

## SOME ASPECTS OF COPRA DETERIORATION

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### SUMMARY

*Copra is a perishable food commodity and the deterioration that can occur in the manufactured product is indeed great. The actual period taken and the degree of such deterioration however would depend on the exact circumstances of processing, handling and storage.*

*Micro-organisms require for their metabolism, besides a source of carbon, also moisture, nitrogenous substances and mineral salts. The Coconut kernel contains all these nutrients and constitutes an ideal medium, providing all the conditions that favour biological deterioration.*

*The fundamental causes of copra deterioration are many and their various effects are not infrequently superimposed. Contained or re-absorbed moisture may be regarded as the most important single factor that governs the initiation and progress of deterioration. Bacterial fermentation and fungal action on copra always imply the presence of moisture. The intensity of such attacks however would generally vary with the precise moisture content. Bacterial activity is greatest at moistures over 10% whereas fungal moulds have been found to be active even at moisture contents below 6%.*

*There are two types of fungi which attack copra under tropical and sub-tropical conditions. These are the superficial and penetrating moulds which are confined to the genus *Aspergillus*. The former appear on the surface of dry copra and are comparatively innocuous. The latter however consume the tissues of wet copra and cause considerable loss and depreciation. Regarding insect pests which breed in copra, they prefer fairly moist and very mouldy conditions when they can readily feed on intermingled fungal mycelia and spores.*

*Without the effective inhibition of bacterial infection, any efforts for the preparation of quality copra would be futile, because bacterial invasion implies discolouration and attack by penetrating moulds followed by insect infestation.*

*In cases where mould cum insect infestation has already commenced the only practicable remedy for controlling deterioration would be with fumigants.*

### INTRODUCTION

It is generally reckoned that the main objectives of copra research should be the determination of the characteristics of high grade copra and an elucidation of the methods of preparation by which these desirable characteristics could be secured. Copra is a perishable food commodity and since the amount of deterioration that can occur in the product after manufacture is very great, it is considered that a proper understanding of this aspect of the subject would also be of much value to both producer and consumer.

Theoretically speaking, it would appear that there is no real reason why poor quality copra should be produced anywhere in the world. Provided ripe coconuts alone are harvested from healthy palms, except for slight differences in oil content, the quality of the meat itself should be very much the same for nuts of different countries. In reality however, the general standard of quality of the world's copra is appallingly low in comparison with the standards of other primary agricultural products that enter world trade. A variety of factors may contribute to this and the fact remains that under normal conditions even superfine copra will eventually deteriorate with the passage of time. The actual period taken and the degree of such deterioration would however be contingent on the exact circumstances of processing, handling and storage.

In the present article, it is proposed to consolidate and interpret briefly some important observations that impinge on the topic of "Copra deterioration".

### THE COCONUT KERNEL IN RELATION TO SPOILAGE

The coconut kernel (or endosperm) contains reserves of stored food material for utilisation by the embryo during its germination and early phases of growth. These food constituents include the major and essential factors: fat, protein, carbohydrate, mineral salts and certain vitamins. In its fresh state the kernel also contains a good deal of moisture, which generally ranges between 42.0 and 46.0 per cent. For practical purposes therefore 44.0 per cent may be regarded as a reasonable average value for the moisture content of the fresh kernel.

It is only too well known that the freshly grated coconut meat is commonly used in Ceylon and certain other countries for culinary purposes, as an addition to curries, and also in many other ways in the diet. In this fresh state it has extremely poor keeping qualities and is indeed very difficult to preserve. Since the wet meat goes bad so easily, for commercial purposes it is dried down to about 6 per cent moisture content in which form its keeping qualities are decidedly improved. The product so obtained is of course the familiar copra. By far the largest proportion of commercial copra is used for the production of coconut oil and in the milling process the residue left behind is coconut press cake or "poonac" which is a valuable protein concentrate for dairy cows and farm stock. Figures showing the chemical composition of a typical sample of fresh coconut kernel as compared with copra and poonac are charted in Table I below :

TABLE 1

1	2	3	4
<i>CONSTITUENT</i>	<i>Fresh coconut kernel (Typical sample) per cent</i>	<i>Number 1 Copra (Average sample) per cent</i>	<i>Poonac (Average sample) per cent</i>
Moisture .. ..	44.0	6.8	9.8
Oil .. .. .	38.2	63.7	8.1
Protein .. ..	4.6	7.6	21.0
Carbohydrates .. ..	9.7	16.1	45.1
Mineral constituents (Ash) ..	1.2	2.0	5.5
Crude fibre .. ..	2.3	3.8	10.5
Total .. ..	100.0	100.0	100.0

The above figures serve to demonstrate and confirm the fact that the kernel of the coconut contains besides the mineral constituents, all three of the major food factors; protein, fat and carbohydrate. It will be further evident that the principal constituent is oil or fat.

Protein by itself, is not a single chemical substance, and in fact proteins from various sources do vary considerably in their ultimate composition. From the point of view of nutrition, the protein of the coconut, unlike a number of plant proteins, is reckoned to be biologically "good" because it has been found to support an animal in health and normal growth, when used as a sole source of protein in an otherwise complete diet. In fact, in connection with animal feeding it has been found that coconut poonac furnishes the necessary protein for growth at almost a normal rate.

The oil or fat of the coconut which is the dominant constituent of the kernel has been found to be the most readily digested of all edible fats (including butter) in general use in the world. Doubtless, the oil in the kernel may therefore be regarded as the coconut's highest contribution to animal and human nutrition.

As regards carbohydrates in the mature coconut kernel, it can be said that at least 7 per cent of ordinary cane sugar is present in fresh copra. The bulk of the carbohydrate however is present in the form of cellulose—much of which has been found to be digestible. The actual carbohydrate composition of coconut meal has been reported by CARAY.<sup>1</sup>

With a knowledge of the nature and composition of the coconut kernel it should now be appropriate to consider how and why spoilage occurs so readily with the fresh meat and the products derived from it.

Provided there is no infection of, or damage to the "soft eye", the wet white inner surface of the endosperm remains sterile until the nut is split open, when it at once provides a perfect nidus for the growth and multiplication of moulds, yeasts, bacteria and associated insects. Micro-organisms in general, require for their metabolism, besides a source of carbon, also moisture, nitrogenous substances and mineral salts. Whilst a pure dry fat by itself, cannot support the growth and reproduction of such organisms, spoilage due to their activity occurs, most readily in fats held in moist tissues containing the other requisite microbial nutrients which have been enumerated above.

Besides containing these nutrients, it should be obvious that the coconut kernel and its products constitute ideal media providing all the conditions which would favour biological deterioration.

### THE CHARACTERISTICS OF COPRA DETERIORATION

From what has been discussed above it should be abundantly clear that a commodity like copra which has to withstand the vicissitudes of storage and transport for considerable periods of time is very prone indeed to deterioration and loss. On the other hand, these degenerative changes could no doubt be minimised by a careful processing followed by proper storage or warehousing of the finished product.

When a coconut is split open, the freshly cut surface of the kernel comes into contact with the atmosphere which invariably carries teeming millions of putrefactive organisms and their dormant spores. Once the wet meat gets casually inoculated with these, the process of deterioration may be said to commence almost spontaneously.

The fat of the coconut is held in the endosperm in the form of tiny droplets of oil in cells possessing thin membranous cell walls. If this membrane gets damaged the contained oil oozes out rendering the surface of the copra greasy and unsightly. Whenever this happens the product becomes very vulnerable

to micro-organic action, the ruptured walls of the oil cells providing supplementary protein for the activity of different organisms.

Though, in a great majority of cases the organisms which attack fatty foods (like the coconut) are of the non-pathological type, yet they can cause much damage by the production of unpleasant flavours and odours and also by the formation of unsightly fungoid growths and discolourations. It should also be mentioned that an actual loss of anhydrous copra may be a concomitant feature of this type of deterioration, the degree and quantitative loss of course varying according to the precise circumstances.

It is a biochemical fact that before the reserves of oil in the kernel can be utilised by the growing embryo they have to be broken down into simpler and more easily assimilable fractions.

It is known that this is accomplished by certain fat splitting (lipolytic) organic catalysts called enzymes which are present in the tissues of the coconut kernel outside the oil cells. Whenever there is rupture of the oil-cells the enzymes come into contact with and attack the fat globules with the production of free fatty acids and glycerine. The acids may then break down further into aldehydes and ketones which are principally responsible for the strong odours, rancid flavours and the darkening in colour which may generally be recognised as distinctive features of copra deterioration.

Though in most coconut producing countries there is no strict commercial definition of copra, in practice the term is applied to the coconut kernel in various stages of dehydration. In most countries, the product is generally bought and sold by attaching various grade designations. Whatever the grading system adopted, good copra is known to possess certain unmistakable physical and analytical characteristics. These characteristics alter whenever the process of deterioration sets in, affording certain useful indications which may be employed for the evaluation of the quality of the product.

Even at the present time the principal method by which purveyors of copra estimate its value is entirely based on visual and tactile inspection. Though this method may appear unreliable it should be pointed out that it is based upon the experience of the valuer who appreciates the relationship between the external and analytical characteristics. Good copra is always made from mature well seasoned and ungerminated coconuts. It is well dried to biscuit hardness so that it is crisp and brittle. It has a good white colour with a pearly lustre and a characteristic sweet smell. It is free from extraneous matter, stains, moulds and burnt marks. If prepared in the form of half nuts (cups) these would generally be smooth and round, of good thickness, size, shape and appearance and also be free from "smalls". Among the analytical factors of copra quality the principal and most useful ones include moisture, free fatty acidity and the oil content. Copra of the best quality would generally have a moisture content ranging between 5 and 6 per cent and would yield an oil with a free fatty acid content under 0.1% (calculated as lauric). As regards the oil content, this would generally range between 67 and 69 per cent (dry basis) in the fresh and undeteriorated product.

Whenever deterioration sets in, the chief visible results on the copra may include a superficial or internal discolouration of the meat associated with a breakdown of the tissues. Whilst a slight and superficial discolouration may not have serious consequences, tissue degeneration is always bound to materially affect the character and quality of the product. In extreme cases, the process results in a soft pulpy mass of black rank smelling slimy copra that is riddled with worms and insects. When copra in such a state of extreme decomposition dries out, it invariably yields a mixture of hard congealed and rubbery pieces of a near black colour, embedded in a mass of loose copra dust, containing "smalls", extraneous dirt, dried fungal mycelia and the remains of insects.

As regards the analytical characteristics of copra it has been observed that certain interesting changes accompany the process of deterioration. Depending on the atmospheric humidity the process of decomposition may add moisture to the copra so that when bad copra is stored under damp conditions in ill-ventilated stores, the quality may easily become progressively worse, resulting in a slimy, dark, matted and evil smelling product. The interesting feature is that under conditions of such deterioration, there is besides a steep rise in the free fatty acidity, also a perceptible increase in the percentage oil content of the meat. In other words, as the moulds destroy the tissues, deterioration involves loss of weight and loss of quality in the oil, but strangely enough also an actual increase in the oil percentage.

The plausible explanation for this phenomenon is that there is to be found in the coconut kernel a definite oil gradient when it is sliced tangentially, parallel to the testa or brown integument. When moulds attack the inside face of copra, the tissues containing the lowest amount of oil are broken down first and removed in the form of gas and water vapour. The unattacked layers of copra nearer the testa, that remain, which are richer in oil, naturally give higher oil figures. It should however be mentioned in this context, that though the oil content (when expressed as a percentage) apparently increases, owing to the progressive destruction of the tissues from biological deterioration, yet the actual recovery of oil on a nut basis would be lower. Further, from the commercial point of view, the quality of the oil and also the poonac recovered from deteriorated copra, is inferior so that losses on refinement would naturally be higher.

### FACTORS AND AGENTS OF DETERIORATION

The fundamental causes of copra deterioration are many and their various effects are not infrequently superimposed. Since it is generally accepted that cases of inferior quality can always be traced to causes in the country of origin, it follows that any improvement which is to be brought about must be wrought at that end. In the generality of cases the spoilage which may ensue before, during or subsequent to drying is generally traceable to gross neglect, insufficient drying, careless methods of preparation in kilns of unsuitable design, or to the practice of blending poor and good copra together. In rare instances, copra can also get inadvertently spoilt as a result of "sea damage".

Starting with a given quantity of fresh coconut kernel, it may be said in general, that the quality and quantity of copra ultimately reaching the oil mill would depend on at least four different factors, which may be epitomised as follows :

1. The care exercised in the various stages of drying and preparation of the product.
2. The initial moisture content of the freshly manufactured copra.
3. How the product is handled and treated during bulking, storage and transport.
4. The actual period of time elapsing between the preparation of the copra and the manufacture of oil from it.

Having considered in outline the factors that determine the quality and keeping properties of copra, we could now proceed to consider the principal agents responsible for deterioration itself.

#### Deterioration due to moisture

Contained or re-absorbed moisture may be regarded as the most important single factor that governs the initiation and progress of deterioration. It has already been pointed out that the fresh wet coconut meat is a ready target for attack by micro-organisms. Insufficient dryage during preparation leaving a

moisture content in excess of 6 or 7 per cent, or inefficient storage in ill-ventilated, damp rooms unprotected from rain, in a stagnant moisture saturated atmosphere also conduce very readily to biological deterioration.

Bacterial fermentation and fungal action on copra always imply the presence of moisture. The intensity of such attacks however would generally vary with the precise moisture content. It is generally reckoned that bacterial activity is greatest at moistures over 10 per cent whereas fungal moulds have been found to be active even at moisture contents below 6 per cent. Regarding insect pests which breed in copra, it is known that they prefer fairly moist, and very mouldy conditions when they can readily feed on intermingled fungal mycelia and spores.

### **Deterioration due to Mycological Factors**

Since the activities of true fungi and bacteria, under practical conditions are closely associated with each other, it would really be superfluous to separate them in a consideration of their influence on the process of deterioration. It should however be mentioned that it is the bacteria (and occasionally yeasts) that break down the cell structure of coconut meat and initiate deterioration owing to their attraction to the sugars in the kernel (and the adhering film of coconut water) which they ferment.

Usually it would take about 6 hours after splitting of the nuts for one to observe the first visible symptom of bacterial infection. Wherever pin-head indentations occur on the meat, bacterial colonies first appear as shiny white specks. In about 8 hours' time these small colonies merge into each other and the meat begins to get gummy and later slimy. Ultimately, the slime assumes a viscous consistency with a yeasty smell, and coats the entire inner surface. If the sliming process is allowed to proceed unchecked it generally results in a marked pitting and corrosion of the tissues of the meat. This is usually followed by the development of penetrating moulds. At this stage, insect activity may commence, reducing the copra in extreme cases to a pulverized mass with concomitant mite infestation. It could be said that the intensity of mould and insect attack on copra is generally dependent upon the extent to which the cell structure is initially broken down by the bacteria.

Copra containing under 10 per cent of moisture has been observed to be generally free from bacterial action. It could be said that the most favourable conditions for bacterial attack are provided when wet or half dried coconut meat is exposed to cold and humid conditions for long periods. At a relative humidity of over 80 per cent and a temperature not exceeding 30°C it has been found that bacterial slime may commence to show even in four hours, while in eight hours the copra can be irremediably spoilt. Mould attack generally follows within 48 hours of bacterial sliming unless the moisture content is reduced to below 20 per cent within this period. It is known that whilst only a yellow discolouration of the meat results from incipient bacterial invasion, with prolonged activity a permanent and penetrating redness is imparted to the copra on drying.

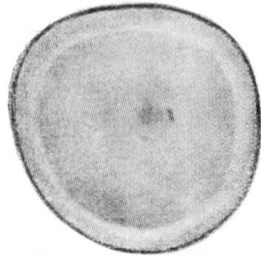
Though moisture is undoubtedly the initiator of deterioration, it cannot be regarded as the sole factor involved in the growth of moulds, because mould activity normally commences only two days after the development of bacterial slime. It is not unlikely that the sequence of attack by bacteria and specific moulds is determined by the appearance of certain degradation products of the complex glycerides, proteins and carbohydrates present in the coconut kernel.

There are two types of fungi which attack copra under tropical and sub-tropical conditions. These are the superficial and penetrating moulds belonging principally to the genus *Aspergillus*. The former appear on the surface of dry copra and are comparatively innocuous. The latter however destroy and

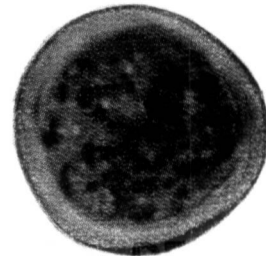
# MOULDS FOUND ON COPRA



**FRESH UNDETERIORATED COPRA**  
(Mould Free)



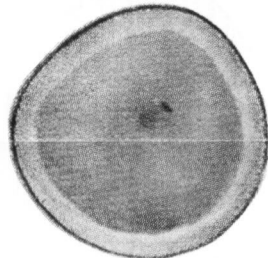
**INCIPIENT DETERIORATION**  
(Bacterial Slime)



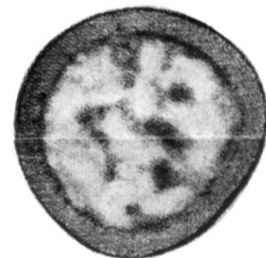
**ADVANCED DETERIORATION**  
(Confluent Moulds)

**SUPERFICIAL MOULDS**

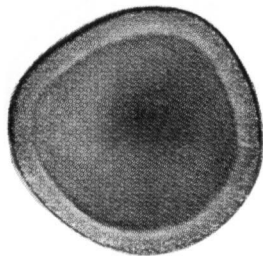
**PENETRATING MOULDS**



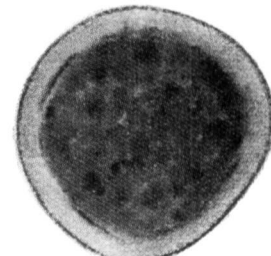
*Aspergillus tamaris* (Buff)



*Rhizopus nigricans* (White)



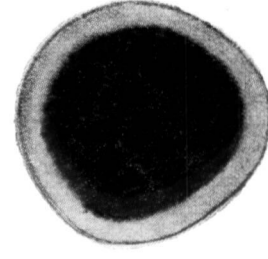
*Aspergillus glaucus* (Green)  
*Penicillium glaucum* (Green)



*Aspergillus flavus* (Yellow Brown)  
*Aspergillus flavus oryzae* (Yellow Green)



*Aspergillus cinnamomeus* (Light brown)



*Aspergillus niger* (Black)

Figure 1

consume the tissues of wet copra and cause considerable loss and depreciation. If deterioration is checked after the penetrating moulds commence their activity, the fungal mycelia dry up, and a dust of high acidity falls off and discoloured copra of high oil content is left owing to the removal of the original surface layer which was least rich in oil. A sample of copra dust has been found to yield an oil with a free fatty acid content as high as 47 per cent. With progressive disintegration of the surface layers of copra into water, gas and acid, the oil content of the residual copra would continue to rise to as much as 75-76 per cent which is generally the average oil content of the tissues nearest the brown integument or testa.

The micro-organisms found in association with coconut meat and copra containing various percentages of moisture have been enumerated, by WARD and COOKE<sup>2</sup> and it should be appropriate to make brief reference to this classification :—

**A. Wet and drying Coconut Meat with 20-50 per cent moisture**

- (1) Two bacteria (short rod and long rod-pale yellow).
- (2) Penetrating mould *Aspergillus niger* (black).
- (3) Penetrating mould *Aspergillus flavus oryzae* (yellow green).
- (4) Penetrating mould *Rhizopus nigricans* (white mould later turning black).

**B. Half dried copra with 12-20 per cent moisture**

The three penetrating moulds mentioned in (A) above.

**C. Insufficiently dried Copra with 8-12 per cent moisture**

- (1) Penetrating mould *Aspergillus tamaris* (buff).
- (2) Superficial mould *Aspergillus glaucus* (green).

**D. Dry Copra with less than 8 per cent moisture**

- (1) Superficial mould *Aspergillus glaucus* (occasionally).
- (2) Superficial mould *Aspergillus cinnamomeus* (light brown).
- (3) Superficial mould *Penicillium glaucum* (green).

**E. Well dried copra with under 6 per cent moisture**

Usually free from even superficial moulds, if the copra is stored in a dry atmosphere. FIGURE—1 is a colour diagram illustrating the different moulds found in association with copra.

Though other micro-organisms have been recorded, they would appear to play only a minor role in causing normal copra deterioration.

**Deterioration due to Entomological Factors**

From what has been discussed already it should be evident that besides bacteria and fungi, insects also contribute appreciably to the deterioration of copra. In this connection, cell degeneration due to the activity of bacteria is known to be a factor of major importance as regards the susceptibility of copra to insect attack. It has been observed that copra which has deteriorated or softened through bacterial sliming has a considerably greater attraction for copra consuming insects than hard well dried copra. "Red" or caramelised copra too has been found to be a special attraction for the majority of these insects.

This has been proved by the fact that "red" copra is attacked first when it is stored adjacent to high grade white copra. It is likely that the degradation products in the caramelised product serve to attract these insects. One interesting point is that unlike the action of moulds the effect of insect attack *in a great many cases* is that the oil percentage is not impaired because the oil is consumed simultaneously with the tissues.

Apart from quantitative losses in anhydrous copra due to actual consumption, the main objection to the presence of insects in copra is the production of 'dust'. Dust is the commercial term generally applied to the mixture of fine broken debris and fractured pieces of copra along with any extraneous contaminants in a sample. It should be mentioned that the presence of dust in the shipped product is the common cause of arbitration for price adjustment. The production of this dust may be traced to two factors. *Firstly*, certain insects associated with copra do not actually consume it, but break down the moulds and burrow into the meat to lay their eggs, and in so doing produce a quantity of this dust. The second factor which is conducive to the production of dust is the activity of a small group of insects which (unlike most others found in copra) feed only on the oil and thereby eliminate a great deal of non-fatty solids as a product of disintegration.

As a rule, the initial attack on soft copra is made by the larger insects. Later on, as the copra dries and hardens, mites and ants may proceed to attack the tissues near the brown integument which is richest in oil. In extreme cases of degeneration the copra may be reduced to a riddled mass of dust, disintegrated debris, and brown testa. This generally happens only when poor quality copra has been kept in storage exposed to insect infestation for very protracted periods of time. It should be pointed out that not all insects associated with degenerated copra actually devour the meat. A certain class is purely predaceous and this group feeds only on larvae and grubs of other insects (and sometimes their own) as they develop in furrows or channels found in disintegrating coconut meat.

It may be said that the actual quantity of mouldy degenerated copra present in a particular location would normally determine the intensity of insect infestation. In other words, insects would be entirely absent in estate stores or warehouses where well dried good quality copra alone is prepared and handled. By world standards Ceylon copra is undoubtedly good, and this explains why we do not have any serious trouble resulting from the depredations of insects. Methods of preparation are satisfactory and the product is rarely kept in storage for very long periods prior to processing or export.

Entomological records from coconut producing countries show that the three most prevalent insects in copra are *Necrobia rufipes* (de Geer), *Carpophilus dimidiatus* (F), and *Ahasverus advena* (Waltl.) Of course the less prevalent insects (including cockroaches) are somewhat numerous. *Necrobia rufipes* which is known to the trade popularly as the "copra bug" is principally a warehousing pest. It is a beetle which is mostly attracted to wet mouldy copra.

A consideration of the biology of *Necrobia* and the other insects associated with copra deterioration, is strictly outside the ambit of this article.

### PREVENTION OF COPRA DETERIORATION

From what has been discussed so far it should be evident that the deterioration of copra could result from a variety of factors. Assuming that the nuts have been carefully harvested, so that under-ripe and over-ripe drupes have been excluded, and that the pre-treatment has been satisfactory, the first 4-8 hours after splitting may be regarded as a very critical period. It is essential to reduce to a minimum the period of delay between splitting the nuts and applying heat. Even in the most perfect system of manufacture

8 hours (inclusive of the time taken to split) may be regarded as the maximum period of delay which is really permissible. The practice of overnight splitting of nuts is definitely one to be discouraged because there is every likelihood of advanced bacterial activity taking place rendering the copra liable to deterioration. The Ceylon method of sundrying for 5-9 hours prior to kiln drying is doubtless one of the best ways of preventing early contamination with bacteria. It should however be borne in mind that it is of primary importance to drain off thoroughly any coconut water from the half nuts, else the sugars present would provide a ready target for bacterial attack. In a nutshell it all means that without the effective inhibition of bacterial infection any efforts for the preparation of superfine white copra without blemish or wrinkle would be futile, because bacterial invasion implies discolouration and attack by penetrating moulds followed by insect infestation.

Regarding precautions at the drying stage, the first thing to remember is that heat should be applied before bacterial attack has had time to develop. It is not adequate merely to place the half nuts on the drying trellis of the kiln without delay. The kiln should be already warmed up and it should be so designed that the copra is not exposed to pockets or draughts of cold air. It is also important that the kiln should not be overloaded so that cold and humid conditions can prevail on the top surface of the bed of copra. Overloading not only prevents free air movement through the stacked copra but also causes the moisture laden air to produce a chilling effect. Unless appropriate precautions are taken conditions favourable for bacterial activity may predominate even inside the kiln. It is imperative therefore that faulty kilns and those of poor design should not be employed.

If sufficient care is not exercised, even properly dried good copra could deteriorate due to bad after-treatment. Careful handling, transport and storage are absolutely vital if copra is to reach its destination in good condition. It is important that copra should be kept in well ventilated dry stores and should never be allowed to get wet, else it will become liable to severe deterioration by moulds and insects. Since wet and poor quality copra are always foci of deterioration, they should never be stored alongside or blended with good copra.

In cases where mould cum insect infestation has already commenced the only practicable remedy for controlling further deterioration appears to be the use of fumigants, though it involves the use of undesirable poisonous vapours. Once the oil cells are ruptured and the oil comes into contact with the enzymes, the copra is bound to degenerate quickly regardless of its moisture content. The enzymes may be said to start off a sort of chain reaction which does egregious damage to the copra. It has been observed that the use of enzyme inactivators or inhibitors has ensured a fair measure of success, in preventing or arresting deterioration. In this connection gaseous sulphur dioxide has been reported to give satisfactory results. It combines fungicidal and insecticidal properties with its potentiality for inactivating enzymes. Though some work has been done on problems of sterilizing, bleaching and fumigating deteriorated copra, further research in this field is considered worthwhile.

## CONCLUSION

The principal use of commercial copra is the manufacture of oil. It is a safe assumption that the greatest part of the commercial supply of coconut oil will continue to be made from copra by conventional methods for many years to come. Since consumers of coconut oil require an odourless oil of light colour and low free fatty acid content the importance of producing quality copra should be appreciated by copra producers, marketing authorities and exporters alike.

Except in such rare instances as damage at sea, almost every case of inferior quality could be traced back to causes in the country of origin. Since careful harvesting, processing, transport, storage and shipment of copra all have an important bearing on the final quality of the product, producers and consumers should appreciate each other's problems and make concerted efforts towards a general improvement of quality which should doubtless pay dividends to the industry.

An endeavour has been made to bring within the compass of this article, a certain amount of information bearing on the subject of copra deterioration, in the hope that the significant features that have been brought into focus will enable a better understanding of the commercial and economic implications of the problem of copra deterioration.

Though the use of fumigants, sterilizers and preservatives may be effective, the simplest and surest way to ensure the production of quality copra with good keeping qualities, would be the exercise of sustained and patient attention to all important details involved in copra manufacture, from the time coconuts are harvested until such time as the manufactured product is ready for milling or export.

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