THE MUSOMA GHEE INDUSTRY*

IN the hot and semi-arid regions of the world not only does the yield of milk vary with the seasons but also it is impossible for primitive people to store milk or butter for use during the dry periods of the year. The inhabitants of hot countries were forced to evolve a method of storing butter fat, and the process developed in India has since spread to other tropical areas. The original Hindustani word for the butter fat so prepared was *ghi* and this term, written as " ghee ", has been retained by most workers on this subject.

The principle underlying the production of ghee is the preparation, in the solid form, of milk fat free from water, proteins and salts. Variations in the details of preparation and particularly in cleanliness cause ghee to vary enormously from a dirty oily fat, possessing an offensive smell, to an attractive yellow solid. The former quality is typical of the article produced by natives of this Territory for their own use, whilst the good quality article is representative of the product of the Government supervised factories. In Tanganyika the term " Clarified Butter " has been given to the Government supervised article, whilst all native-made butter fat is called " ghee ", whether it is made by improved methods or under the old insanitary conditions

The Musoma ghee industry as outlined below illustrates the steps taken by the Veterinary Department to effect a larger production of a better quality article. It indicates the policy of the department towards the large stock-owners, namely that (i) the production of ghee can afford a means of obtaining cash in areas devoted to livestock and unsuited to crops, and (ii) these cattle owners may be educated gradually to realize the economic advantage of possessing a few good milking cows instead of a larger number of half-starved poor-yielding animals. The Musoma conditions are well suited to the production of ghee and as a result production there much exceeds that from any other district. Musoma ghee is now well-known commercially, finds a ready market and commands a good price. Nevertheless, it will be seen that there is further room for improvement, even though figures for the sales of ghee show that an improvement in quality has recently taken place. This has been particularly apparent since the introduction of the direct cream-to-ghee method of production.

MUSOMA CONDITIONS

The Musoma district is situated on the east side of Lake Victoria and comprises an area of some 6,200 square miles stretching up to the Kenya border. Five main rivers drain the country from the east into Lake Victoria, but only

* By M. H. French, M.A. Ph.D., Biochemist, Veterinary Department, Tanganyika Territory, in *The East African Agricultural Journal*, Vol. III., No. 4, January, 1938

the largest, the Mara, flows continuously throughout the year. All the other water-courses dry up for varying periods. The altitude of the different parts of the district varies from about 3,700 feet at the Lake shore to 6,000 feet at Tagari, the highest point. As a result it is not possible to indicate any average climatic conditions. The rainfall on the Lake shore averages 30 inches yearly, but varies over the district according to altitude. Most of the rain falls between February and the end of May, but it is doubtful if any part of the district is completely without rain during any month of the year.

The Musoma district is subdivided into two administrative divisions by the Mara river, which forms a suitable boundary for topographic, climatic, and geological as well as political reasons. The North Mara district generally lies at a higher altitude than South Mara, and as a result the North Mara mountain grassland areas receive a better distributed and probably greater rainfall than the grazing areas of South Mara. The rainfall and its distribution govern the grazing conditions, so that North Mara has an advantage over South Mara for raising cattle and producing milk.

The Musoma district is also divided into cattle and non-cattle areas by the presence of tsetse flies. The greatest concentrations of these flies are in the north, west, and south-east portions of the district. The total cattle population of the district is approximately 350,000 but its density varies very considerably, the chief factors being the presence of tsetse flies, the incidence of East Coast Fever, and the vicinity of adequate water supplies and grazing land.

As rainfall is the main factor governing the grazing conditions of the district, it also determines the output of milk and therefore the yield of ghee. Ghee is made in both North and South Mara, but by far the greater proportion of the total output comes from North Mara. There the abundance of grazing all the year round results in an almost steady output of ghee, whereas a seasonal variation is to be observed in the output from South Mara. The Musoma district is thus well suited to the development of a large and prosperous ghee industry.

The natives of the Musoma district were well known in the past for their fierce and warlike tendencies, and their inability to resist the temptations of stock-thieving. The civilizing influence of administration and education has checked stock-thieving and consequently has toned down the belligerent natures of the natives. Through contact with civilization, aided by the recent economic depression and the development of the Musoma gold-mining activities, the Musoma native is fast realizing the economic significance of wealth in the form of money instead of in possessions.

The production of ghee is essentially a cash producing enterprise. When and where agricultural rather than pastoral habits are followed, cash crops such as cotton, ground nuts and sesame are grown and ghee production becomes of little or no importance. When considering the future of the ghee industry it is necessary to bear in mind the fact that it is the need for cash and not the wish to market a surplus commodity (milk and butter fat) that will determine the output of ghee. The pastoralists who require cash have four alternative methods of obtaining it. They sell some of their cattle, or make ghee, or else

they are forced to turn agriculturists or to seek employment. The true pastoral natives hesitate to adopt the last two alternatives, and much prefer to obtain the necessary cash by the sale of an animal or its products. Therefore the lower the price of stock the greater the tendency for pastoral natives to sell milk or cream for ghee production.

REVIEW OF THE DEVELOPMENT OF THE MUSOMA GHEE INDUSTRY

Ghee has been made in small quantities by individual families to meet their own domestic requirements for an indefinitely long period. It is still made by many of the less sophisticated natives, and particularly by the nomadic pastoralists of the east and south-eastern parts of the Musoma district, solely for their own consumption. The method used is a simple one and the quality of the resulting ghee is poor. Briefly, the method consists of allowing the milk to sour in a large gourd. The gourd is then suspended from the roof of the hut and shaken by the lady of the house until the butter separates. This is scooped out and collected in an earthen pot until sufficient is available to make it worth while boiling into ghee. During the period that the milk stands to sour, and also during the storage of the butter, much dirt and many insects collect on the surface, and a high degree of rancidity develops. Very little of either of these undesirable adjuncts is removed during or after boiling, so that the quality of the ghee cannot be high.

This poor quality ghee was the only type prepared up to 1930, but the quantity produced for sale had gradually increased. In 1930–31 Purvis introduced two separators into the North Mara area and " butter-ghee " was first made. This term has been used for ghee made by first separating cream from milk, allowing the cream to ripen, and then converting the cream into butter, prior to clarification.

The fall in the price of cattle and the economic need for cash led to the rapid development of this " butter-ghee " industry. Many separators were purchased by natives, chiefly Jaluo from South Kavirondo, who had learnt the process of ghee production in Kenya mission stations. This development was encouraged by Emson, who reported at the end of 1932 that sixty-six separators were in operation and that 50 per cent. of the exported product was of the improved " butter-ghee " quality. During 1932 the total export of ghee was but slightly increased but the improved quality of the article led to a big increase in the revenue from this product.

During 1932 a scheme was sanctioned to allow some of the Native Authority funds to be used to establish local natives in the " butter-ghee " industry. Under this scheme a native, who could produce evidence of a sufficient stock wealth as a security, could obtain a separator and churn on loan from the Native Authority. This loan was paid back at the rate of a *debi* (four gallons) of ghee a month. Under this scheme forty-two separator and churn units were issued. At the same time the local Indian traders instituted a similar scheme of issuing separators, but often the Indian retained the ownership of the separator and the native operator received a wage from the Indian.

The number of ghee-producing units rapidly increased so that the competition became " cut-throat ", and many natives who had obtained a separator and churn under the Native Authority loan, were being crowded out of their "pitch" by natives setting up the separator units financed by Indians. Eventually the Native Authority scheme was abandoned, and the Indian system is the one now in vogue.

The rapid rise in the industry may be judged from the following export figures, which represent only the ghee being exported through Musoma, and do not include the internal Musoma trade, nor the ghee carried over the border into Kenya by individual natives :—

		Exported at a value of
1931 ..	.. 2,748·42 Cwt.	.. Sh. 113,216/36
1932 ..	.. 2,950·16 Cwt.	.. Sh. 157,294/40
1933 ..	.. 5,442·57 Cwt.	.. Sh. 221,975/70
1934 ..	.. 7,383·35 Cwt.	.. Sh. 329,886/94
1935 ..	.. 10,457·00 Cwt.	.. Sh. 475,260/00
1936 ..	.. 11,823·99 Cwt.	.. Sh. 632,506/82

This year there are over five hundred ghee-producing units scattered through the Musoma district, chiefly in North Mara. This probably represents the useful working limit and any further increase in the number of separators will not necessarily be followed by a permanent increase in the output of ghee. Even with the present number of separators, overcrowding is obvious in certain areas and the owners are working in opposition, to their mutual disadvantage. Much could be done to effect a better distribution of ghee units, with consequent increase in the total output. Although about 70 per cent. of the present population are pastoralists, there will almost certainly be an increase in the number of natives engaged in the mining industry, and probably also an increase in the agriculturists in South Mara. Both these increases will tend to reduce the ghee output of the district. This decrease could be counterbalanced by a better distribution of the existing units, but it is doubtful if an increase in the total number will be advisable.

THE METHODS OF GHEE PRODUCTION

As already stated, ghee is still being prepared by the old primitive method (shaking soured milk into butter and then boiling the butter) by the nomadic pastoralists of the eastern area, and also by numerous small cattle owners all over the district. This type of ghee compares with the poor grade native made ghee from the Central Province, and does not enter into the export market. It is produced solely for the domestic requirements of the household.

The " butter-ghee " produced for export comes from three types of producing units, which may be classified into :—

I. The native-owned " Separator " unit.

II. The native-owned " Separator and churn " unit.

III. The " Indian *duka* " unit.

The quality of the ghee from these different types of unit does not vary greatly, and fairly good ghee can be produced by any of them. The following note indicates what can and does take place, but it should be pointed out that the more progressive natives take more trouble and work under cleaner conditions.

THE NATIVE-OWNED "SEPARATOR" UNIT

This type is by far the most common unit in operation. In the majority of cases the native owner has acquired a separator on the hire purchase system (usually from an Indian) and has arranged to buy cream from his neighbours. The separator is normally erected on the box in which it was delivered, and a number of stones are placed inside the box to keep it firm. The separator may be housed under a small thatched structure or a tree, but is often left completely in the open.

Milk is brought from the surrounding kraals in gourds or earthen pots, and it has been the custom to pour it directly into the separator. As a result of recent efforts by the Veterinary Department the natives are now beginning to use straining cloths to remove some of the dirt and insects prior to separation. The cream from the milk is measured in a small enamel cup ($\frac{1}{3}$ to $\frac{1}{2}$ pint capacity) and is paid for on delivery at the rate of 10 cents a cup. This is a very low price but the natives appear satisfied.

The cream is emptied into a collecting *debi*. Often the amount received daily is very small and it may take three or more days to fill a *debi*. The cream is stored in the *debi* for a few days to ripen and is then stirred with a stick until the butter separates. This is a tedious job, and there is a tendency to leave the cream to become very sour before it is stirred into butter. When this separates, as much butter milk as possible is poured off and the butter set aside to accumulate. The butter is not washed with water to remove all the butter milk and consequently it is very rancid by the time it is boiled into ghee.

When larger amounts of cream are purchased, the cream is stored until six *debis* have collected and then the whole lot is stirred into butter which is boiled the following day.

For the boiling either an earthen pot, an aluminium saucepan or a large iron pan is used. It is set on three large stones over a small fire burning in a shallow depression in the ground. Stirring is performed intermittently with a stick or wooden ladle.

When boiling has finished the ghee is removed in a bowl or kettle for filling into *debis*. The usual procedure is to spread a small (4 inches square) piece of cloth over a small hole in the *debis*, and then to pour the hot ghee through this cloth. This is a long job and, as the piece of cloth is usually very old, the straining process is not very efficient. Much of the protein curd passes into the *debi* of ghee and reduces considerably the keeping quality. Since the protein has already begun to hydrolyse the ghee possesses a pungent cheesy smell from the time it is made.

Usually the ghee made in this way is overboiled and boiled too slowly, so that it fails to solidify on cooling to ordinary temperatures.

THE NATIVE OWNED "SEPARATOR AND CHURN" UNIT

Compared with the previous type a very much smaller number of this kind of unit is in operation. The natives owning both a separator and churn were largely established under the Native Authority Scheme, the use of a churn being advised to improve the quality of the butter and hence the nature of the ghee.

Usually this kind of outfit is set up in a good cattle area, and a larger quantity of cream is purchased than with the "separator" unit. The method of purchase, separating and boiling is exactly as described for the separate unit. The difference in procedure is that with this type the cream is stored until six or so *debis* have collected and soured. The cream is then churned into butter in a rotary metal churn. Again the butter is not washed, although by doing so a very much better quality butter could be produced with this unit than when the butter is made by stirring the cream in a *debi*. In practice there is very little difference to be observed in the quality of the ghee resulting from the two types. There is perhaps slightly less rancidity in the ghee prepared by this type of operator, but I think this is due to the shorter interval between separating and boiling rather than to the outfit.

THE "INDIAN DUKA" UNIT

This type of ghee producing plant is owned entirely by local Indian traders. The separator is set up outside their shops and milk is purchased in the usual manner. A native is employed by the Indians to do the work, and this type of unit is essentially the same as that in which the separator is owned by a native. The only difference is that the Indian has more capital, and so can buy on a larger scale than the native. Also the native likes this type of unit because he can spend his cream money straight away in the shops.

As a modification of this system, one finds that Indians own several separators which are set up in the nearby village. A native is employed to work and look after the separator and then the cream is brought in to the duka where it is mixed with cream from the duka separator.

The cream is allowed to stand until about six *debis* have been collected and then it is stirred into butter with a stick. No churn is used in this type of unit. Boiling is usually done in a large iron pan and the process is the same as for the previous two types.

Ghee of the same standard as the previous types is produced.

IMPROVEMENTS BEING ENCOURAGED BY THE VETERINARY DEPARTMENT

An Assistant Livestock Officer tours the Musoma district whenever opportunity arises, and gives instruction in methods of making ghee. Great stress is being paid to the question of improved cleanliness of utensils and operators. The use of straining cloths is being urged both for straining the milk and for removing the protein curd from the ghee. Efforts are being made to encourage the use of better fireplaces and the quicker boiling of the butter into ghee.

Demonstrations are being held in each sub-district to teach the operators the correct point at which to stop the boiling process, and the correct way to filter off the curd and collect the ghee in containers for export.

Amongst those natives who wish to continue making " butter-ghee " the Veterinary Department is doing its utmost to reduce the time of storage of the cream and butter. Where there is little probability of frequent churnings and boilings the natives are being taught to make their ghee by the direct boiling of cream each day.

THE DIRECT CREAM TO GHEE METHOD

Under the existing conditions the cream is allowed to ripen for several days before being churned into butter. The longer the cream is allowed to stand the higher the rancidity and acidity that develops. Further, as the normal butter-making process does not include washing, much of this acidity and rancidity is left in the butter. During the storage of the butter further rancidity and acid-producing changes take place, so that by the time the butter is boiled its quality is often very poor. The boiling process removes much of the rancidity and acidity, but naturally the greater the initial values the greater the amount that will remain in the final ghee.

Therefore, for the production of the best quality ghee the cream and butter should not be allowed to stand longer than is absolutely necessary. Under the present conditions, the daily cream purchase is, with but few exceptions, too small to make it worth a native's while to go through the laborious and slow business of stirring the cream into butter.

With the existing conditions of a small daily supply of cream, there is no alternative but to abandon the present system completely. In its place each day's supply of cream should be boiled directly into ghee on the day of separation and without the intermediate step of making butter.

Tests in the laboratory and at the Clarified Butter Factories have shown that ghee made by the direct boiling of cream does not develop rancidity or high acidity. Also once butter-fat has been freed of moisture and proteins it can be stored almost indefinitely without fear of deterioration. It seems, therefore, that the logical procedure in Musoma, where only small quantities of cream are available daily, is to convert the cream into ghee directly, eliminate the laborious butter-making process and thereby obtain a better quality article.

In the Government supervised Clarified Butter centres of the Western Province, it has been the practice to mix the cream with water and re-separate to reduce the protein content of the cream. Under the Musoma conditions where very much smaller quantities of cream have to be dealt with, this re-washing of the cream is unnecessary.

Demonstrations of the method have been given in 1936, and many natives are taking up this simplified process and thereby obtaining a better quality ghee for which the Indian dealers are paying a higher price.

Briefly, the cream is boiled as soon as possible after being separated from the milk. Quick boiling is advised and when the protein curd has sedimented the

boiling pan is taken off the fire and allowed to cool. The contents are then strained through four layers of cloth into an open vessel. The last dregs of fat are squeezed out of the curd by twisting the ends of the cloth, and it is recommended that these last portions be collected separately and reboiled with the next day's cream. This prevents any curd being poured into the exporting container and the quality of the ghee is considerably enhanced thereby.

The extra price being paid for this better quality product, which does not involve extra labour in preparation, is proving a sufficient incentive for the wider use of this direct method.

QUALITY OF MUSOMA GHEE

Average Musoma " butter-ghee " is a semi-solid article, the amount of solid varying considerably. The ghee is not free completely from protein material and possesses a pungent cheesy smell. Its rancidity varies greatly between individual samples, as does also the solidity and the extent of protein and dirt contamination. The variation in quality is a result of the long intervals of storage of the cream and butter, and of differences in the efficiency of the clarifying technique. Nevertheless, on the whole the quality of this " butter-ghee " during the last few years has been definitely superior to that of the ordinary native made product from other parts of the Territory. Similarly the ghee made by the direct boiling of cream without any interval of storage and ripening is very much superior to the " butter-ghee ". It is highly probable that if this direct cream method increases in popularity a product will be marketed from Musoma which may challenge the supreme position of the Government Certified Clarified Butter.

It is seen, therefore, that Musoma ghee varies considerably in quality. The best article is comparable with the Clarified Butter sold for European consumption ; it is free from rancidity and proteins, and is solid, but the good name which might be enjoyed by these best samples is kept tarnished by the presence in the same consignment of ghee of poorer quality.

MARKETING OF MUSOMA GHEE

This branch of the industry is at present almost entirely in the hands of Indians. These traders generally buy the ghee from the native producers, grade it, and then export it to various places according to the quality of the product that is required. Musoma ghee has become well known, and Indian traders have built up connexions which appear to be capable of absorbing more than the present production. It is transported long distances, as far, it is said, as the Persian Gulf.

The present marketing system appears to be working satisfactorily for all parties concerned, and no interference is contemplated. It is considered that the best way of furthering the industry is to improve the quality without making drastic alterations in existing methods of production, and to rely on the better quality ghee commanding a better price.