Hull, shell and kernel relationships in almond fresh fruits

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Hull, shell and kernel relationships in almond fresh fruits (1) (2)

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ABSTRACT

Hulls proved to be the heaviest part of almond fresh fruits, followed by shells and kernels.

A compensative development between hulls and shells in cultivars bearing fruits with similar fresh weight, has been found regardless of whether with paper or hard-shell.

It was suggested the opportunity of paying more attention, in the choice of the cultivars and in breeding programs, to cultivars with the useless hulls as thin and light as possible and with shells sufficiently hard and well sealed to ensure a satisfactory protection of the kernels.

Almond fruits are dehiscent drupes: the ovary wall matures into a pericarp with a leathery mesocarp (the hull) and a more or less stony endocarp (the shell), that contains and protects one-two seeds (the kernel/s).

At maturity, the hulls begin to split along the suture line, then contract and dry out, exposing the shells. At harvesting time, some hulls may separate naturally from the shells, then the growers will complete the hulling mechanically.

The edible part of almond fruits are the kernels; the shells, particularly those of very hard and hard shell cultivars, may be utilized by the extractive industry; no use is generally made of the hulls, that are burnt down.

The particular ripening pattern and the lack of value may contribute to explain the generalized indifference for the outer part of the pericap of almond fruits. In fact, for genetic and horticultural purposes, almond fruits are considered as consisting only of the binomial «shell plus kernel», the nut. The only mentions to the hulls concern some biological traits, such as «hull dehiscence pattern» and «hulling ease» (3, 4).

Working on almond, there were opportunities of observing and pointing out that the hull is an important part of the fruit (1); so that it was decided to initiate specific studies in order to ascertain the relationships among all the parts of the fresh almond fruits, including hulls.

Table 1

Fresh weights

Cultivar	(Doubles)	Fruit	Kernel		Shell		Hull		Hull + Shell (Pericarp)	
	%	g	g	%	g	%	g	%	g	%
JORDANOLO	(0.0)	28.18 a	2.84 b	10.1 i	5.57 dg	19.8 m	19.76 a	70.1 a	25.33 a	89.9 a
FRAGIULO PICCOLA	(11.7)	26.28 a	2.81 b	10.7 i	9.31 a	35.4 eg	14.16 b	53.9 de	23.47 a	89.3 a
CRISTOMORTO	(25.0)	22.67 b	3.30 a	14.5 ef	9.97 a	44.0 a	9.40 eg	41.5 m	19.37 b	85.5 de
TRIANELLA	(13.3)	21.92 bc	2.46 dg	11.2 hi	7.41 b	33.8 fg	12.05 cd	55.0 d	19.46 b	88.8 ab
NONPAREIL	(0.0)	21.24 bc	2.70 bd	12.7 gh	4.71 gi	22.2 l	13.83 bc	65.1 b	18.54 bc	87.3 bc
RACHELE GRANDE	(23.3)	21.03 bc	3.25 a	16.0 ce	7.60 b	36.1 e	10.08 df	47.9 h	17.68 bd	84.0 eg
MONTRONE	(1.7)	19.21 cd	2.83 b	14.7 ef	7.79 b	40.6 bc	8.59 ei	44.7 il	16.38 ce	85.3 de
NE PLUS ULTRA	(11.7)	19.00 ce	2.58 be	13.6 fg	3.78 i	19.9 m	12.64 bc	66.5 b	16.42 ce	86.4 cd
ZIN ZIN	(40.0)	18.78 ce	2.59 be	13.8 fg	5.91 dg	31.5 h	10.28 de	54.7 d	16.19 ce	86.2 cd
FERRANTE	(70.0)	18.77 ce	3.32 a	17.7 ab	6.42 cd	34.2 f	9.03 eh	48.1 h	15.45 de	82.3 hi
TUONO	(23.3)	18.68 ce	2.56 be	13.7 fg	6.34 ce	33.9 fg	9.78 ef	52.4 eg	16.12 ce	86.3 cd
FALSA BARESE	(1.7)	16.66 df	2.22 fg	13.3 fg	5.37 eg	32.2 h	9.07 eh	54.5 d	14.44 ef	86.7 cd
CINQUANTA VIGNALI	(3.3)	16.61 df	2.11 g	12.7 gh	6.90 bc	41.5 b	7.60 gl	45.8 i	14.50 ef	87.3 bc
TEXAS	(13.3)	16.59 df	2.34 eg	14.1 fg	3.80 i	22.9 l	10.45 de	63.0 c	14.25 ef	85.9 cd
GENCO	(1.7)	15.83 ef	2.37 eg	15.0 df	5.42 eg	34.2 f	8.04 fi	50.8 fg	13.46 eg	85.0 df
SCORZA VERDE	(65.0)	14.90 f	2.78 bc	18.6 a	4.84 gh	32.5 gh	7.28 hl	48.9 gh	12.12 fg	81.4 i
FILIPPO CEO	(38.3)	13.93 f	2.51 cf	18.0 ab	4.73 gi	34.0 fg	6.69 il	48.0 h	11.42 g	82.0 hi
CATUCCIA	(66.7)	13.63 f	2.40 dg	17.6 ac	3.91 hi	28.7 i	7.32 hl	53.7 de	11.23 g	82.4 gi
FRANCISCUDDA	(40.0)	13.43 f	2.29 eg	17.0 ac	5.29 fg	39.4 cd	5.85 l	43.6 l	11.14 g	83.0 gi
MINCONE	(25.0)	9.70 g	1.61 h	16.6 bd	3.73 i	38.4 d	4.36 m	45.0 i	8.09 h	83.4 fh
M E A N		18.35	2.60 C	14.5 C'	5.94 B	32.8 B'	9.81 A	52.7 A'	15.75	85.5

MATERIAL AND METHODS

The investigation was carried out in 1981, in an experimental dryfarmed orchard near Bari, on twenty cultivars, most of Apulian origin; the trees were 12-years-old and grafted on sweet almond.

To guarantee uniformity of sampling for comparison purposes, the fruits were chosen at random only among those between the «J» and the «K» stages (2), i. e. with turgid hulls before onset of dehydration process and with a barely visible suture line, no wider than 1-2 mm.

Three samples of 50 fruits each were prepared for each cultivar and the fresh weight of the different parts (kernel, shell and hull) was calculated. Particular attention was payed to the incidence, in absolute and percentual values, of the whole pericarp.

The experimental data were worked out statistically and referred to the single fruit.

RESULTS AND DISCUSSION

Table n.° 1 shows that the fresh weight of the fruits varied significantly among the cultivars from a maximum of 28.18 g. ('Jordanolo') and a minimum of 9.70 g ('Mincone'). With reference to the weight of the fruit (average 18.35 g), the hull was the heaviest part (average 9.81 g), followed by the shell (average 5.94 g) and the kernel (average 2.60 g).

Likewise, significant differences were observed in the percentual incidence of each single part of the fruit. Thus, for instance, the kernel had an incidence varying from a maximum of 18.6 % ('Scorza verde') to a minimum of 10.1 % ('Jordanolo'), the shell ranged from 44.0 % ('Cristomorto') and 19.8 % ('Jordanolo') and the hull from 70.1 % ('Jordanolo') and 41.5 % ('Cristomorto').

The hull was percentually the heaviest part (average 52.7 %) of all fresh fruit parts, followed by shell (average 32.8 %) and kernel (average 14.5 %).

According to the above indications, if the pericarp as a whole is considered, it appears that its weight varied significantly among cultivars and with wide differences between maximum (25.33 g of 'Jordanolo') and minimum (8.09 g of 'Mincone') values.

However, the gap between extreme values of percentual incidence of pericarp on the fruit was much narrower, ranging only between 89.9 % ('Jardanolo') and 81.4 % ('Scorza verde').

As pointed out above, pericarp originates from the development of ovary wall tissues, its outer layer giving rise to exocarp and mesocarp (the hull) and deeper layer producing the endocarp (the shell). In the case of almond, there may be a sort of compensative development of hulls and shells, at least in cultivars bearing fruits with similar fresh weights, regardless of whether with paper or hard shell. In fact, as shown in table n.° 2, there are no significant differences in the percentages of whole pericarp and, obviously, also of kernel fresh weights inside comparable groups of cultivars, i.e. with similar fresh fruit weight.

Table 2

Lack of difference between pericarp fresh weight, pericarp per cent and kernel per cent in almond cultivars with similar fresh weight of fruits (Abstract from Table 1).

Cultivar	Shell type	Fresh Fruit g	Pericarp Fresh Weight g	Pericarp Fresh Weight %	Kernel per cent %
First example					
JORDANOLO	paper	28.17 a	25.33 a	89.9 a	10.1 i
FRAGIULIO PICCOLA	very hard	26.28 a	23.47 a	89.3 a	10.7 i
Second example					
TRIANELLA	very hard	21.29 bc	19.46 b	88.8 ab	11.2 hi
NONPAREIL	paper	21.24 bc	18.54 bc	87.3 bc	12.7 gh
Third example					
MONTRONE	very hard	19.21 cd	15.38 ce	85.3 de	14.7 ef
NE PLUS ULTRA	paper	19.00 ce	16.42 ce	86.4 cd	13.6 fg
ZIN ZIN	hard	18.78 ce	16.19 ce	86.2 cd	13.8 fg
TUONO	hard	18.68 ce	16.12 ce	86.3 cd	13.7 fg
FALSA BARESE	hard	16.66 df	14.44 ef	86.7 cd	13.3 fg
TEXAS	semi-soft	16.59 df	14.25 ef	85.9 cd	14.1 fg
GENCO	hard	15.83 ef	13.46 eg	85.0 df	15.0 df

CONCLUSIONS

Almond fruits are made up of three parts: hull, shell and kernel. No attention is usually paid to the hull, which is unanimously considered as useless. Yet the present investigation has shown that the hull is the heaviest part of the fruit, in absolute and percentual values, in all the considered cultivars, but especially in the paper shelled ones.

It could be, therefore, methodologically incorrect to continue considering almond fruits as composed by shell and kernel only, thus ignoring the heaviest part, the hull, and the role that it must play in the nutritional and water balance of the fruits, particularly in areas without or with poor water supplies.

The results of the present study allow also for some critical considerations about the choice of the cultivars and the aims of breeding programs.

It is well known that the shell of paper shelled cultivars is often cracked, thus exposing the kernel while on the tree or during storage to injuries by pathogens and pests. In the light of the shown value complementarity between weight of hulls and shells of cultivars with similar fruit fresh weight, it would appear desirable to grow those cultivars endowed with hard or semi hard shells, which could guarantee an efficient protection of the kernel.

As to breeding programs, it has been amply demonstrated that, by proper crossing, a betterment of the shelling percentage is readily achievable (5). One wonders, however, if it would not be advisable to aim at obtaining cultivars with shells well-sealed because sufficiently hard, but also with hulls as thin and light as possible.

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(2) Progetto finalizzato MAF «Sviluppo e miglioramento della frutticoltura da industria, della fruticoltura precoce et dell'agrumicoltura». Pubblicazione N. 55.

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