CLASSIC PAPER

Margarine

Commentary

M Toms

The idea of effective, marketable 'neutraceuticals' (1) were a long way off, both when margarine was invented for Napoleon III as a cheaper and more robust substitute for butter, and when Colonel Comyn wrote his paper in the 1930s extolling the virtues of the spread. The World Service intonation is almost audible as he highlights with true British eloquence the average contents of several brands and with almost prophetic foresight, describes its benefits to the soldier in the form of vitamin supplementation and calorific content. Some things familiar to Colonel Comyn remain familiar to the military doctor today. He euphemistically describes the "prolonged cooking which is deleterious to the vitamin content" which is difficult to avoid when cooking for large numbers in field conditions and he also alludes to the problem of "sick wastage in army life" which in his day was due to inflammation and infection.

Margarine itself has come a long way since then. It is well recognised that specific dietary manipulation can be beneficial in the reduction of morbidity and mortality from cardiovascular disease (CVD), probably due to the ability to modify established risk factors such as dyslipidaemia, hypertension and obesity (2–4). Westrate *et al's* randomised double blind crossover study (5) demonstrated a significant reduction in both total and LDL cholesterol of 8–13% with spreads containing plant sterols compared to 'original' Flora. This effect, which was achieved in approximately three weeks was not gender specific and was independent of starting levels of cholesterol. The role of reducing total and LDL cholesterol in the secondary prevention of CVD is well documented and explains why statins have become such a widely used drug group. Lifestyle change, including dietary review, is also a part of guidelines for reducing cholesterol. However, it is interesting to note that NICE guidelines for secondary prophylaxis of myocardial infarction state that there is no compelling evidence to allow them to recommend a specific dietary strategy.

It is also possible that nutritional manipulation can indirectly modify cardiac risk factors. Carlson and Monti's review (4) highlights the benefit of adequate calorific availability to be able to perform vigorous physical activity - a benefit mentioned by Comyn and accepted by all of us who have regularly consumed large quantities of high calorific food prior to exercise or strenuous training! Similarly, nutritional micro-molecules are believed to be able to modulate the oxidant stress in chronic smokers and this comprehensive review also points out the potential role of diet in modifying less traditional cardiac risk factors such as inflammation and arrythmias. Whilst the mass administration of pharmacological agents is hotly debated (such as the ongoing discussion regarding the addition of fluoride to domestic water supplies) the provision of a good quality, balanced diet with the ability to make individual and well informed choices can only be beneficial to health, but there remains much scope to provide good quality evidence from well designed studies for the role of dietary manipulation in the secondary prevention of CVD. Is there sufficient evidence for the military doctor to suggest that products such as plant sterol enriched spreads and drinks be made a part of the daily ration for soldiers? Probably not, but I believe Colonel Comyn was ahead of his time when he recognised the ability of simple margarine to convey a health benefit from nutritional manipulation.

Major (Retd) M Toms
MBChB.
Specialist Registrar in Anaesthesia and Intensive Care Medicine,
Worthing and Southlands Hospitals,
Lyndhurst Road,
WORTHING,
West Sussex.
E-mail:
marktoms@doctors.org.uk

References

1. Colquhoun, DM. Neutraceuticals: vitamins and other nutrients in coronary heart disease. *Curr Opin Lipidol* 2001; **12(6)**: 639-646.
2. Hu FB. Dietary pattern analysis: a new direction in nutritional epidemiology. *Curr Opin Lipidol* 2002; **13**: 3-9.
3. Kris-Etherton PM, Etherton TD, Carlson JJ, Gardner C. Recent discoveries in food based approaches and dietary patterns for CVD risk reduction. *Curr Opin Lipido.* 2002; **13**: 397-407.
4. Carlson JJ, Monti VMS. The role of inclusive dietary patterns for achieving secondary prevention cardiovascular nutrition guidelines and optimal cardiovascular health. *J Cardiopulm Rehabil* 2003; **23(5)**: 322-333.
5. Westrate JA, Meijer GW. Plant sterol-enriched margarines and reduction of plasma total and LDL cholesterol concentrations in normocholesterolaemic and mildly hypercholesterolaemic subjects. *European Journal of Clinical Nutrition 1998;* **52**: 334-343.

RAMC JOURNAL 1939 Vol LXXII 250-254

Margarine

By Colonel K Comyn

Margarine owes its origin to war – Napoleon III offered a reward during the Siege of Paris in 1870 to anyone who could find a substitute for butter. Mouries invented this commodity, and shortly afterwards the families of Jurgens and van den Berghs commenced production in Holland on a commercial scale.

Margarine has now become one of the most universal and constant items of the soldier's diet. Data culled from the messing books of various units show that the average consumption per man per day is 1½ ounces.

The fact that it has been arranged to vitaminize several brands of margarine as supplied to the N.A.A.F.I., without increasing the retail cost, has added considerably to the value of margarine as a food. It has long been a matter of controversy whether the soldier's daily diet gives him sufficient vitamins. Considerable stress has often been laid upon the provision of green vegetables, tomatoes, salad, etc., in order to provide vitamin C. But what of vitamins A and D? It has been presumed that there is sufficient of these in his ration of meat, bread, potatoes, bacon and cheese - and in summer months his outdoor life and sunshine enable him to produce sufficient vitamin D for his needs; but the soldier's food is always subject to prolonged cooking which is deleterious to the vitamin content. To what extent the vitamin A is destroyed by this cooking cannot be measured. It seems possible, if not probable, that during the winter months the soldier's daily diet is deficient in Vitamins A and D. It seems possible also that this condition of avitaminosis may play a part in the incidence of such diseases as tonsillitis and inflammation of areolar tissue, which includes many cases of boils, septic sores and abrasions so often associated with being "run down." These two groups of diseases cause a very large proportion of the sick wastage in Army life, especially in young soldiers.

The value of margarine as a vehicle for the addition of vitamins A and D to the soldier's food does not appear to have been sufficiently recognised - the factors which determine its value are (i) its universal daily use, (ii) its use in the raw state, only occasionally being used for cooking, (iii) its use within the maximum period of three weeks from manufacture.

Perhaps a brief description of the composition and method of manufacture of margarine may be of interest.

Composition

The protein is derived from added milk; the fat is derived principally from vegetable oils. The salt has to be added during the process of manufacture.

Taking an average from several brands	
Protein	0.2 per cent
Fat	84.8 per cent
Salt	2.0 per cent
Water	13.0 per cent

Several Acts of Parliament have been passed governing the manufacture, sale and distribution of margarine, but these have now been covered by a Consolidation Act – "The Food and Drugs (Adulteration) Act 1928." The principal points of this Act are that margarine shall not contain more than 16 per cent water, or 10 per cent butter, and be free from preservative, other than common salt, (this provision does not apply to margarine consumed outside the United Kingdom). There are also several regulations regarding the branding of the word MARGARINE on the boxes, and on any wrapper in which it is enclosed.

The War Office has a contract standard laid down in the Handbook of Specification for Supplies, 1930. The principal details of this specification are that the margarine must not contain more than 16 per cent of water, not more than 3 per cent salt, and be free from preservative. In the case of margarine for hot climates, the melting points of the fat shall not be less than 31°C., as determined by the cooling curve method. This quality is packed in hermetically sealed 2lb tins.

Food Value

The food value, apart from any added vitamin, depends entirely upon that of the fat or vegetable-oil content, the protein being negligible. The vitamin content in the vegetable oil is nil, and that of added milk or animal fat so slight as to be negligible.

The caloric value of the vegetable oil is high. The average of a number of samples according to Professor Plimmer's tables is 3,579 calories per pound, so that 1½ ounces of margarine will provide the soldier with approximately 335 calories, or one-twelfth of his total daily requirement, at a cost of less that ½d.

Keeping Quality

If kept under ordinary conditions of coolness (under 12°C. recommended) and cleanliness margarine will remain fresh and suitable for use for three weeks. It will keep longer, but prolonged keeping is not recommended. The manufacturers will guarantee the keeping qualities for up to six months if this is specially stipulated in the contract, but that would necessitate a special quality and special packing in sealed tins as is done for margarines sent abroad.

Manufacture

The process of manufacture may be conveniently divided into various stages for descriptive purposes :-

(1) *The Production of the Vegetable Oil* - The oils used in manufacture are all of vegetable origin obtained by crushing the seeds of many plants. The more commonly used are groundnut, cotton seed and soya bean. There are very few plant seeds from which the expressed oil cannot be utilized. In a few cases some poisonous or toxic substance prohibits their use.

The oil is expressed in factories at Selby, Liverpool and other towns in the north, and the crude oil is transported in tank waggons to the margarine factory at Purfleet.

(2) *Refining the Oils* - The crude oils after expression always contain some impurities which are undesirable, and which have to be removed. For example, fatty acids impart undesirable tastes or odours, and colouring matters cause variation in the appearance of the finished article.

The oils are subjected to processes of neutralisation to remove fatty acids, bleached with charcoal or bleaching earth to remove colouring matters and some other bodies that are not pure fat, and distilled to remove volatile substances. The pure oil thus produced is pressed through filters made of cotton cloth and filter paper. When finished, the oils and fats are odourless, colourless and tasteless.

(3) *Blending of Oils* - The various oils are put into large tanks which are heated to a temperature which will keep the oil liquid. The melting points of the different oils vary considerably. This materially affects the condition of solidity or stability of the finished article. It is essential that the margarine should have a definite stability and known melting point, not only from the point of view of marketing and keeping quality, but also that of digestibility. The digestibility depends considerably on the state of solidity and melting point. To this end the requisite quantities of the different oils are run into the blending vats to give the correct mixture which will give a product with a definite and constant melting point, not too high to cause indigestability not too low to render it soft in warm weather, and to give a digestibility equal to butter.

The proportions of the different kinds of oil necessary for blending are known, so that it is unnecessary to test each churn or mixing for melting point or to work out proportions in each particular case.

(4) *Proportion of Milk* - The milk used at Purfleet is pasterurized liquid milk. Samples of this milk are tested bacteriologically every day. It is again pasteurized by the flash method at 190°F.

The object of milk-blending is chiefly to impart the required flavour to the margarine; it is not intended to increase or alter in any way the food values. To acquire the flavour that is necessary the milk has to be "ripened" This is done by adding standard bacterial cultures of lactic acid and other allied bacilli, and incubating the bulk of the milk in large vats in which rotating paddles keep the milk in constant motion. The temperature during this process is maintained at 18° to 28°C., and the process continued for a period of eight to twenty hours varying with the activity of the bacterial action. The milk is tested periodically during this time for the amount of lactic acid formed, and when this is found sufficient, the ripening process is stopped by cooling off.

(5) *Churning* - The two chief constituents are now ready to be blended for the final processes. The refined oil mixture and the ripened milk are run from their respective vats or tanks through pipes into the mixing vats, where, by constant stirring with revolving paddles, a homogeneous emulsion is made. During this process the requisite amount of colouring matter is added. This colouring matter is one of the soluble coal tar derivative dyes permitted by the Ministry of Health, and which is very constant in imparting the same colour to the finished product. The proportion of milk blended with the oil varies from 10 per cent to 30 per cent, the variation depending mainly upon the quality of the margarine and upon the flavour required.

The temperature of the mixture in the vat during mixing and churning is kept at a few degrees above the melting point of the oil or fat. The process of mixing, lending or churning is continued for about thirty minutes.

(6) *Addition of Vitamins* - In the better brands of margarine vitamins A and D are added in the form of standard concentrates, which are obtained from courses rich in these accessory factors. They are added during the curning or mixing process.

The presence of vitamins in these brands is subsequently proved by testing samples just before packing. These tests are chemical (Carr and Price modified by Anderson and Nightingale), physical (ultra-violet rays) and animal feeding.

(7) *Cooling and Kneading* - Up to this stage in the manufacture the oil or fat mixture has been maintained at a temperature a little above its melting point to prevent solidification, and the final milk blended, vitaminized, coloured and thoroughly churned mixture has now to be cooled and solidified into the final product which is recognised as margarine. If the emulsified mixture is allowed to cool slowly, there is a tendency to crystallisation of some of the constituents, similar in appearance to that observed when butter is melted and then cooled slowly. To prevent this effect, the emulsion on completion of the churning process is rapidly cooled. Cooling is started

in the churning vat by adding cubes of ice which are made in an adjoining section of the factory. The emulsion, while still liquid is then run by pipes to large metal rollers, on to which it is poured from fine jets forming a thin layer on the metal surface. The rollers are cooled to a temperature of - 15°C. by the evaporation of liquid ammonia circulating through them. The layer of emulsion is rapidly solidified into homogeneous film. This film on the rollers is approximately $1^1/_2$ millimetres thick. It is scraped off by a knife edge abutting on the under surface of the roller and is deposited in large aluminium trucks which are run underneath the cooling machine. This machine cools four tons per hour, each truck taking approximately twenty minutes to fill.

After the margarine has been mixed or churned, rapidly cooled and scraped off the cooling rollers, it is still in a somewhat brittle or friable condition, which is unsuitable for ordinary use. In order to impart to it a more cohesive or spreadable character it has to be kneaded. This is done by passing it between closely applied revolving rollers, set in pairs, revolving in an inward direction towards each other, so that the margarine deposited on them from above is rapidly carried through between the roller surfaces. The gap between the rollers varies according to the quality of margarine being manufactured at the time. The average gap is $^1/_4$ inch. There are three pairs of rollers through which margarine passes consecutively. From beneath each pair of rollers it is conveyed to the top of the next pair on a travelling belt made of a special composition of rubber and canvas. From beneath the third pair of rollers it is deposited into large collecting bins.

During the process of kneading the requisite amount of salt is added. Samples are tested just before the kneading for salt content and water content. The salt content is invariably below 3 per cent, and salt is added as required, the kneading process ensuring an even distribution throughout. The water content is usually round about 12 to 13 per cent varying chiefly with the amount of milk blended in and the amount of kneading that has taken place during the manufacture.

The margarine is now finished and ready for weighing and packing. The varieties of margarine differ mainly in the quality of the fats and oils used and also in the flavour imparted by milk blending and in the food value of added vitamins.

Many thanks are due to Mr Anderson of the Technical Department, and to Mr. Euren of the Sales Department, of Messrs, Unilever, Ltd., for their courtesy and patience in describing the details of manufacture.