SAMAC QUALITY ASSURANCE HANDBOOK

CHAPTER 4
SAMPLING PROCEDURES FOR CONSIGNMENT
EVALUATION AND QUALITY CONTROL

4.1 INTRODUCTION

Macadamias have been marketed around the world as the gourmet dessert nut – a cut above the rest. By implication, this means that their marketing has been targeted at a high quality niche bracket, demanding marketing strategies which portray a superlative quality image. To do justice to the portrayal of this premium quality image, requires an intensive and equally superlative quality control system, in the entire chain of production and processing of macadamia kernel.

In order to achieve this high standard of quality control, standardised sampling procedures need to be implemented throughout the process flow, which ensure the representivity of samples taken for:

- ❑ Determining sound and unsound kernel recovery rates;
- ❑ Determining kernel moisture contents
- ❑ Checking cracker performance
- ❑ Checking % wholes in the various styles
- ❑ Physical, chemical and microbial analyses of both work in process and finished products.

The procedures recommended here for sampling Wet-in-Shell (WIS) nuts at delivery, and the procedures for determination of moisture content and kernel recovery rates, are especially important to ensure uniform, accurate and fair methods for determining payments to growers.

Of no less importance, are the recommended procedures for amounts and frequency of sampling at critical points in the process, for ensuring continuous quality control and improvement.

4.2 SAMPLING OF WIS NUTS AT DELIVERY

The representivity of this sample is critical for ensuring the accuracy of moisture content and kernel recovery rates reported to the grower, on which the subsequent payment to the grower is based. Even in factories practicing individual batch processing, the data obtained from this sample serves as an important back-up and cross check to the actual data obtained from processing the batch.

4.2.1. Bulk Sample:

A random sample consisting of 2.5% of the weight of the consignment is taken at delivery as follows:

a) ***Bagged consignments and/or lugboxes:***
Take 2.5% of the contents of each bag or lugbox, ensuring equal weights are drawn from the top, middle and bottom of each bag/lugbox.

b) ***Crates:***
Take 2.5% of the contents of each crate, ensuring that equal weights are drawn from four positions each in the top, middle and bottom layers of the nuts in the crate, ie, from 12 positions in all, from each crate. Since this is rather impractical and well nigh impossible to do, a system of sampling the 2.5% of contents of the crate should be devised so that this sample can be drawn when the crate is unloaded.

b) ***Bulk Deliveries:***
Take 2.5% of the contents of the bulk delivery randomly as the nuts are being removed from the bulk container, or out of the weighing hopper into the drying silos/bins.

NOTE: The sampling process can be accurately mechanised for all delivery methods (containers) and consignment sizes, by building in a sampling chute or gap in the rotary slatted or round-bar drum, *which most factories use at their delivery points for removal of foreign matter and nuts smaller than 18mm in diameter. Ensure that the size of this sampling shute or gap is such that it removes 2.5% of the nuts passing over the rotary drum.*

Ensure that the container used to collect the bulk sample is emptied and thoroughly cleaned before use.

4.2.2. Sub-sample:

Each bulk sample as drawn in 4.2.1 a), b) or c) will be placed into an effective mixing device and thoroughly mixed. a 2kg sub-sample will then be drawn at random from the thoroughly mixed bulk sample, to be representative of the weight of the consignment as follows:-

<u>Consignment size:</u>	<u>Sub-sample weight:</u>
<1 ton WIS	2kg WIS
>1 ton WIS	2kg WIS for every 2 tons or part thereof, of the consignment

The remainder of the bulk sample can then be returned to the consignment from which it was drawn. Where consignments are 2 tons WIS or more, separate bulk samples of 2.5% of contents must be drawn, from which 2kg sub-samples must be taken for each two tons of the consignment. These separate 2kg samples must be analysed in full for moisture content and kernel recovery rates and the results of each separate 2kg sample must be meaned (averaged) for the total consignment, for reporting to the grower.

The representative 2kg WIS sub-sample so obtained will be used in the following manner:-

250g WIS	-	for determination of WIS moisture content
500g WIS	-	for determination of kernel recovery

The remaining 1250g WIS of the sub-sample will then be bulked and again thoroughly mixed, before a 1kg sample is drawn from this, sealed in a suitable container and carefully labelled, to be retained by the processor for at least 3 months as a reference sample. The remaining WIS can again be returned to the consignment from which it came.

By now it should be clear that a well appointed laboratory is a necessity in a macadamia processing plant. This should be contained in a separate room, capable of being sealed off from the rest of the factory, so as to avoid air movement affecting weight recordings in weighing balances, and in an area not affected by vibration from factory machinery. The laboratory sgould have plenty of space for the storage of samples in cupboards or on racks. A well organized administrative system for coding or labeling of samples, and the analytical data recorded from samples, should also be in place and clearly understood by all staff members involved in the sampling and analytical activities.

It goes without saying that this laboratory should be kept scrupulously clean and hygienic at all times, and that all spillage, especially around the scale and moisture meter area, should be cleaned up immediately. Macadamia nuts have a high oil content and it is amazing how this oil rubs off onto everything that the nuts touch. The importance of exceptionally high standards of cleanliness and hygiene, both in the laboratory area, and in the entire factory, cannot be emphasized enough.

4.3 DETERMINATION OF WIS MOISTURE CONTENT

The 250g WIS sample mentioned in 4.2.2 should be accurately weighed (0.1g accuracy) within 24 hours of sampling and the weight recorded (A). The sample should be placed immediately into a forced air draft oven at 105^{o}c (oven should have an accurate thermostat to maintain this temperature) and dried to a constant weight (B).

The WIS moisture content is then calculated and recorded. WIS moisture content will be reported to the nearest 0.1% moisture:-

$$\text{WIS MC\%} = \frac{A - B}{A} \times 100$$

Example:

Weight of WIS nuts 250.0g
Weight after drying 212.5g

$$\text{WIS MC\%} = \frac{250 - 212.5}{250} \times 100$$

$$= \frac{37.5}{250} \times 100$$

$$= 0.15 \times 100$$

$$= \underline{15.0\%}$$

4.4 CONVERSION OF WEIGHT AT DELIVERED WIS MOSITURE CONTENT TO WEIGHT AT 1.5% MOISTURE CONTENT (DIS)

The weight of WIS nuts delivered at Y% moisture content per consignment, as determined by the factory weighment hopper or scale, will be converted to a weight of Dry-in-shell at 1.5% moisture content using the moisture content determined in 4.3 above, by the following calculation:-

Weight of DIS @ 1.5% MC = (Weight WIS @ Y% MC) x (100-Y%)/(100-1.5%)

Example 1:
1560kg of WIS nuts are delivered at 15% moisture content. Wjat is the weight of the DIS nuts at 1.5% mositure content?

Weight DIS @ 1.5% MC = 1560 x (100-15)/100-1.5)

= 1560 x 85/98.5
= 1560 x 0.8629
= 1346.1kg
Rounded to nearest 0.5kg = 1346kg

Example 2:
Four tons of WIS nuts are delivered at 10% moisture content. What is the DIS weight of these nuts at 1.5% moisture content?

Weight DIS @ 1.5% MC = 4000 x (100-10)/(100-1.5)
= 4000 x 90/98.5
= 4000 x 0.9137
= 3654.8kg
Rounded to nearest 0.5kg = 3655kg

In factories where batch processing of individual growers nuts is done, this weight adjustment serves only as a backup and cross check to the actual weight of the DIS nuts recorded at the scale immediately before cracking.

4.5 KERNEL RECOVERY

The 500g sub-sample selected by the sampling procedure in section 4.2.2 is used to determine kernel recovery rates. This sub-sample will be weighed to 0.1g accuracy (weight A) and then dried to 1.5% moisture using the following drying regime:-

Maximum Temperature	Approx. Duration	For WIS MC % of
35 °C	48 hr	>15%
40 °C	48 hr	8-14%
50 °C	48 hr	5-7%
60 °C	48 hr	1.5 – 4%

Drying of the 500g sub-samples in this manner approximates the drying regime which will be applied to the bulk of nuts from which the sub-sample was drawn. This is most easily accomplished by placing the clearly labelled 500g sub-sample into a light hesioan or woven polyethylene bag (orange bag) and placing it into the drying silo/bin in which the consignment from which the sub-sample was drawn is being dried. Alternatively these samples can be dried to 1.5% moisture content in a sample oven at a constant temperature of 50°C.

After the sample is dried in this manner, the cooled DIS nuts will be weighed (0.1g accuracy) and the weight recorded (weight B). The DIS nuts are then cracked (sample cracker of by hand) and all the kernel removed from the sample:- all wholes, halves, pieces and fines. The kernel is weighed (0.1g accuracy) and the weight recorded (weight C). As a cross check to ensure weighment accuracy, the shells can also be weighed (0.1g accuracy) and the weight recorded (weight D).

<u>Cross Check:</u>
Weight B = weight C + weight D

4.5.1 <u>For factories using a single bath wet separation system with brine solution at SG1.02</u>

All the kernel recovered from the sample (including pieces and fines), will then be placed in a clear container (1l, glass beaker) containing a brine solution at ambient temperature and specific gravity of 1.02. This will be stirred once and allowed to stand for 15 to 30 seconds. The kernel in the top half of the solution (floaters) and the kernel in the bottom half of the solution (sinkers) will be recovered separately, within 30 seconds, towelled dry and weighed separately. The weights will be recorded:-

Floaters - weight E
Sinkers - weight F

The <u>floaters</u> will then be visually examined under a UV light and sorted into two categories:-

1 sound kernel
2 unsound kernel

in accordance with the definitions of these categories given in Chapter 3. The <u>sound</u> kernel thus selected will be weighed (0.1g accuracy) and the weight recorded (weight G). The <u>unsound</u> kernel will be weighed to 0.1g accuracy (weight H) and sorted into the following defect categories:

Defect	Description
Immature	Kernel which is shrunken, shrivelled or deformed
Mould	Kernel showing the slightest appearance of mould
Discoloured	Any abnormal discolouration of the kernel
Germination	Kernel which shows signs of germination (rid
Insect damaged	Kernel showing any obvious insect damage
Decomposed	Kernel which is partially or totally decomposed
Rancid	Kernel detected by odour and/or taste to be rancid
Fines/Dust	All kernel material which passes through a 2mm square opening
Other	Any other obvious defect which must be described if present

The kernel in each category will be weighed (0.1g accuracy) and the weights recorded. (H1, H2, H3 …) These weights can then be used to express individual defect categories as a <u>percentage of the TOTAL UNSOUND KERNEL derived from the FLOATERS</u> (weight H).

The sinkers will then be visually examined under the UV light and sorted into the same defect categories. The kernel in each category will then be weighed (0.1g accuracy) and the weights recorded (F1, F2, F3 …). These weights can then be used to express individual defect categories as a percentage of the TOTAL UNSOUND KERNEL derived from the SINKERS (weight F).

Weights of defect kernel categories derived from both sinkers and floaters can then be added together for the individual defect categories and these weights (J1, J2, J3 …) used to express defect categories as a percentage of the TOTAL UNSOUND KERNEL (weight J).

The weights recorded on the 500g sub-sample used for determining kernel recovery rates up to this point can be summarised as follows:-

WIS (A)
DIS (B)
SHELL (D)
KERNEL (C)

FLOATERS (E) — SOUND KERNEL (G); UNSOUND KERNEL (H)

SINKERS (F)

FLOATER DEFECTS		SINKERS DEFECTS		TOTAL UNSOUND KERNEL
(H1)	+	(F1)	=	(J1)
(H2)	+	(F2)	=	(J2)
(H3)	+	(F3)	=	(J3)
..	+	..	=	..
..	+	..	=	..
..	+	..	=	..
(H)	+	(F)	=	(J)

These weights are used to calculate sound and unsound kernel recovery rates as follows:-

(i) Sound Kernel Recovery % = $\frac{\text{Weight sound kernel @ 1.5\% MC}}{\text{Weight DIS @ 1.5\% MC}} \times 100$

SKR% = $\frac{(G)}{(B)} \times 100$

(ii) Unsound Kernel Recovery % = $\frac{\text{Weight unsound kernel @ 1.5\% MC}}{\text{Weight DIS @ 1.5\% MC}} \times 100$

USKR% = $\frac{(J)}{(B)} \times 100$

The weights can also be used to calculate the individual defects as a percentage of the total:-

(iii) Individual floater defects as % of total floater defects:-
H1/H x 100
H2/H x 100
" " "

(iv) Individual sinker defects as % of total sinker defects:-
F1/F x 100
F2/F x 100
" " "

(v) Individual unsound kernel defects as % of total unsound kernel:-
J1/J x 100
J2/J x 100
" " "

The following cross checks can also be made:-

(vi) Moisture content % = (A-B)/A x 100
This moisture content can be checked against the MC% determined from the other sub-sample as described in section 4.3.

(vii)	DIS	= Kernel	+ shell
	B	= C	+ D
(viii)	Kernel	= floaters	+ sinkers
	C	= E	+ F

The information so determined from these consignment samples is used to report to growers in the standard format described in Chapter 5.

The full SAMAC Quality Assurance Handbook is available to SAMAC members on the members' section of www.samac.org.za