SURVEY RESULTS FOR PNG COCOA BEAN QUALITY FACTORS

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ABSTRACT

The quality factors of cured cocoa beans are essential for a primary producer to understand to meet the requirements of manufacturers. In this paper, results of a survey carried out on some of the important physical and chemical quality factors which contribute to the assessment of the quality status of PNG cured cocoa beans for the export market are presented.

***Key words**: cured cocoa beans, shell content, moisture content, bean weight, pH, acidity.*

INTRODUCTION

Since chocolate is sold in one of the most competitive food markets in the world, manufacturers demand high standards in the initial "quality" of cured cocoa beans that are produced by cocoa growers. This is understandable since the quality of the processed products depends very much on the initial quality as well as the types of cocoa beans available.

The word "quality" is often used to describe several important aspects (quality characteristics) of cocoa beans required by manufacturers. In a limited sense it is often referred to as the intensity of the chocolate flavour.

The need for primary producers to understand manufacturer's requirements and the criteria by which they assess the suitability of cured cocoa beans for processing into various chocolate products is, therefore, most essential.

A number of factors are taken into consideration in the selection and/or grading of cocoa beans by manufacturers. These can be divided as follows:-

a.) those that influence flavour (chocolate flavour) as determinned sensorialy:

- acidity, bitterness, astringency, and/ or other "off-flavours" such as smoky and mouldy flavours.

(b) Those physical characteristics which affect the edible material and thus the quality, i.e. bean size, shell percentage, fat and moisture content.

-The butter fat hardness and/or its melting behaviour which affect mouth feel and flavour release in chocolate products, as well as maintaining the quality of these products during storage.

(c) The purity of the raw cocoa bean product which implies the absence of foreign flavours or contaminants, e.g., toxic chemical residues that may be due to improper use of agricultural chemical (pesticides), etc;

The three categories of quality (quality factors) considered together often affect the value of a particular cocoa bean supply in relation to other "cocoas". The actual price at a given time is however, a factor of the prevailing market situation.

Though cocoa butter is by far an important quality criteria in the cocoa trade, chocolate manufacturers are equally concerned that cocoa liquor used along with deoderized cocoa butter in the manufacture of chocolate products is also high in chocolate flavour intensity.

Chocolate flavour is a property which can neither be precisely defined nor can it be assessed objectively. Assessment of this property is by tasting. Defects in flavours (or presence of "off"-flavours, e.g. mouldy, smoky, acidic, bitter and

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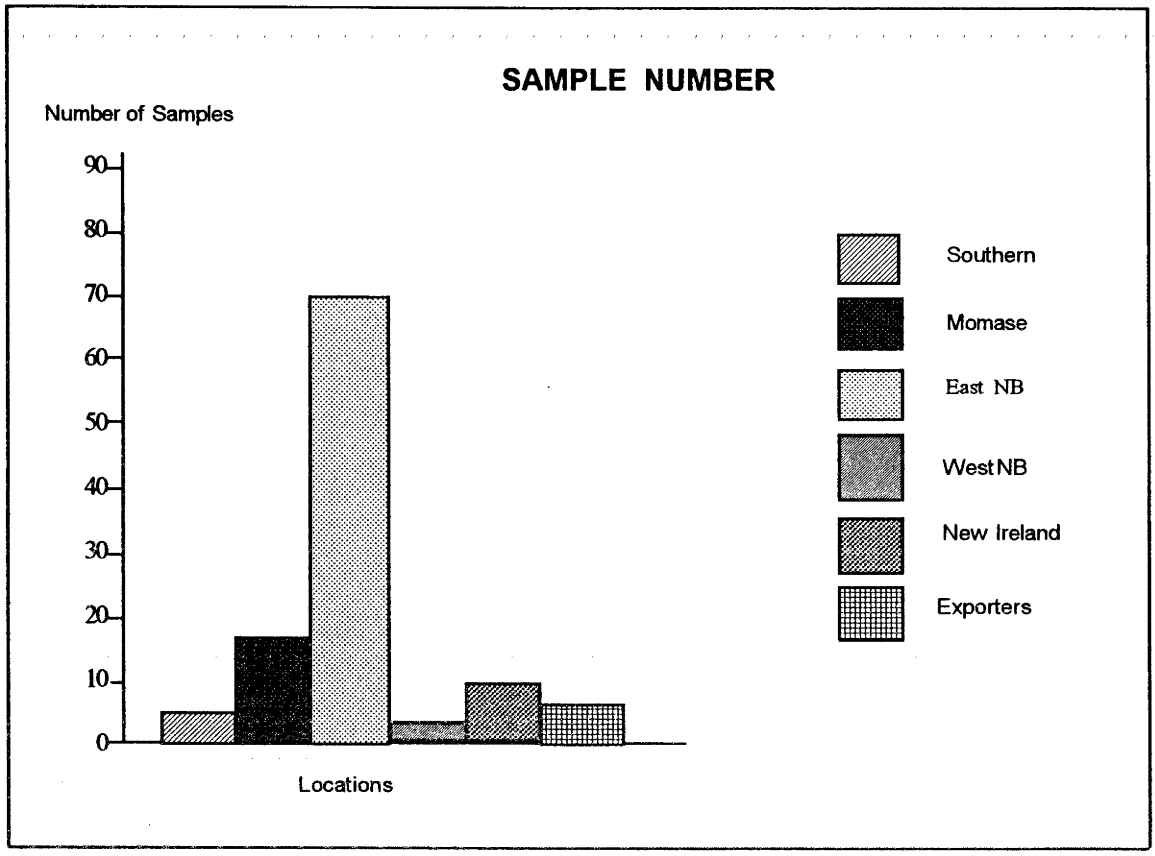
Figure 1. **Number of cocoa bean samples analysed for the areas surveyed.**



astringent flavours) can also be detected through tasting. These often lower the level of acceptability of such cocoa bean products and are frequently the cause for rejection of cured cocoa beans.

As for the physical characteristics of cocoa beans (i.e. bean weight, shell percentage, fat content, moisture content), these properties can be measured objectively.

In this note, results are presented for some of the physical and chemical characteristics of PNG cocoa beans obtained in the survey carried out in 1992. The survey was attempted in order to establish some base line measurements of important physical characteristics which might be contributing to the quality status of cocoa beans destined for the export market.

One of the important physical properties listed above, the fat content, was not tested due to the lack of required facilities. Other quality indicative measurements, namely pH and Titratable acid (T.A.), were included.

REGIONS AND PROVINCES SURVEYED

Regions and provinces covered in the survey were Southern Region (Gulf, Central and Milne Bay Provinces), Momase Region (West and East Sepik and Madang Provinces), East New Britain, West New Britain and New Ireland. Exporters were also included.

Cocoa bean samples were collected randomly from fermentaries in Provinces, mainly by Cocoa Board Inspectors and some staff members of the Cocoa Quality Improvement Project (CQIP). Cocoa samples were considered to be mostly of export quality. These were put into calico bags and forwarded to the Cocoa Quality Laboratory at Keravat for analysis. The results are presented in figure 1-6.

As shown in Fig 1, a large number of samples were collected from Rabaul and Gazelle area of East New Britain Province, since fermentary owners were reached quite easily by road. Only two samples were analysed from West New Britain; the rest of the samples received were, unfortunately, not adequate for analysis and were discarded. Small numbers of samples were also obtained from two Rabaul-based Cocoa Exporters, namely Commodity Development Pty Ltd and Ag Mark.

DISCUSSION

Comparatively, cured cocoa beans from the Southern region were less acidic in terms of the pH and Titratable acid measurements obtained. As well as these, the shell content was also found to be consistently lower than that found in the other areas of the survey. Each of the quality factors measured may be discussed as follows:

Bean weight

It is normally accepted that the average weight of a dried fermented bean should not be less than one gram. This assessment is known as the "bean count" and simply expresses the number of beans per one hundred grams.

The mean value for bean count of 79.08 (approximately 79 beans per 100 grams) does indicate that the bean size is relatively large. This is most preferable from the manufacturer's point of view, provided that this is consistent throughout the cropping seasons. There are some degrees of variation in bean size measurements among and within each area (as revealed in Fig 2). This is, however, still well within the accepted limits and is not a cause for concern.

Bean size variation is a factor which can always be expected as it is not only genetically controlled but can also be influenced to a certain degree by a number of environmental and physiological factors. (e.g. climate, rainfall, soil fertility, and tree age).

As observed in West Africa, in the wet season bean weight increases in excess of 1 gram (Wood and Lass 1985). In Peninsular Malaysia there were periods of drought which resulted in low bean weight. Another point worth noting (Wood 1985) is that, when the bean weight exceeds 1 gram, there is little change in shell percentage and fat content, but in beans weighing less than 1 gram, the shell percentage increases and fat content decreases. As will be seen later, PNG beans suffer from high percentage of shell, which may imply a situation of slightly lower fat content in such beans, compared to those with lower shell content.

Shell Content

The shell content for cocoa beans in the areas surveyed is invariably high (Fig 3).

Manufacturers tend to prefer beans with low shell content since cocoa bean shells virtually constitute waste products.The shell content measurements yielded a mean value of 16% as obtained in the survey. This is rather high compared to Ghanaian beans which are usually reported to contain about 11-12% shell content.This marked difference is mostly due to the different planting materials grown in these countries.

Both the bean count and shell content are factors not likely to be affected to any great extent during the course of a normal fermentation process as practised throughout the cocoa growing Provinces. Any major improvement, especially the percentage shell content, can be achieved only through a plant breeding program.

% Moisture

The moisture as well as pH and T.A. measurements, are factors which are always going to be influenced greatly by the individual farmers, especially in the individual processing method.

High moisture values often result when a farmer does not adequately dry his/her cocoa beans. This condition is conducive to invasion by mould and should be prevented as much as possible. This can be achieved by adequately drying the cocoa beans to a safe moisture level of 6-7%. Mouldy and smoky flavours are equally unacceptable to manufacturers and may be much more undersirable than those defects associated with excessive residual acidity.This survey

found that the occurrence of underdrying of beans is greater than that of overdrying. It was estimated that 33% of beans registered moisture values of 8% and above, whereas only about 2 to 3% of samples recorded moisture values below 6%.The range of moisture levels obtained are as shown in Fig 4.

Cocoa beans which have been excessively dried often shatter when pressed even lightly between the fingers.This should also be avoided as cocoa beans dried to this stage may not be very presentable. Rapid drying should also be avoided as it tends to make beans retain excessive amounts of acetic acid which is deleterious to flavour.

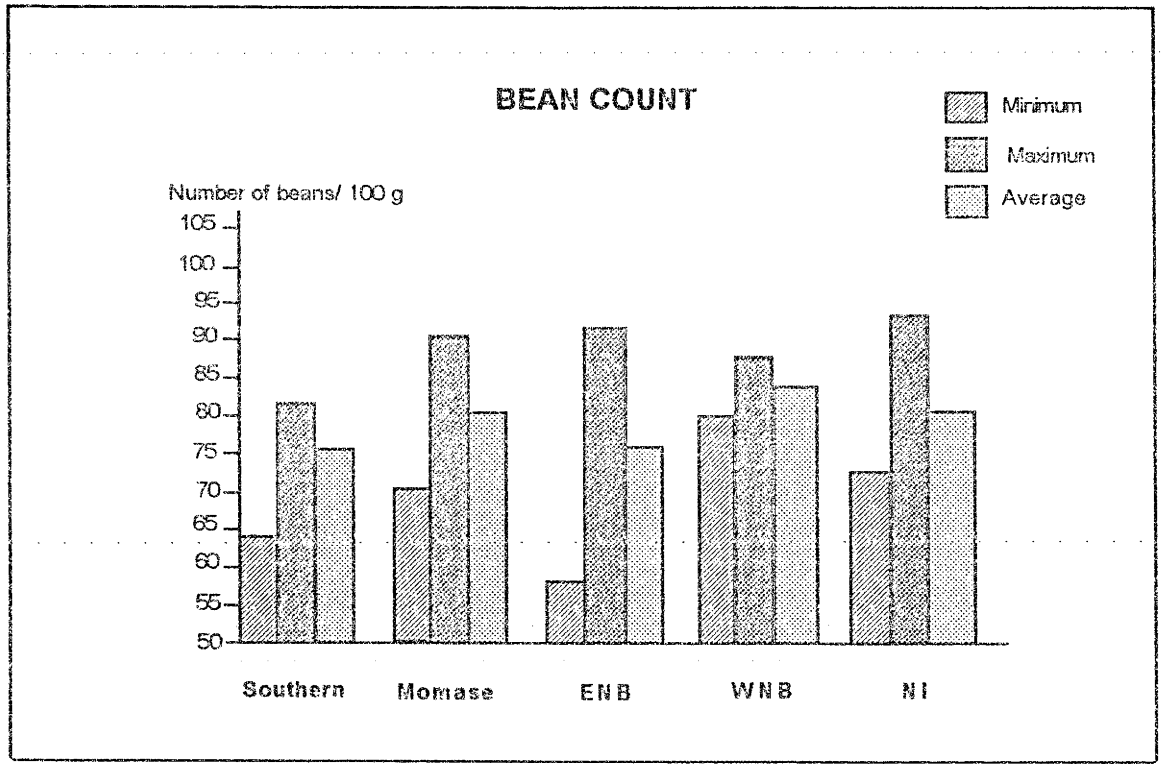
Acidity (pH and T.A. Measurements)

pH and T.A. measurements are both useful indicators of acidity. All cocoa beans are acidic to a certain degree, most to an extent that is acceptable to chocolate manufacturers. However, when the amount of acid in the beans is excessive, there will be an adverse effect on the flavour of the finished products.

In spite of the large range of pH values observed, the average values do indicate that the PNG beans are quite acidic in nature. From the survey, the mean pH value obtained was about 4.9.This is certainly acidic compared to pH values from Ghanaian beans which range from about 5.1 to 5.5 pH units. (It should be further noted that the relative strength changes 10 fold for each unit change in pH).

Figures 5 and 6 show the range of T.A. and pH values obtained. As often argued, high pH values do not necessarily indicate acceptable flavour.The measurement is of the degree of acidity and not of flavour, and should be treated with care. As a matter of fact pH values of well over 5.5 for PNG cocoa beans usually indicate a condition of over-fermentation which again is not acceptable, because of resulting "off"-fla-

Figure 2. **Bean count of cocoa in the areas surveyed.**



vours (mouldy odours) that are detectable.

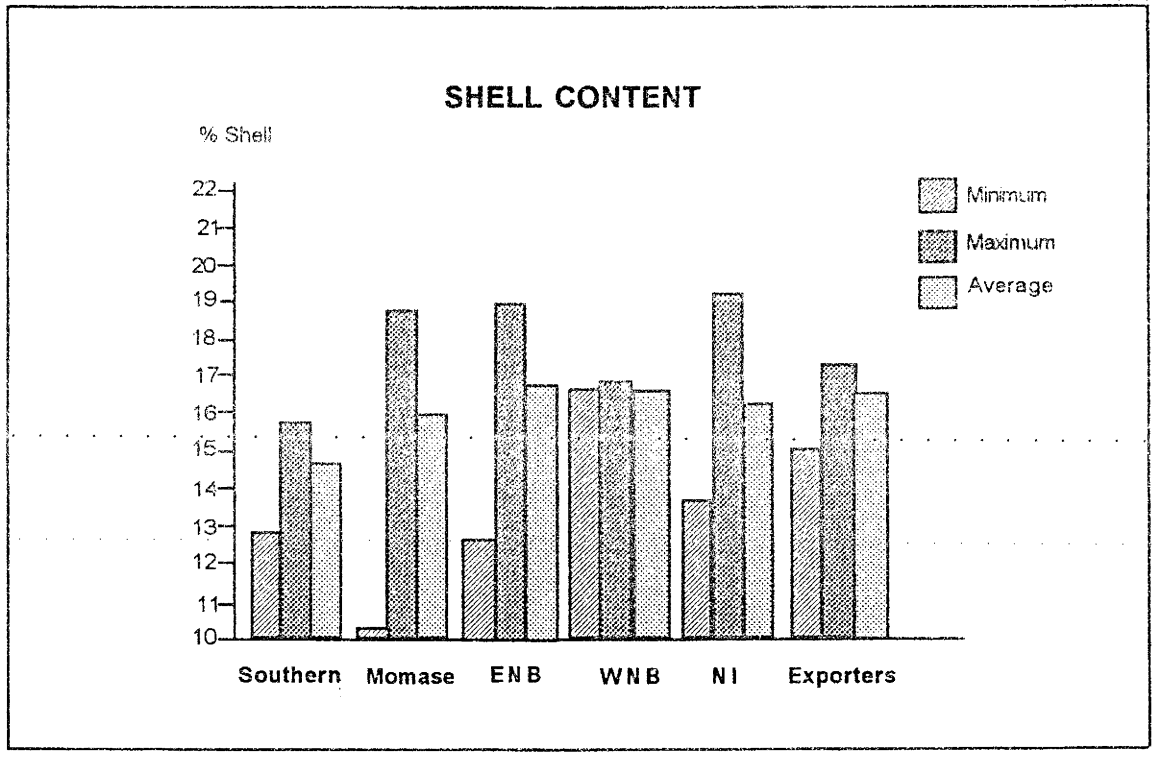
In practice, pH and T.A. measurements have been very useful in monitoring changes in bean acid level during the course of the fermentation process, and in such trials they have been found to be highly correlated.

For a comparison of the acid level in cured cocoa beans from different sources, measurement of total titratable acid is thought to be more useful than pH (Shepherd 1982). Doubts have infact been expressed (Carr & Dougan 1977) on the use of pH as an effective measurement of perceived acidity in chocolate derived from the cocoa beans. T.A. measurements on the other hand, have been shown to correlate very well with measurement of perceived acidity.

Both pH and T.A. measurements cannot, however distinguish between the individual acids that combine to produce total acidity. In cocoa beans there are a number of organic acids that contribute in varying degrees to total acidity (i.e. oxalic, citric, tartaric, succinic, malic, lactic, formic, acetic and butyric acids). Their contribution to the cocoa bean acidity phenomena depends on factors such as the degree of dissociation, buffer effects and relative concentration within the beans. It is felt therefore, that these factors warrant further investigations. Two of these acids, acetic and lactic, have been implicated in excessive acid flavour. In figure 5, the range and mean T.A. values expressed as milliequivalent per gram citric acid is presented. (note: 1 meq of citric acid is equivalent to 60.028 mg anhydrous citric acid).

The mean T.A. value of 0.18 meq/g (18 meq/100 g citric acid) obtained from the survey is considered to be relatively higher than that of the Ghanaian beans which usually have an average T.A. value of about 0.12 to 0.14 meq/g (12-14 meq/100 g citric acid). These differences in acid content could account for some of the differences, especially the acidic flavour, as per-

Figure 3. **The shell content for cocoa in the areas surveyed.**



ceived sensorially in the cocoa beans. It has, infact, been suggested (Lopez and Flavian 1984) that 12 to 15 meq NaOH/100g, could be a margin to aim for. According to their experiences, this value is in keeping with the desired pH range of 5.1 to 5.8 and the taste assessment results which showed reasonable acidity. On the basis of the fact that, in acid-base titration, one milliequivalent of a base will neutralise one milliequivalent of an acid, the average value of 18 meq citric acid per hundred gram of sample found in the survey samples would require an equal amount of base i.e. 18 meq of NaOH per hundred gram of sample.

CONCLUSION

With the absence of figures on fat content which was not studied at the time of this survey, little can be said about this very important quality factor. It is reported elsewhere that PNG cocoa bean does have an acceptable level of fat. The problem is in fact with the characteristically high shell content which tends to reduce the fat yield. The average shell content of about 16 percent obtained in the survey is very high compared to other world cocoa varieties. This, therefore, calls for relevant research to be undertaken through a breeding program to ensure that lower shell content and a correspondingly higher fat content are achieved. It is important to note also that any increase in fat yield would very likely lead to an increase in the price that manufacturers are prepared to pay since it is the most important economic criteria to both the chocolate manufacturers and the pressing industry.

In terms of the degree of acidity, the results clearly showed that PNG cocoa is high in acidity. Whether or not this is a serious economic factor will always remain a question for discussion.

There are definitely wide ranging demands from manufacturers for different cocoa flavours. The high acidic cocoa as produced in PNG continue to find its place in the international market along

Figure 4. **Moisture content of cocoa beans.**

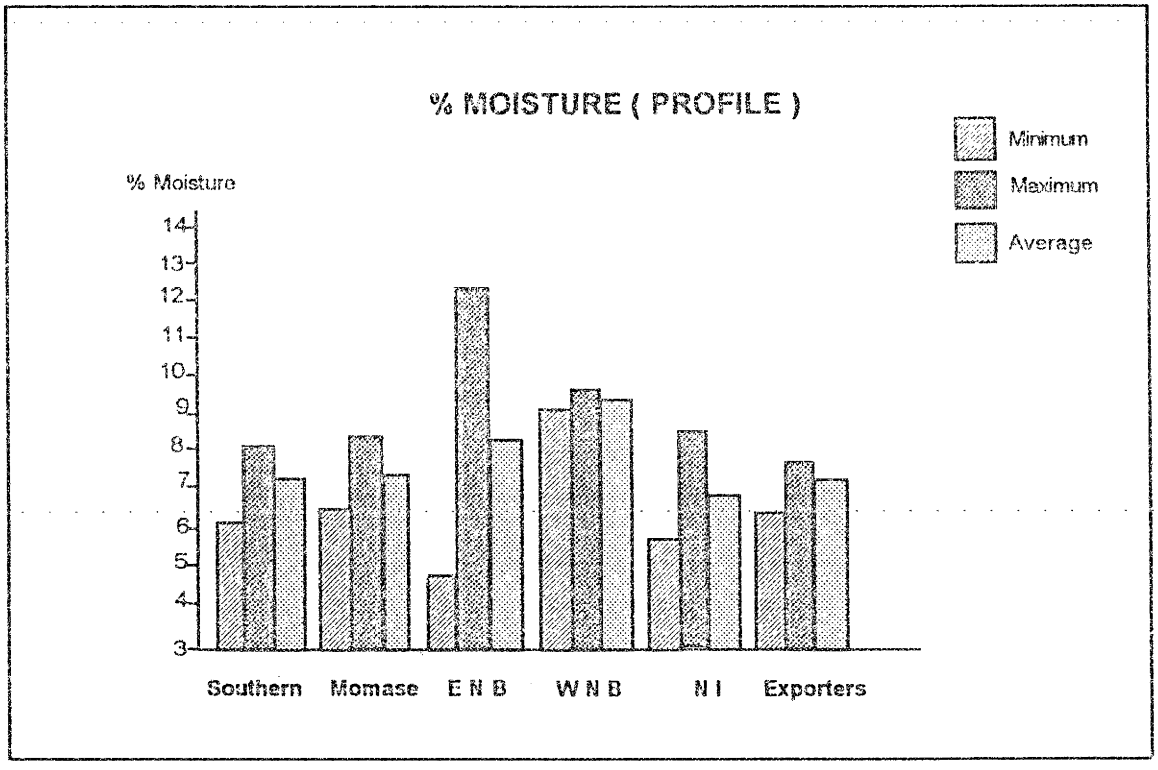


Figure 5. **T.A. profile of cocoa beans for areas surveyed.**

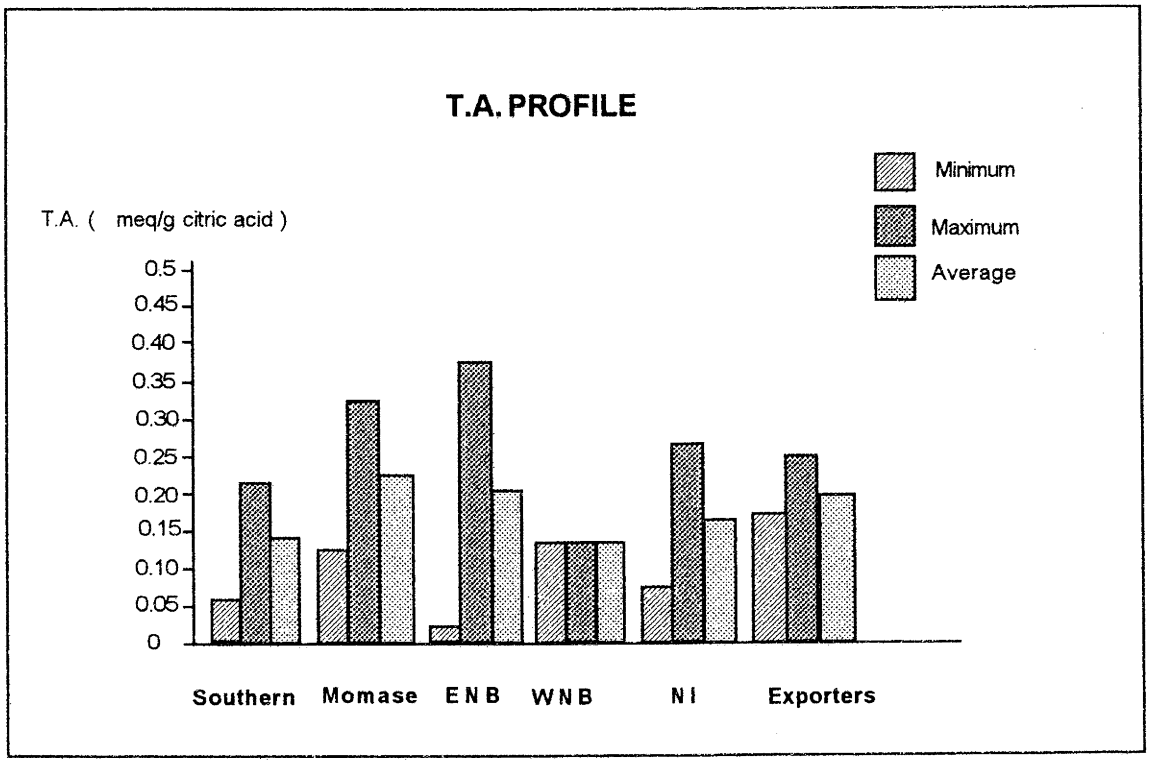
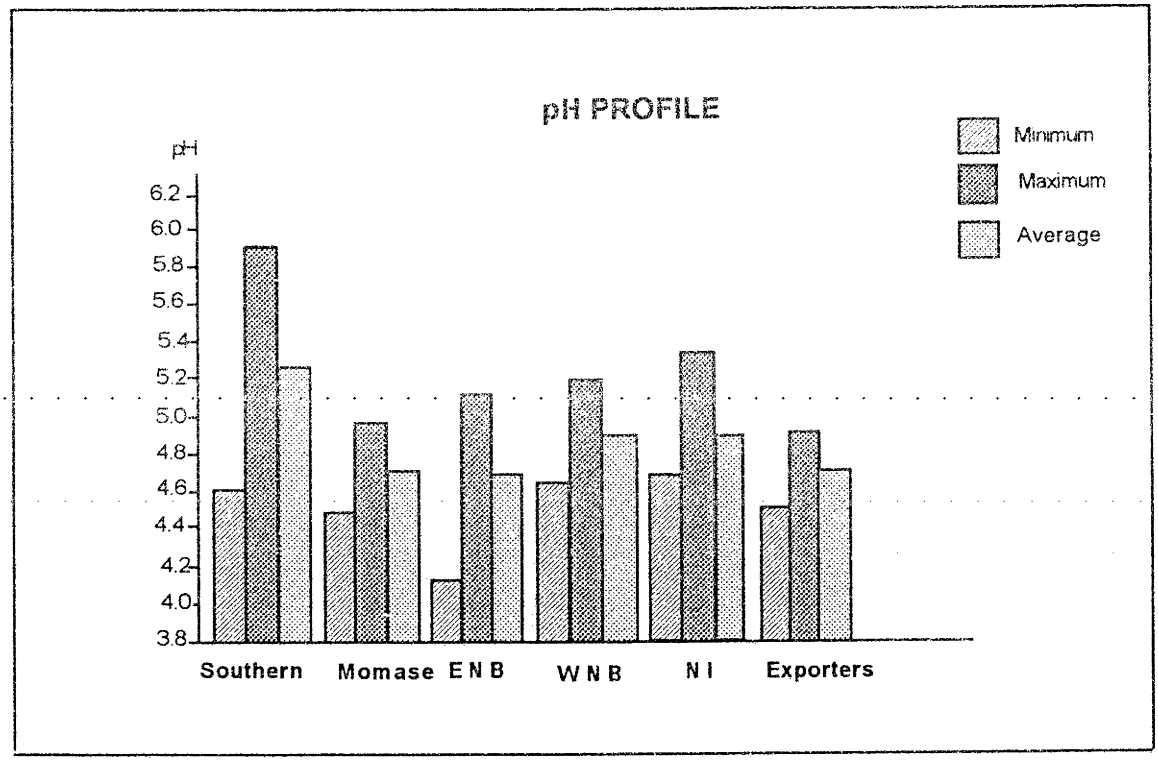


Figure 6. **pH profile of cocoa beans for the areas surveyed.**



with those "cocoas" from other countries which may be regarded as low acid beans. This does imply that PNG cocoa beans could be used by manufacturers in one way or an other.

It is clear that the question of flavour will always remain a subject of discussion, as indeed it seems to relate more to some specific flavour attributes (supplementary flavours) which each manufacturer seeks in his/her specific chocolate product. It may not always be possible for primary producers to know the specific requirements of each manufacturer in such a competitive market as this. For this reason the best the primary producers can do is to ensure that the cocoa bean supply is not masked to any great extent by any off-flavours including excessive acidity.

ACKNOWLEDGEMENTS

The Cocoa Quality Section and the Cocoa Quality Improvement Project acknowledge with gratitude the ongoing assistance provided by the Cocoa Board Inspectors in collecting the samples, and to the owners of fermentaries and the two cocoa exporters (Commodity Development Pty Ltd and Ag mark) for providing the cured cocoa bean samples in this survey.

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