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Comparisons of 'Honey Dew' and Netted Muskmelon Fruit Tissues in Relation to Storage Life

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Abstract. **Changes in morphology of epidermal layers and in permeability of mesocarp membranes of 'Honey Dew' and netted muskmelon fruits (*Cucumis melo* L., var. inodorus and reticulatus, respectively) were compared for 10 through 60 days after anthesis to relate tissue changes to storage life. Twenty-day-old netted muskmelon fruit developed lenticular tissue (net) over the entire melon surface. The muskmelon net had become fissured by 50 days after anthesis (10 days postharvest). 'Honey Dew' fruit did not develop lenticular tissue nor did the epidermis become fissured. 'Honey Dew' and netted muskmelon fruits had similar membrane electrolyte leakage characteristics (60% ± 3%) when harvested ripe, but, after 10 days at 20°C, electrolyte leakage was 70% and 87%, respectively. Membrane electrolyte leakage for both cultivars had a high regression coefficient (R^2 = 0.97) with fruit maturation and postharvest senescence. An intact epidermis indirectly affected mesocarp membrane permeability and perhaps contributed to differences in muskmelon cultivar storage life.**

Netted muskmelon fruit typically have a storage life of < 14 days, depending on cultivar and stage of ripeness at harvest. Compared to 'Honey Dew' fruit, which have a potential storage life of nearly 4 weeks, the netted muskmelon is highly perishable (6). If enclosed in heat-shrink film, netted muskmelon fruit will store as long as 'Honey Dew' fruit (3). It appears that characteristics unique to 'Honey Dew' or netted muskmelon fruit surface tissues strongly influence postharvest shelf life. Consequently, the present study was designed to relate morphological characteristics of epidermal tissues and membrane permeability of mesocarp tissues to the postharvest life of 'Honey Dew' and netted muskmelon fruit.

Seeds of 'Perlita' muskmelon and 'Greenflesh Honey Dew' were planted and grown in the greenhouse as single plants (2). Flowers were hand-pollinated, and one fruit per plant was allowed to develop. Fruit were examined 10, 20, 30, 40, 50, and 60 days after pollination. Netted muskmelon fruit designated as 50 and 60 days postanthesis, and 'Honey Dew' fruit designated as 60 days postanthesis, were harvested at 40 days and 50 days postanthesis, respectively, and stored at 20°C in 95% ± 5% RH.

Segments (10 x 5 mm) of the fruit equatorial region were fixed for at least 48 hr in formalin–acetic acid–alcohol under a slight vacuum. The segments were dehydrated in a tertiary butyl alcohol series, embedded in Paraplast (melting point, 56° to 57°C), sectioned at 12 μm, and stained with safranin and fast green (1).

Membrane permeability was determined by electrolyte leakage. Leakage was determined on endo-mesocarp, middle-mesocarp, and the hypodermal-mesocarp tissue disks (10 x 1 mm) (3). The endo-mesocarp disks were from a plug of tissue taken within 5 mm of the mesocarp closest to the seed cavity, the middle-mesocarp disks were from a plug of tissue taken from the center of the mesocarp, and the hypodermal-mesocarp disks were from a plug of tissue taken from within 5 mm under the epidermis. Leakage was calculated based on the conductivity of electrolytes that had leaked from the tissue disks into a water bathing solution after 1 hr of soaking.

Data were expressed as a percentage of the conductivity of total electrolytes after homogenization with the bathing solution and filtration.

All data were arcsin-transformed for comparison of percentage data and analyzed by regression or by analysis of variance. All treatments were replicated three times.

During development, epidermal and adjacent hypodermal-mesocarp cells proceeded differently in 'Honey Dew' and netted muskmelon fruit. Between 10 and 20 days postanthesis, netted muskmelon developed columnar phelloderm tissue within the hypodermis, which ultimately became a biconvex mass of tissue bulging and rupturing the epidermis (Figs. 1 and 2). This cellular mass is muskmelon fruit net. During the next 20 days, loosely associated complementary tissue developed (Figs. 3 and 4). At harvest (40 days), the net was generally intact (see Fig. 11). Just prior to harvest, however, fissures in the netting appeared near the blossom end and had, by 50 days (10 days postharvest), channelled nearly the entire net (Fig. 5, see Fig. 12). 'Honey Dew' fruit surface tissue morphology did not appear to change during the 50 days of development (Figs. 6–10). A major anatomical difference between 'Honey Dew' and netted muskmelon fruit, aside from the surface net, was epidermal cell size. 'Honey Dew' epidermal cells measured ≈150 x 30 μm, with a noticeable nucleus in each cell throughout the 50 days. Netted muskmelon epidermal cells were ≈60 x 30 μm and lacked a stainable nucleus. The mesocarp parenchyma cells of both fruit types were similar in size and density and had a noticeable nucleus.

Electrolyte leakage from disks of endo-, middle-, and hypodermal-mesocarp of 'Honey Dew' and netted muskmelon fruit increased steadily after anthesis (Table 1). Endo-mesocarp tissue had the greatest electrolyte leakage during the 30 days after anthesis, regardless of melon cultivar, whereas hypodermal-mesocarp tissues had the least electrolyte leakage. 'Honey Dew' tissue leaked less electrolytes from endo- and middle-mesocarp tissues than did netted muskmelon tissues during 20 through 50 days after anthesis. Leakage from hypodermal-mesocarp tissues followed a similar pattern throughout the 60 days. Both 'Honey Dew' and netted muskmelon fruit hypodermal-mesocarp tissue electrolyte leakages were highly correlated with fruit age. The best-fit regression equations were: $34.1 - 0.735 \times \text{days} + 0.024 \times \text{days}^2$ (R^2 = 0.97) and $34.1 - 0.106 \times \text{days} + 0.021 \times \text{days}^2$ (R^2 = 0.98) for 'Honey Dew' and netted muskmelon, respectively. At harvest, 'Honey Dew' (50 days postanthesis) and netted muskmelon (40 days postanthesis) hypodermal-mesocarp tissues

Table 1. Efflux of electrolytes into water from endo-mesocarp, middle-mesocarp, and hypodermal-mesocarp disks from 'Honey Dew' and netted muskmelon fruits 10, 20, 30, 40, 50, and 60 days postanthesis.

	Electrolyte leakage (%)					
Days after anthesis	Endo-mesocarp		Middle-mesocarp		Hypodermal-mesocarp	
	Honey Dew	Netted muskmelon	Honey Dew	Netted muskmelon	Honey Dew	Netted muskmelon
10	74	53	53	40	30	36
20	80	86	63	67	31	41
30	91	96	78	91	33	49
40	94	100	89	100	42	63
50	100	100	94	100	58	87
60	100	100	100	100	70	100
$LSD_{0.05}$	4	6	4	4	5	6

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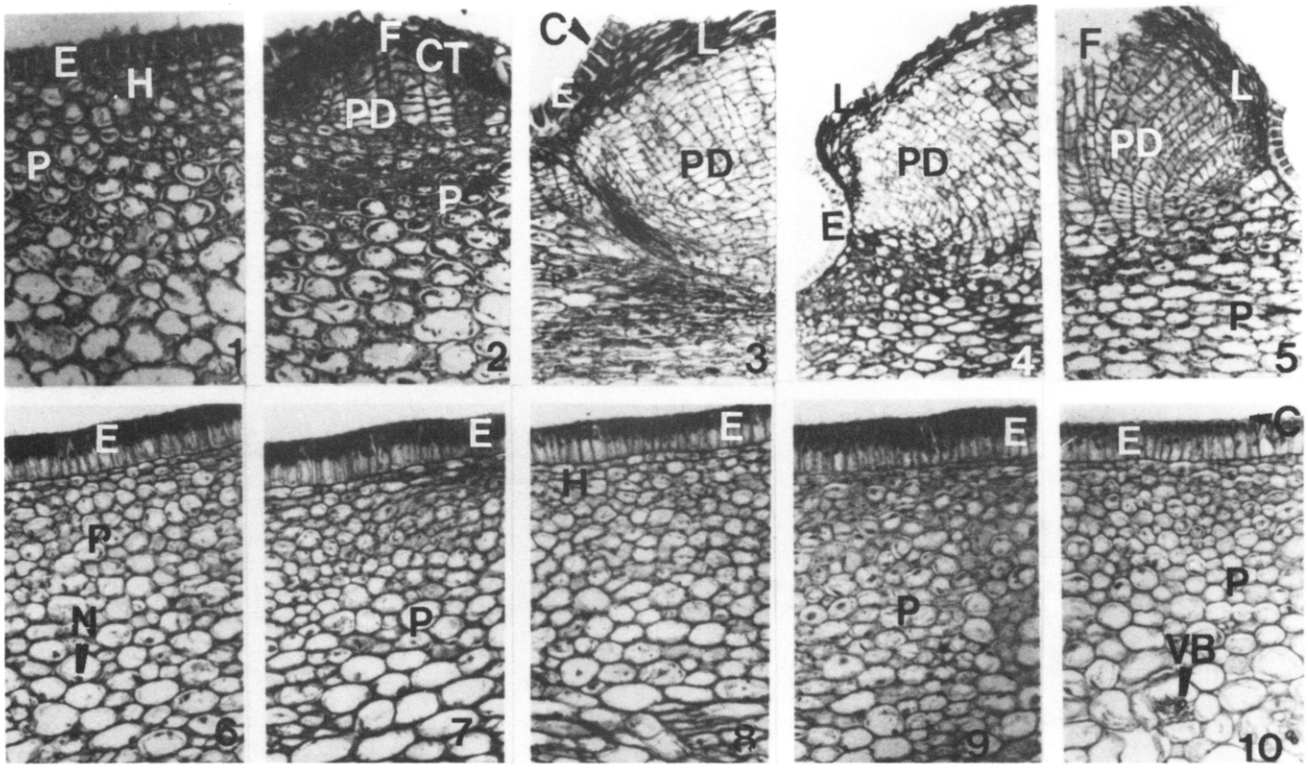
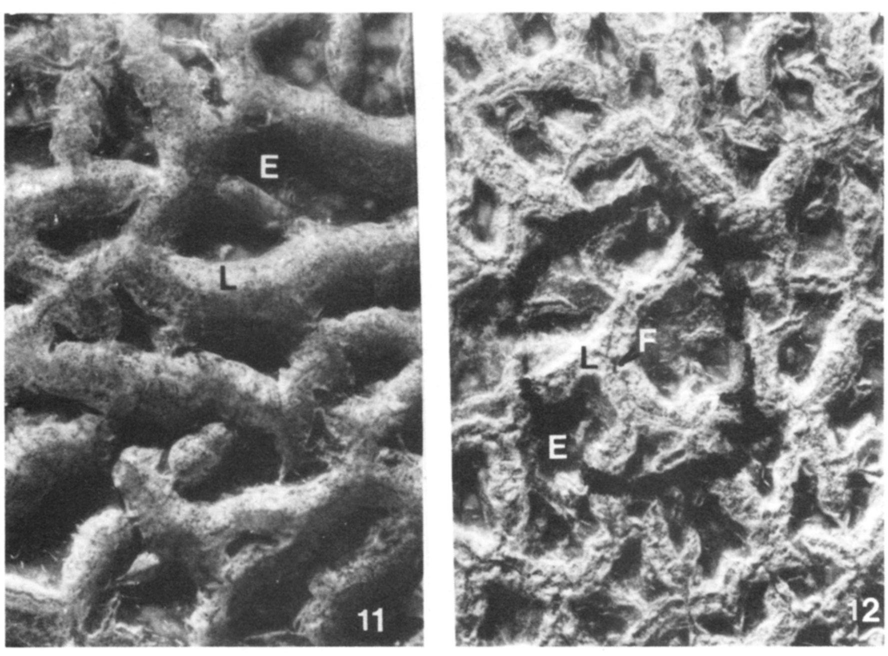


Figs. 1–10. Photomicrographs of longitudinal sections of epidermal and hypodermal tissue from the equatorial region of netted muskmelon fruit (Figs. 1–5) and 'Honey Dew' fruit (Figs. 6–10). (**1**) Ten-day-old tissue, intact epidermis, 139× (all ages start at anthesis). (**2**) Twenty-day-old tissue, development of phelloderm mound, fissuring of the epidermis, and complimentary tissue developments, 139×. (**3**) Thirty-day-old tissue, extensive development of phelloderm and complimentary tissue, 139×. (**4**) Forty-day-old tissue at harvest (full slip), 113×. (**5**) Fifty-day-old tissue, breaking and disintegration of lenticle, 113×. (**6–10**) 10-, 20-, 30-, 40-, and 50-day-old 'Honey Dew' tissue, respectively, intact epidermal surface, 139×. L = lenticel, E = epidermis, H = hypodermis, P = parenchyma tissue, F = fissure, CT = complementary tissue, PD = phelloderm, N = nucleus, C = cuticle, VB = vascular bundle.



Figs. 11 and 12. Photograph of muskmelon fruit surface 5×. (**11**) Forty-day postanthesis fruit surface showing intact lenticle (net) and epidermis. (**12**) Fifty-day postanthesis muskmelon fruit surface showing fissuring (arrow) of lenticle. Black ring is to define area. E = epidermis, L = lenticle, F = fissure.

had similar electrolyte leakage values (60% ± 3%). At 10 days postharvest, although there was a significant increase in electrolyte leakage for both cultivars, the increase was twice as much for netted muskmelon as for 'Honey Dew' muskmelon fruit.

Netted muskmelon fruit reach their climacteric peak at ≈40 days postanthesis (4) and 'Honey Dew' fruit at about 50 days postanthesis (5). Electrolyte leakage from endo- and middle-mesocarp tissue of 'Honey Dew' and netted muskmelon reached 100% at or just prior to the predicted climacteric, which supports the hypothesis that changes in muskmelon fruit membrane permeability precede the climacteric (7). Changes in hypodermal-mesocarp membrane permeability may be involved in the initiation of the climacteric in muskmelon as judged by the doubling in electrolyte leakage in both 'Honey Dew' and netted muskmelon fruits just about 10 days before their respective predicted climacteric peaks (Table 1). The hypodermal-mesocarp is the only mesocarp tissue with functional membrane permeability regulation at pre- and postclimacteric stages. The integrity of this tissue appears to be highly correlated with muskmelon fruit storage life.

Full-slip 'Magnum 45' netted muskmelon fruit, shrink-film-wrapped to prevent moisture loss and stored under cool conditions, have been maintained beyond 40 days in storage (3). 'Honey Dew' muskmelons under recommended storage conditions have a storage life of up to 40 days and lose fresh weight at a much slower rate than netted muskmelon fruit under recommended storage conditions (6). Throughout the entire life of the 'Honey Dew' fruit, the epidermis remains intact and must regulate both pre- and postharvest fruit transpiration and gas exchange. Netted muskmelon fruit by 20 days postanthesis developed a complete surface netting, through which the intercellular free space of the loosely associated complementary tissue regulates moisture and gas exchange (8). However, in this work, splitting

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of the muskmelon net had occurred by 10 days postharvest, which coincides with the time reported for a significant loss of fruit moisture and relatively fast aging (3).

Changes in electrolyte leakage between 'Honey Dew' and netted muskmelon fruit reflect changes in aging, i.e., potential postharvest life. Therefore, the intact (closed) epidermis of 'Honey Dew' vs. the fissured (open) epidermal tissue of netted muskmelon during postharvest storage may be responsible for the differences in electrolyte leakage and the associated differences in fruit storage life.

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Fruit Quality of Rabbiteye Blueberries as Influenced by Weekly Harvests, Cultivars, and Storage Duration

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Abstract. **Fruit of 'Bonita' and 'Beckyblue' rabbiteye blueberry (*Vaccinium ashei* Reade) cultivars were harvested weekly, then stored in two different types of consumer baskets and subjected to five time/temperature storage regimes. Fruit increased in total soluble solids (TSS) and pH and decreased in acidity (Ac) with advancing harvest dates. Total soluble solids and pH of 'Bonita' fruit were significantly lower and Ac higher than for fruit of 'Beckyblue'. After 3 weeks of storage at 1°C plus 3 days at 16°, 'Beckyblue' had higher (8 times) decay than fruit of 'Bonita'. There were no cultivar differences in fruit firmness or weight loss due to storage, but fruit weight was reduced significantly when packaged in molded pulp fiberboard baskets. Fruit of 'Bonita' can be used for both domestic and export markets, requiring long storage duration, but 'Beckyblue' fruit should be limited to domestic markets.**

In the 1920s, commercial blueberry plantings in northern Florida totaled ≈900 ha (13). During the next decade, the Florida blueberry industry went into serious decline for the next 40 years. The reemergence of the Florida blueberry industry in recent years is firmly based on sound plant selection and cultural practices, and the industry is expected to make a strong and successful comeback. Currently, the blueberry industry in Florida is expanding rapidly (8). As tonnage of harvested fruit increases and markets are developed farther from producing areas, this industry must focus on postharvest handling and marketing problems.

More postharvest literature on blueberries is available on highbush *Vaccinium corymbosum* L. (3–7, 10–12) than on rabbiteye (2, 9, 14, 15) cultivars. Most reports indicate that rabbiteye fruit are more resistant to fungal decays than highbush fruit, and generally have smaller stem scars (1), which tend to inhibit entry of decay-causing organisms. Although fruits of these species are similar, there are climatic and geophysical differences in production locations that effect the extent of postharvest fruit deterioration. Information on postharvest fruit quality is useful to growers and shippers and to plant breeders in developing cultivars with fruit quality to withstand the rigors of shipping to distant markets.

The objective of this study was to determine the effects of cultivars, harvest dates, storage durations, and packaging materials on the quality of rabbiteye blueberry fruit produced in Florida.

Fruit of 'Bonita' and 'Beckyblue' were harvested at three weekly intervals and subjected to two packaging and five storage duration treatments. Berries were hand-harvested from 4-year-old bushes located in a commercial plantation in Gulf County, Fla., on 4, 11, and 18 June 1986. Harvested berries were placed into plastic field bins that contained 12 consumer baskets (0.48 liters), each constructed of either traditional fiber pulp (FPB) or experimental styrofoam (SFB). Baskets of berries then were transported by truck to the packing shed, capped with cellophane, placed into fiberboard shipping containers, and delivered to the Orlando Horticultural Research Laboratory (≈500 km in distance). Upon arrival (≈6 to 8 hr after harvest), gross weight of each basket of berries was recorded. Fruit of each cultivar contained in two basket types were randomly combined into five time/temperature storage

Table 1. Mean weight loss of berries after storage for 7, 14, 21, or 24 days by cultivar and package type.

Cultivar	Package type	Mean wt loss (%) Storage time/temperature 7 days at 1°C	14 days at 1°	21 days at 1°	21 days at 1° + 3 days at 16°
Bonita	Pulp	1.3[z]	1.8	2.2	2.6
Bonita	Styrofoam	0.9	1.3	1.5	1.6
Mean		1.1	1.6	1.9	2.1
Beckyblue	Pulp	1.2	1.9	2.2	2.6
Beckyblue	Styrofoam	0.9	1.2	1.5	1.7
Mean		1.1	1.5	1.9	2.2
Significance[y]					
Harvest time		NS	*	*	*
Package type		*	*	*	*

[z]Value is mean of nine consumer baskets of fruit.
[y]Factorial analysis by analysis of variance procedures; significant at 5% (*) or nonsignificant (NS).

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