Does harvest management or husking method affect macadamia kernel quality more?

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A variety of machines have been developed for dehusking, one of those macadamia postharvest tasks that can't be avoided. Despite the fact that all nuts harvested must be subjected to the trauma of dehusking, there has been comparatively little research on the effect of dehuskers on kernel quality. The number of cracked nuts produced by a new dehusker was evaluated by Luan and Ling in 1983, but there is limited information available on the effects of different dehuskers on other aspects of quality such as whole kernel, shoulder damage, production of pieces and effect on roasting quality.

Because the interval between harvest rounds may vary from one week to four weeks depending on farm management, the post-abscission age of fruit may vary greatly at dehusking. Partial drying of fruit usually occurs between abscission and harvest, and partially dried kernels may be more prone to damage during mechanical dehusking than those freshly abscised. These factors may affect both raw and roasted kernel quality.

Damage to kernels can result in shoulder damage, production of pieces, bruising, production of dust and after-roast-darkening (ARD) when kernels are roasted. The trauma of dehusking may cause cellular damage leading to ARD of kernels. Dehusking at high (field) moisture content causes shoulder damage. It is not known whether dehusking affects whole kernel and weight of pieces or predisposes kernels to ARD. In addition, it is not known whether dehusking at reduced moisture content (~ 10% wet basis) affects whole kernel, shoulder damage, weight of pieces and ARD.

Our study compares the effect on raw and roasted kernel quality of mechanical dehusking of macadamias:

- immediately after harvest at field moisture content
- at reduced moisture content after partial drying on the ground.

Two mechanical dehuskers are compared with hand dehusking as a control.

ASSESSING THE EFFECT ON RAW AND ROASTED KERNEL

Raw kernel

Experiment 1. Fruit of cultivars HAES 344 and HAES 741 was dehusked at reduced moisture content after a period drying on the ground at ambient temperature and then examined to assess the effect of dehusking at reduced moisture content on raw kernel quality. There were three treatments:

1. Hand dehusking (the control) with aviation snips.
2. Mechanical dehusking with a scroll-type mechanical dehusker.
3. Mechanical dehusking with an Admac dehusker.

Fruit was dried partially at ambient outdoor temperature (~ 18 - 21°C max.) before dehusking by spreading it in a thin layer on a concrete slab which received mild winter sunlight in the afternoon but was protected from rain by a roof. When fruit had dried to ~10% moisture content (about three weeks of drying) it was dehusked by the above three methods, then dried to 3% nut-in-shell moisture content for cracking.

Experiment 2. The purpose of this experiment was to compare the effect of two mechanical dehuskers on macadamia raw and roasted kernel quality when dehusking at field and intermediate moisture contents. The three dehusker treatments for both moisture contents of this experiment were the same as for Experiment 1, i.e. hand dehusking, a scroll type dehusker and an Admac dehusker.

Fruit of cultivar HAES 344 was dehusked straight after harvest when the nut-in-shell moisture content was 23%. Fruit for the lower moisture content treatments was dehusked after being dried for three weeks on the ground under a roof at ambient outdoor temperatures (~ 18 - 21°C max.) to 12% nut-in-shell moisture content. Whole kernel weight (% wt of sound kernel), shoulder damage (% of whole kernel number), weight of pieces (% wt of sound kernel), dustiness (% of whole kernel number) and oiliness (% of whole kernel number) were calculated for both experiments.

Roasted kernel

Roasting. Ten whole kernels were selected at random from each replicate for Experiment 2. Samples were air roasted in a fan-forced laboratory oven for 20 minutes at 130°C. Roasted samples were examined for colour, mottled colour and surface damage.

WHAT DOES THIS MEAN?

Shoulder damage. This study showed that mechanical dehuskers can cause significant shoulder damage when dehusking fruit that has dried to around 10 to 12% moisture content. There was no difference between the two mechanical dehuskers for shoulder damage. Previously, mechanical dehusking has been shown to cause shoulder damage to kernels at field moisture content.

It's important to ensure that dehuskers are adjusted regularly and for optimal performance.

Whole kernel. Whole kernel was reduced significantly in Experiment 2 when dehusking was delayed for three weeks, similar to when harvest was delayed for three to five weeks. It is unclear whether this reduction is due to dehusking at lower moisture content or some other factor related to time. Delaying harvest (and therefore dehusking) appears to weaken the bond between the halves of kernels.

Weight of pieces. Weight of pieces increased significantly for all methods when dehusking was done at lower moisture content. It is interesting that pieces increased even in the hand-dehusked low moisture content treatment. This suggests that slow drying on the ground predisposes kernels to mechanical damage even when handled with the utmost care. Pieces were also increased after three weeks delayed harvest in a previous study.

Dark kernels. A lot of dark kernels can be generated at roasting after mechanical dehusking of fruit following a period of slow drying on the ground. After roast, nuts became darker in all dehusker treatments in this study (including hand dehusking) after slow drying at ambient temperature.

Mechanical dehuskers did not cause dark kernels, as there were also more dark kernels from fruit dehusked by hand when dehusking was delayed. Dark kernels were related to the time delay, rather than the dehusker. All losses of quality in these experiments confirm that delaying harvest (and therefore dehusking) leads to loss of both raw and roasted kernel quality.

THE BOTTOM LINE

Whole kernel can decrease, while shoulder damage, weight of pieces and after-roast-darkening can increase significantly when fruit is dehusked after drying on the ground for three weeks. Any cause of nut-in-shell remaining at high moisture content for two to four weeks results in loss of kernel quality.

So, the bottom line is that the time between harvest rounds is a much more important factor in macadamia kernel quality management than the method of dehusking.

Acknowledgments

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References

Albertson PL, Bursle JK, Forrester RI, McConchie CA (2006). Hexose synthesis by cell wall invertase activity and its effects on the roasting behaviour of macadamia kernel. *Australian Journal of Agricultural Research* **57**: 47-54.

Luan JM, Liang T (1983). An improved macadamia nut dehusker. *Journal of Agricultural Engineering Research* **28**: 337-347.

Mason RL, Wells IA (1984). The effect of harvest interval on the quality of ground-harvested macadamia nuts. *Food Technology Australia* **36**: 373-378.

Walton DA, Wallace HM (2005). Dehusker effects on macadamia quality. *Acta Horticulturae* **687**: 417–418.

Walton DA, Wallace HM (2008). Postharvest dropping of macadamia nut-in-shell causes damage to kernel. *Postharvest Biology and Technology* **49**: 140–146.

Walton DA, Wallace HM (2009) Delayed harvest reduces quality of raw and roasted macadamia kernels. *Journal of the Science of Food and Agriculture* **89**: 221–226.

Walton DA, Wallace HM (2010). Dropping macadamia nuts-in-shell reduces kernel roasting quality. *Journal of the Science of Food and Agriculture* **90**: 2163-2167.

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WHAT WE FOUND

Raw kernel

In Experiment 1, when fruit at 10% moisture content was dehusked after three weeks slow drying on the ground, there was significant shoulder damage ($P < 0.05$) from both mechanical dehusker treatments for both cultivars compared with hand dehusking (see Figure 1). For HAES 741 mechanical dehusking increased shoulder damage by ~ 12% - 14% over hand dehusking. The scroll dehusker caused more damage to HAES 344 kernels than to HAES 741 kernels. Whole kernel weight, weight of pieces, dustiness and oiliness were not affected by dehuskers.

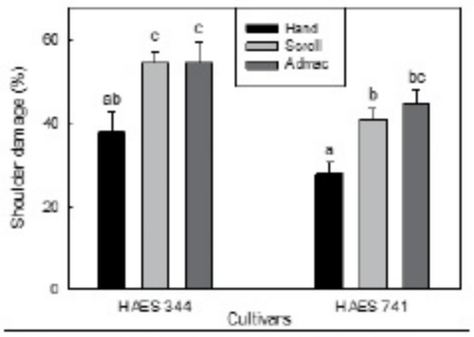

Figure 1. *Shoulder damage (%) for two macadamia cultivars dehusked at intermediate moisture content (10%) in Experiment 1. Two mechanical dehuskers are compared with hand dehusking as a control ($P < 0.05$).*

In Experiment 2, we compared kernel quality when fruit was dehusked at high (23%) moisture content and at a lower moisture content (12%). After three weeks drying at ambient temperature, there were significant differences ($P < 0.05$) between treatments for whole kernel (see Figure 2) and weight of pieces (see table), but no differences for shoulder damage, oiliness and dustiness. Whole kernel was greatly reduced when dehusking at low moisture content with the scroll dehusker.

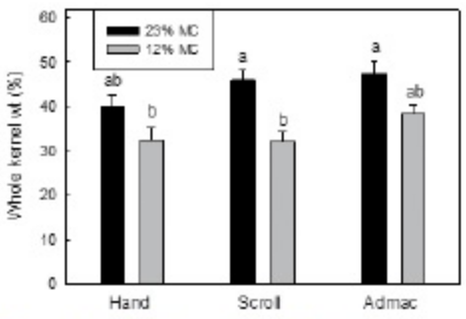

Figure 2. *Whole kernel weight for three dehusking methods used on macadamia fruit of cultivar HAES 344 dehusked immediately after harvest at 23% moisture content, and at 12% moisture content after ambient drying for three weeks ($P < 0.05$).*

Weight of pieces increased significantly for all dehusking treatments when fruit was dehusked at lower moisture content after partial drying (see table).

Dehusker	Dehusk at 23% MC	Dehusk at 12% MC
Hand	4.28 (0.45)$_{ab}$	6.29 (0.97)$_{c}$
Scroll	4.24 (0.90)$_{ab}$	6.06 (0.82)$_{c}$
Admac	3.63 (0.56)$_{a}$	8.60 (0.87)$_{d}$

MC = moisture content; values in the same column with different letters are significantly different.

Table. *Weight of pieces (% wt of sound kernel) for macadamia fruit dehusked at field moisture content (23%) and at lower moisture content (12%) following three weeks drying on the ground at ambient temperature ($P < 0.05$).*

Roasted kernel

There were significant numbers of dark kernels for fruit dehusked at intermediate moisture content (12%) after partial drying at ambient temperature compared with fruit dehusked at field moisture content in Experiment 2 (see Figure 3).

All treatments dehusked at 12% moisture content, including the hand dehusked control, had significantly more dark kernels ($P < 0.05$) than the three treatments dehusked at high moisture content. There was no difference, however, between the three dehusking methods at either moisture content and nor were there any significant differences in mottled colour and surface damage.

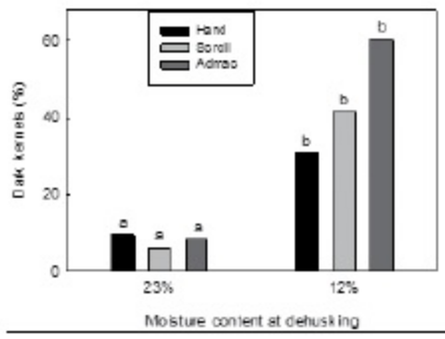

Figure 3. *Dark kernels for macadamia fruit dehusked after harvest at high moisture content (23%) and for fruit dehusked at lower moisture content (12%) after three weeks drying at ambient temperature. Different letters indicate significant difference ($P < 0.05$).*