats.

It seemed desirable to ascertain (i) whether digestion after Soxhlet's extraction gives a larger yield of fats, (ii) whether more complete disintegration of the flour by further trituration in the course of extraction allows of more complete extraction of fats, and (iii) whether preliminary digestion of the flour increases the yield of fats by Soxhlet's method.

Methods.

(i) The meal was extracted by Soxhlet's method with ether and the fat weighed. The meal residue was treated with HCl and pepsin for 24 hours, dried, pulverised and extracted in a Soxhlet with ether and the extract dried and weighed.

(ii) A weighed portion was extracted in a Soxhlet apparatus with ether and the fat weighed. The residue was then pulverised and again extracted in a Soxhlet apparatus with ether, the extract being again weighed. This was repeated until negligible quantities of fat were obtained. Finally, the meal residue was treated with HCl and pepsin for 24 hours at 38°, the digest dried and extracted in a Soxhlet apparatus with ether and the extracted fat weighed.

(iii) A weighed portion of the meal was digested with HCl and pepsin, the digest dried, pulverised and extracted with ether in a Soxhlet apparatus and the fat weighed.

Results. (I) Extraction and subsequent digestion:

	Fat	
	Soxhlet extraction %	Extraction in Soxhlet after subsequent digestion %
Wheat	1.65	1.99
Oats	7.13	7.62
Barley	1.94	2.38
Soya bean	17.15	18.24

This shows an increased yield of about 6 % after digestion.

(II) Extraction and repeated extraction with trituration, then subsequent digestion:

	Fat		
	First extraction %	After four triturations %	Total %
Wheat	1.65	2.14	2.16
Oats	7.14	7.70	8.03
Barley	1.95	2.68	2.73
Soya bean	17.21	18.65	19.22

(III) Extraction after digestion and drying:

				Fat %					Fat %
Wheat	...	...	...	1.65	Barley	...	...	...	1.92
Oats	...	...	...	7.15	Soya bean	...	...	...	16.7

(IV) Extraction in separator after digestion:

				Fat %					Fat %
Wheat	...	...	...	1.71	Barley	...	...	...	1.94
Oats	...	...	...	7.16	Soya bean	...	...	...	17.05

The analyses of barley show a wide discrepancy and Plimmer's results diverge widely from other analyses.

SUMMARY.

1. Soxhlet's extraction with ether removes only a small proportion of the fats from breads, whilst extraction after peptic digestion removes two or three times as much.

2. The usually accepted average of 0.3 % of fats in dried wheaten bread, which seems disproportionately small when compared with the 2 % in wheaten flour, is altogether too low. In white bread it is more nearly 0.6–0.9 %.

3. In flours, Soxhlet's method, as usually carried out, does not extract all the fats. A further amount of about 6 % may be separated after digestion.

4. Soxhlet's method with repeated trituration of the flour in the course of extraction secures a very complete removal of the fats and gives a higher result than extraction by Soxhlet after digestion or by extraction in a separator after peptic digestion.

5. The remarkable difference between the proportion of fat extracted by Soxhlet's method from bread and from flours must be due to some change produced in the process of baking.

REFERENCES.

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