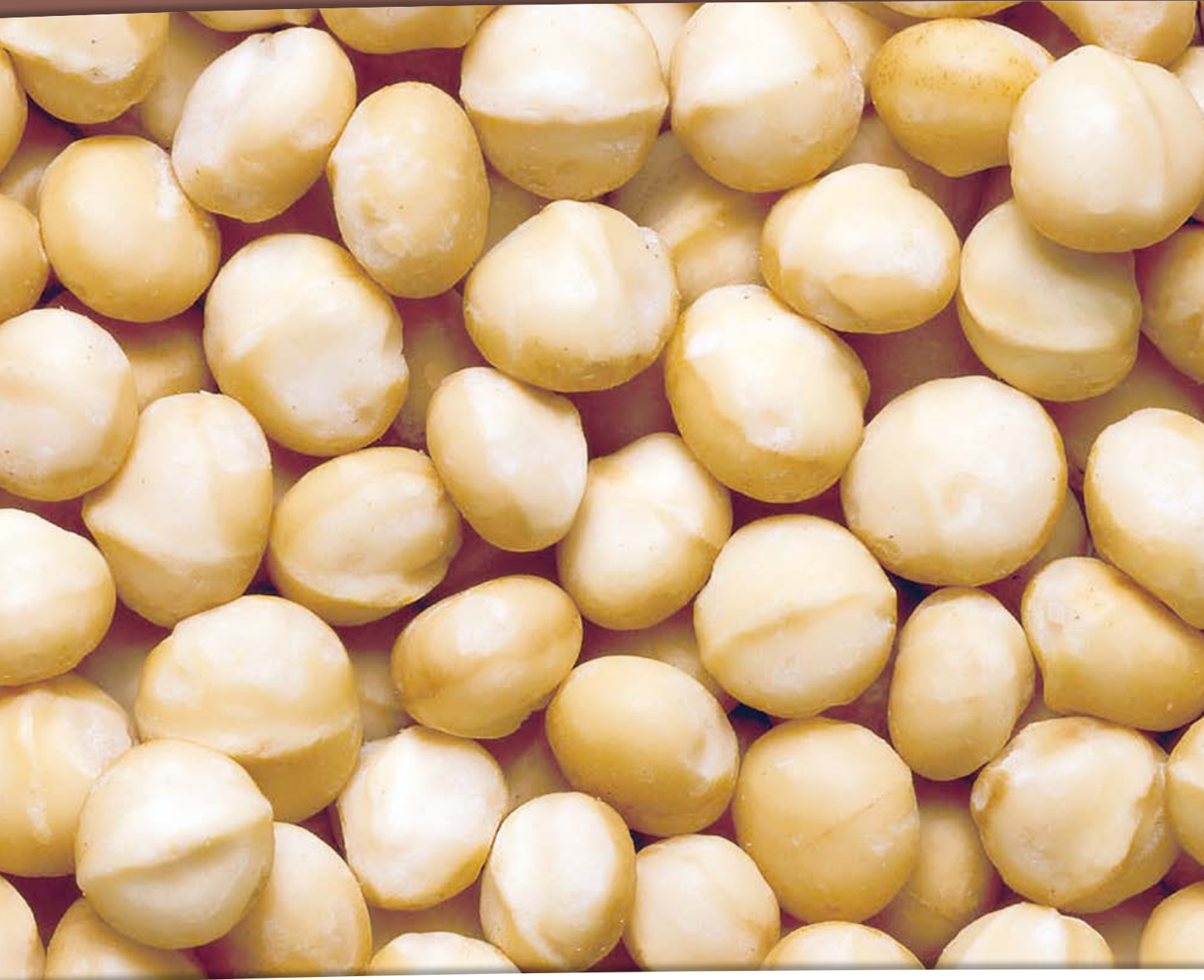




Macadamia

Technical Information



Macadamia

1. General Information

Macadamias are evergreen trees native to Australia. According to the Australian Macadamia Society, the Aboriginal people called the macadamia by different names: Kindal Kindal, Boomera, Jindill, or Baupal. Macadamia nuts were always considered a delicacy and were used for trade between tribes and as special ceremonial gifts at inter-tribal corroborees. In the 1850s, these trees were noticed by Ferdinand Von Mueller, a British botanist, and Walter Hill, the Director of the Botanical Gardens of Brisbane, Australia. Mueller named the genus *Macadamia* in honor of his friend Dr. John McAdam, a prominent scientist of that time. Today the largest producers of macadamia nuts are Australia and South Africa, representing about 50% of the total production, followed by Kenya, China, USA, Guatemala, Brazil, Malawi, Vietnam, Colombia, New Zealand and Swaziland.



Macadamias belong to the Proteaceae family. There are seven species of macadamia endemic to Australia and two are grown for their edible nuts: *Macadamia integrifolia* (smooth shelled) and *Macadamia tetraphylla* (rough shelled) the nut of which is not as good for roasting as *M. integrifolia*. Macadamia trees are evergreen and grow slowly up to 12-15 m after 10-15 years. Most cultivars are partly or completely self-incompatible so insects, especially bees, have an important role in pollination.

The fruit has a pericarp (husk), a hard testa (seed coat or shell) and an embryo (kernel or nut meat). The thick husk and the extremely hard shell may provide greater protection of the kernel against microbiological contamination.

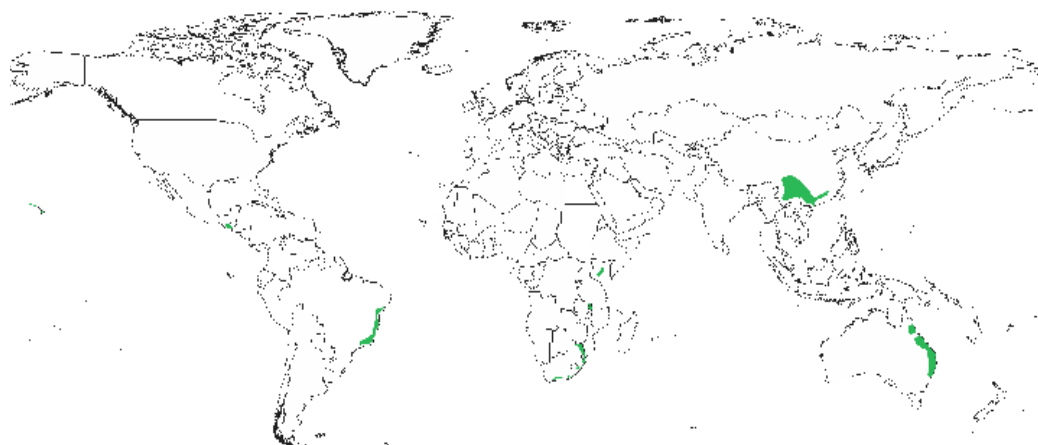
Macadamia nuts have a subtle, buttery flavor, and velvety-soft crunch that make them highly regarded by consumers. They are perfect as a snack, breakfast topping, in salads or as part of a main meal, either raw, roasted and salted, or with other flavorings. In addition, they combine perfectly with many different flavors, making them an extremely versatile ingredient in many sweet and savory dishes.

Apart from their great taste and versatility, macadamia nuts have an interesting nutritional composition since they are high in monounsaturated fats (such as omega-7 fatty acids), fiber, magnesium, copper, manganese and thiamin, and are a source of vitamins B6, niacin and minerals such as iron, phosphorus, potassium and selenium.



Overview of Macadamia Production

World production of macadamias has seen an increase of 49% in the last ten years, reaching about 57,000 MT (kernel basis) in 2018. The largest producers of macadamia nuts are Australia and South Africa, representing about 50% of the total production, followed by Kenya, China, USA, Guatemala, Brazil, Malawi, Vietnam, Colombia, New Zealand and Swaziland.



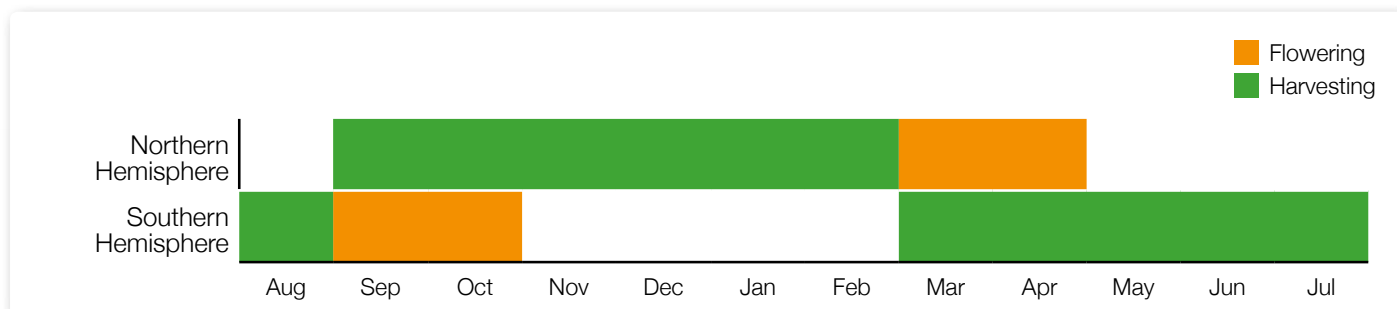
Main Macadamia Growing Areas (Source: INC)

Seasons



Flowering occurs in late winter/early spring over several months with nuts forming in early summer and, by early autumn, clusters of plump green nuts appear, although the exact timing depends on variety, location and climatic conditions.

Nuts reach maturity when oil accumulation is completed, approximately 5 to 6 months after the nut sets. Macadamias grow encased in a hard, woody shell, which is protected by a green-brown fibrous husk. Shell hardening takes place in late spring, followed by rapid oil accumulation in early summer. Between autumn and winter, the mature nuts fall to the ground. Because flowering occurs over several months, macadamia nuts mature and drop to the ground over an extended period, thus, they have to be harvested regularly. Due to long-term maturity, it is possible for flowering and harvesting to overlap.



The chart shows the higher concentration months of flowering and harvesting, but dates can vary depending on the tree variety and the zone.



Macadamia

2. Tree Products

Macadamia nuts are highly valued by consumers due to their flavor, versatility and crunchy texture. They also have a healthy nutrition profile and, therefore, including a handful of macadamias a day in your diet is recommended. In addition, macadamias are considered a high-oil nut, containing about 68-79% oil, which can be extracted from the kernels. This oil, natural source of palmitoleic acid (omega-7), has both good nutritional and cosmetic properties.



© SAMAC



© SAMAC

Macadamia nuts are used as a snack, breakfast topping and in main meals, desserts and ice creams. They are also characterized by their versatility. As they taste great eaten raw from the shell or dry roasted, they can be used as an ingredient in a huge variety of dishes (cakes, desserts, ice cream, salads, roasts and casseroles).

They contain a range of nutrients such as monounsaturated fats, antioxidants, fiber, vitamins and minerals, which may beneficially affect the cholesterol levels and may, consequently, reduce the risk of cardiovascular disease (CVD) (1). Choosing macadamias as a snack is a good way to include some essential nutrients in your diet.

Nutrients in 100 g of dry roasted macadamias without salt added

Energy	718 kcal
Protein	7.79 g
Saturated fat	11.948 g
Monounsaturated fat	59.275 g
Polyunsaturated fat	1.499 g
Carbohydrate	13.38 g
Fiber	8.0 g
Iron	2.65 mg
Selenium	11.7 µg
Phosphorus	198 mg
Magnesium	118 mg
Potassium	363 mg
Thiamin	0.71 mg
Niacin	2.274 mg
Vitamin B6	0.359 mg

Source: USDA National Nutrient Database for Standard Reference 1 Release April, 2018.



© SAMAC

■ Uses as a Snack

Examples of Macadamia Snacks Commercialized

Raw macadamias	Coffee glazed macadamias
Salted dry roasted macadamias	Butter candy glazed macadamias
Chocolate covered Macadamias	Honey roasted macadamias
Wasabi soy macadamias	Sweet onion & garlic macadamias
Barbecue macadamias	Macadamia cheddar crunch



© SAMAC

■ Uses in Bakery and Confectionery

Industry	Used as
Ice cream	Macadamias are used both to make and as a topping on ice creams. It is easy to find a range of ice creams made with macadamias.
Baked goods	Macadamias are used as an ingredient in the elaboration of cakes, cookies, muffins and biscuits.
Confectionery	Macadamias are used as ingredient in chocolates, brittles, nougats and health bars.



© SAMAC

■ Other Uses

Industry	Used as
Oil Industry	Due to the high percentage of monounsaturated oil that macadamias contain, they are a new source of healthy oil. The oil made from macadamias is similar to olive oil in its composition and can be used for cooking or raw, as salad dressing, for example.
Cosmetic	Macadamia oil is present in many cosmetic formulations. Shampoos, conditioners and skin oils are some examples of the products that can contain macadamia oil.
Beverage	Macadamias may be used for the elaboration of macadamia nut based drinks.

Sources:

(1) Griel, A. E., Cao, Y., Bagshaw, D. D., Cifelli, A. M., Holub, B., & Kris-Etherton, P. M. (2008). A macadamia nut-rich diet reduces total and LDL-cholesterol in mildly hypercholesterolemic men and women. *The Journal of nutrition*, 138(4), 761-767.



Macadamia

3. Forms

The following forms and specifications are included in the United Nations Economic Commission for Europe (UNECE) Standard DDP-22 and DDP-23 concerning the marketing and commercial quality control of inshell macadamia nuts and macadamia kernels.

Companies may set quality standards of their own. This kit only reflects the UNECE Standards, as internationally recognized minimum requirements for dry and dried produce. UNECE Standards are voluntary and operators are free to choose which standards they use in their business practice and subject to national regulations.



1. MACADAMIA KERNELS:



Style 0

Description	Size
Wholes: shall consist of at least 95% whole kernels with the remaining percentage consisting of pieces	of which no more than 1% will pass through a 6.25 mm (1/4 inch) square opening.



Style I

Description	Size
Wholes: shall consist of at least 90% whole kernels, with the remaining percentage consisting of pieces	of which no more than 1% will pass through a 6.25 mm (1/4 inch) square opening.



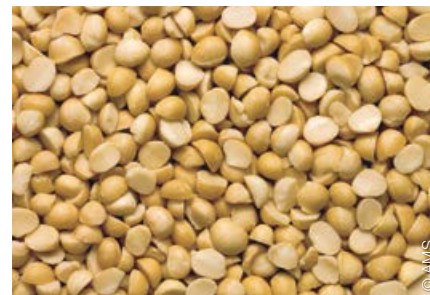
Style II

Description	Size
Wholes and halves: shall consist of at least 50% whole kernels, with the remaining percentage consisting of pieces	of which no more than 2% will pass through a 7.8 mm (5/16 inch) square opening.



Style III

Description	Size
Cocktail: shall consist of at least 90% half or larger kernels, included therein at least 15% whole kernels, with the remaining percentage consisting of pieces	of which no more than 2% will pass through a 6.25 mm (1/4 inch) opening.



Style IV

Description	Size
Halves and pieces: shall consist of at least 50% half kernels, with the remaining percentage consisting of pieces with no more than 5% larger than half kernels	<p>Style IV L: kernel size is larger than 16 mm (round caliber).</p> <p>Style IV M: kernel size is between 14-16 mm (round caliber).</p> <p>Style IV S: kernel size is between 10-14 mm (round caliber).</p>



Style V

Description	Size
Large diced: shall consist of units which are smaller than half kernels	of such size that no more than 5% will pass through a 7.8 mm x 25 mm (5/16 inch x 1 inch) opening, included therein not more than 2% that will pass through a 2.34 mm (3/32 inch) square opening.



Style VI

Description	Size
Chips: shall consist of units	that at least 95% will pass through a 7.8 mm x 25 mm (5/16 inch x 1 inch) opening but no more than 2% will pass through a 2.34 mm (3/32 inch) square opening.



Style VII

Description	Size
Bits and diced: shall consist of units	smaller than half kernels and of such size that at least 95% will pass through a 7.8 mm (5/16 inch) square opening but no more than 10% will pass through a 2.34 mm (3/32 inch) square opening.

Style VIII

Description	Size
Fines: shall consists of broken, chipped or chopped kernels	all units will pass through a 6.25 mm (1/4 inch) square opening and most will also pass through a 2.34 mm (3/32 inch) square opening.

If companies follow a standard other than UNECE standard, it is recommended to specify if sizing is determined with a round or square holes sieve

Sources:

- UNECE STANDARD DDP-22 concerning the marketing and commercial quality control of inshell macadamia nuts, Edition 2010.
- UNECE STANDARD DDP-23 concerning the marketing and commercial quality control of macadamia kernels, Edition 2011.



Macadamia

4. Processing

Macadamia nuts are harvested when they have fallen to the ground. Dehusking nuts after harvesting prevents deterioration from sweating and overheating. They are then processed to obtain the macadamia kernels in optimal condition.

Product storage, packaging, and transport conditions are key to ensuring the quality of the final product.

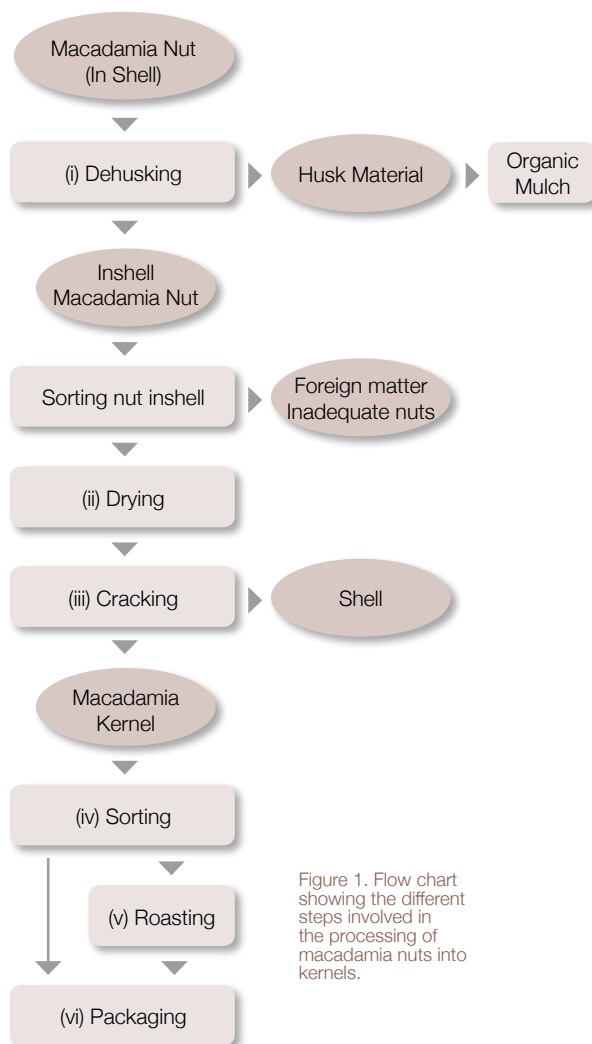


Figure 1. Flow chart showing the different steps involved in the processing of macadamia nuts into kernels.

RECOMMENDATIONS FOR PROCESSING, STORAGE, PACKAGING AND TRANSPORT

PROCESSING

The Processing of Macadamia Nuts into Kernels

Processing macadamia nuts into kernels comprises the following steps (Figure 1): (i) dehusking, (ii) drying, (iii) cracking, (iv) sorting, (v) roasting and (vi) packaging.

To prevent the deterioration of kernel quality, the outer husk of the macadamia should be removed after harvesting. Thus, the heat respiration is lower and the drying is easier. Nuts are typically dehusked on-farm and then transported to the processor for drying. The fibrous husk material is usually recycled as organic mulch.

Drying is the critical step in maximizing the quality of the end product. After harvesting, macadamias can have a moisture content of up to 30%. In this step, the goal is to reduce kernel moisture content to below 1.5% (nut inshell moisture content of 3.5%). Drying can be done by spreading the nuts on racks or using forced air in silos or bins. Prolonged exposure to direct sunlight can cause rancidity and shell cracking. If



heating is used during drying, excessive temperatures can result in internal browning and discoloration (temperature should not exceed 60 °C).

During the cracking, damage to the kernel should be avoided. Cracking machines have been developed to crack the shell without damaging the kernel inside. In addition, after drying, the kernel shrinks away from the inside of the shell with minimum damage to the kernel.

In order to meet the requirements of the quality standards set for styles, mechanical equipment and hand sorting are used for sorting inshell and shelled nuts according to size, color and the presence of defects.

In case of roasted macadamias, roasting times and temperatures vary according to batch size, the scale of the roasting equipment used, and the desired color for the final product.



■ STORAGE

Raw Macadamia Nuts Inshell

Raw macadamia nuts inshell are commonly stored in silos. It is recommended to have a larger number of small silos than fewer larger ones. This allows nuts to be separated into different batches according to variety, storage time, humidity, etc. Silos should have adequate airflow and a bed depth lower than 3 m.

Raw Macadamia Kernels

Macadamia kernel stability is related to moisture content and to oxidative rancidity. Exposure to moisture results in loss of crispness and shelf life whereas exposure to oxygen results in rancidity. Therefore, it is important to protect the dry kernels from moisture and oxygen. The packaging materials have to be impervious to moisture. Vacuum packing or nitrogen flushing offers protection from oxygen.

Cold storage is normally not necessary for short-term storage but required at <12 °C to maintain shelf life. When nuts have to be stored for long periods, they have to be maintained in as cool and dry conditions as possible.

■ PACKAGING

According to UNECE Standards DPP-22 concerning the marketing and commercial quality control of inshell macadamia nuts (2010) and DPP-23 concerning the marketing and commercial quality control of macadamia kernels (2011), inshell macadamia nuts and macadamia kernels must be packed in such a way as to protect the produce properly.

The materials used inside the package must be clean and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications, is allowed, provided that the printing or labelling has been done with non-toxic ink or glue.

■ TRANSPORT

To preserve the quality of macadamias, the time in transit of the nuts should be minimized. Before loading, a careful inspection of the transport container is necessary to ensure that it is dry and clean. Since dried kernels are susceptible to bruising and fracturing, transporting nuts over rough roads and using vehicles with excessive vibration should be avoided.



Sources:

- UNECE STANDARD DDP-22 concerning the marketing and commercial quality control of inshell macadamia nuts, Edition 2010.
- UNECE STANDARD DDP-23 concerning the marketing and commercial quality control of macadamia kernels, Edition 2011.
- Australian Macadamia Society.
- O'Hare, P., Stephenson, R., Quinlan, K., & Vock, N. (2004). Macadamia grower's handbook. Queensland Department of Primary Industries and Fisheries: Nambour, Qld.
- Cavaletto, C.G (2004). Macadamia Nut. The commercial storage of fruits, vegetables, and florist and nursery stocks. USDA Agricultural Handbook 66.
- Harris, L. J. (Ed.). (2013) Impact of nut postharvest handling, de-shelling, drying and storage on quality. Improving the safety and quality of nuts. Elsevier. p. 22-34.



Macadamia

5. Quality Requirements

To ensure the safety of macadamias, international growers and processors are developing a wide range of good agricultural, manufacturing and storage practices. Macadamia nuts should be produced with consideration for quality control and international food safety standards. Careful practices have been established to control the chemical, microbiological, pesticide, and contaminant content.



QUALITY - MINIMUM REQUIREMENTS (UNECE)

INSHELL MACADAMIA NUTS		
Shell	Kernel	Whole Produce
Intact	Free from rancidity	Sound
Clean	Sufficiently developed	Free from visible mold filaments
Free from blemishes, areas of discoloration, or spread stains	Free from blemishes, areas of discoloration, or spread stains	Free from living pests
Free from defects		Free from damage caused by pests
Free from visible mold filaments		Free from abnormal external moisture
Well formed		Free from foreign smell and/or taste



QUALITY - MINIMUM REQUIREMENTS (UNECE)

MACADAMIA KERNELS

Intact	Free from living pests
Sound	Free from damage caused by pests
Clean	Free from visible mold filaments
Sufficiently developed	Free from rancidity
Free from blemishes, areas of discoloration, or spread stains	Free from abnormal external moisture
Well formed	Free from foreign smell and/or taste

CHEMICAL AND MICROBIOLOGICAL PARAMETERS

Approximate Quality Characteristics for Raw Macadamia Kernels:

	Australian Macadamia Society (AMS) ¹	Southern African Macadamia Growers' Association (SAMAC) ²	Brazilian Macadamia Association (ABM)
Chemical			
Moisture	Not to exceed 1.8%	Maximum 2%	1.5% ± 0.3%
Free fatty acids	≤ 0.5%	≤ 0.5%	≤ 1.0%
Peroxide value	≤ 2 meq/kg (2 years shelf life); 2 < X < 3 meq/kg (1 year shelf life)	≤ 3 meq/kg	≤ 3 meq/kg or ≤ 5 meq/kg (some markets)
Microbiological			
Total plate count	< 30,000 cfu/g	< 20,000 cfu/g	< 30,000 cfu/g
Yeast and mold	< 20,000 cfu/g	< 20,000 cfu/g	< 20,000 cfu/g
Coliforms		< 300 cfu/g	< 350 cfu/g
<i>E. coli</i>	< 3/g (AS 5013.15 - 2006 test method)	Not detected (BS 5763 method)	< 3 cfu/g
<i>Salmonella</i>	Not detected /250 g (AS 5013.10 - 2009 test method)	Not detected in 25 g (ISO 6579 or BAM method)	Negative in 250 g

¹ These may not necessarily apply to commercial grade, only first (premium) grade. Source: Australian Macadamia Society, Kernel Quality Standard for Processors. Version: AMKQS-V1 Issue date: 20/06/2018.

² These standards are mainly applicable to styles 0-4. More lenient standards will be required for styles 5 and above. In addition, these may not necessarily apply to commercial grade, only first grade. Source: Southern African Macadamia Growers' Association, SAMAC Kernel Standards. Updated 10 January 2018.

PESTICIDES

The use of chemicals is carefully regulated and should be used responsibly. Pesticides are useful in controlling pests and other organisms, and thus provide safe and high-quality macadamias.

Codex Alimentarius Maximum Residue Levels for Tree Nuts (2018)

Pesticide	MRL (mg/kg)	Pesticide	MRL (mg/kg)	Pesticide	MRL (mg/kg)	Pesticide	MRL (mg/kg)
2,4-D	0.20	Cyhalothrin	0.01*	Fluxapyroxad	0.04	Pyrethrins	0.50* Po
Abamectin	0.005*	Cypermethrins	0.05*	Glufosinate-Ammonium	0.10	Saflufenacil	0.01
Acetamiprid	0.06	Difenoconazole	0.03	Hexythiazox	0.05*	Spinetoram	0.01
Azoxystrobin	0.01	Diflubenzuron	0.20	Hydrogen Phosphide	0.01 Po	Spinosad	0.07
Bifenazate	0.20	Emamectin benzoate	0.001*	Imidacloprid	0.01	Spirodiclofen	0.05
Bifenthrin	0.05	Endosulfan	0.02*	Methidathion	0.01*	Spirotetramat	0.50
Boscalid	0.05*	Etoxazole	0.01*	Methoxyfenozide	0.10	Sulfuryl fluoride	3.00 Po
Carbaryl	1.00	Fenbuconazole	0.01*	Methyl Bromide ¹	0.01* Po	Tebuconazole	0.05*
Carbendazim	0.10*	Fenpropathrin	0.15	Methyl Bromide ²	10.00 Po	Thiacloprid	0.02
Chlorantraniliprole	0.02	Fenpyroximate	0.05*	Paraquat	0.05	Trifloxystrobin	0.02*
Clofentezine	0.50	Flubendiamide	0.10	Penthiopyrad	0.05		
Cyantraniliprole	0.04	Flumioxazin	0.02*	Phosmet	0.20		
Cyflumetofen	0.01*	Fluopyram	0.04	Pyraclostrobin	0.02*		

*At or about the limit of determination.

Po: The MRL accommodates post-harvest treatment of the commodity.

¹ To apply to commodity at point of retail sale or when offered for consumption.

² To apply at point of entry into a country and, in case of cereal for milling, if product has been freely exposed to air for a period of at least 24 h after fumigation and before.

CONTAMINANTS

International MLs for Aflatoxins in Ready-to-eat Macadamia Nuts

Country	Aflatoxin B1 (ppb)	Total Aflatoxins (B1-B2-G1-G2) (ppb)	Source
Australia	-	15	Australia New Zealand Food Standards Code – Standard 1.4.1
Brazil	-	10	Resolução N°7, de 18 de fevereiro de 2011. Ministério da Saúde da Brasil
EU	2	4	Commission Regulation (EU) N° 165/2010
India	-	10	Food Safety and Standards Authority of India (FSSAI)
USA	-	20	U.S. Food and Drug Administration Compliance Policy Guides (CPG) Sec. 555.400





QUALITY ASSURANCE

The following programs are endorsed by the industry:

- Good Agricultural Practices (GAPs), which provide growers guidelines and principles to apply for on-farm production and post-production processes, to provide safe and healthy macadamia nuts, minimizing potential hazards such as pathogens, contaminants, and pest management materials.
- Good Manufacturing Practices (GMPs), which define procedures to be used in the processing, packaging, storing, and transport stages by handlers to ensure the quality of the product. GMPs are used by handlers to treat macadamias under the best sanitary conditions.
- Good Storage Practices (GSP), which provide procedures that should be in place in the post-harvest, processing, and transport stages by handlers to control the moisture content and temperature and to minimize the levels of fungi (especially aflatoxins) and insects.
- Hazard Analysis Critical Control Point (HACCP), which provides a systematic preventive approach to food safety that identifies, assesses, and controls the risk of biological, chemical, and physical hazards in production processes.

Sources:

- CODEX Alimentarius. Pesticide Database.
- UNECE STANDARD DDP-22 concerning the marketing and commercial quality control of inshell macadamia nuts, Edition 2010.
- UNECE STANDARD DDP-23 concerning the marketing and commercial quality control of macadamia kernels, Edition 2011.
- Australian Macadamia Society, Industry Standards: <https://www.australian-macadamias.org/trade/industry-standards>.
- Kernel Quality Standard for Processors. Version: AMKQS-V1 Issue date: 20/06/2018.
- Southern African Macadamia Growers' Association: <https://www.samac.org.za/standards/>. SAMAC Kernel Standards. Updated 10 January 2018.



Macadamia

6. Standards and Grades

These standards and grades apply to inshell macadamia nuts and macadamia kernels of varieties (cultivars) grown from *Macadamia integrifolia*, *M. tetraphylla*, *M. ternifolia*, and their hybrids. Both inshell macadamia nuts and macadamia kernels are classified on the basis of their allowed defects.

The following is extracted from the United Nations Economic Commission for Europe (UNECE) Standard DDP-22 and DDP-23 concerning the marketing and commercial quality control of inshell macadamia nuts and macadamia kernels, respectively. These UNECE Standards were created by the Specialized Section on Standardization of Dry and Dried Produce of the United Nations Economic Commission for Europe (UNECE) with the help and recommendations of the International Nut and Dried Fruit Council (INC) and the supervision and approval of the main producing countries.

Companies may set quality standards of their own¹. This kit only reflects the UNECE Standards, as internationally recognized minimum requirements for dry and dried produce. UNECE Standards are voluntary and operators are free to choose which standards they use in their business practice and subject to national regulations.



QUALITY

The shell must be practically intact, clean, sound, free from blemishes, free from mold filaments visible to the naked eye, well-formed and not visibly misshapen. In addition, the kernel must be free from rancidity, sufficiently developed, practically free from blemishes and areas of discoloration or spread stains in pronounced contrast with the rest of the kernel.

The whole produce (shell and kernel) must be sound and free from mold filaments visible to the naked eye, living pests, damage caused by pests, abnormal external moisture and foreign smell and/or taste.

CLASSIFICATION

Classification is made according to the defects allowed, which are listed in the following tables:

INSHELL MACADAMIA NUTS		
Defects allowed	Tolerances allowed*	
	Class I	Class II
(a) Tolerances for the shell not satisfying the minimum requirements of which no more than:	5	7
Macadamia shells with adhering husk/hull	1	2
Damage by pests (scars)	2	3
Living pests	0	0
(b) Total tolerances for the kernel not satisfying the minimum requirements of which no more than:	7	10
Mold	0.5	1
Foreign smell and/or taste	2	3
Shrunken or shrivelled kernel	2	3
Gum or brown spot	2	3
Other types of unsound kernels	2	3
Deterioration, damage by pest	3	5
(c) Size tolerances:		
Inshell macadamia nuts not conforming to the minimum size 15.87 mm (5/8 of an inch) diameter	0	0
Not conforming to the size marked	10	10
(d) Tolerances for other defects		
Loose/foreign extraneous material	1	2

*Percentage of defective inshell macadamia nuts by number or weight.

¹ Organizations such as the Australian Macadamia Society (AMS) and the Southern African Macadamia Growers' Association (SAMAC) have developed industry standards, available on the internet: Kernel Quality Standard for Processors (AMS) <https://www.australian-macadamias.org/trade/industry-standards> Standard for Macadamia Kernel (SAMAC) <http://samac.org.za/standards/>



MACADAMIA KERNELS

Defects allowed	Tolerances allowed*	
	Class I	Class II
(a) Tolerances for macadamia kernels not satisfying the minimum requirements of which no more than:	7	10
Not sufficiently developed, shrunken, and shrivelled	3	5
Moldy	1	1
Rancid or damaged by pests, rotting, or deterioration	1	2
Off-odor or off-flavor by any cause	1	2
Living pests	0	0
(b) Size tolerances:		
For produce not conforming to the size indicated, if sized	7	7
(c) Tolerances for other defects		
Macadamia kernels belonging to varieties or commercial types other than those indicated	10	10
Foreign matter, loose shells, shell fragments, dust (by weight)	0.25	0.25

*Percentage of defective kernels macadamia nuts by number or weight.

■ SIZING

In macadamias, sizing is optional in all classes. However, when sized, inshell macadamia nut size is determined by the diameter of the shortest axis of the shell (measured in mm or inches). In the case of macadamia kernels, size is determined by the maximum diameter of the equatorial section of the whole nut or by the widest diameter of the designated style size requirements.

INSHELL MACADAMIA NUTS		
Size designations	Diameter (mm)	Diameter (inches)
Extra large	28 mm and larger	1.1 inches and larger
Large	23 - 28 mm	0.9 - 1.1 inches
Medium	18 - 23 mm	0.7 - 0.9 inches
Small	16 - 18 mm	0.6 - 0.7 inches
Undersize	Less than 16 mm	Less than 0.6 inches

MACADAMIA KERNELS		
Style	Description	Size
0	Wholes: shall consist of at least 95% whole kernels with the remaining percentage consisting of pieces	of which no more than 1% will pass through a 6.25 mm (¼ inch) square opening.
I	Wholes: shall consist of at least 90% whole kernels, with the remaining percentage consisting of pieces	of which no more than 1% will pass through a 6.25 mm (¼ inch) square.
II	Wholes and halves: shall consist of at least 50% whole kernels, with the remaining percentage consisting of pieces	of which no more than 2% will pass through a 7.8 mm (5/16 inch) square opening.
III	Cocktail: shall consist of at least 90% half or larger kernels, included therein at least 15% whole kernels, with the remaining percentage consisting of pieces	of which no more than 2% will pass through a 6.25 mm (¼ inch) opening.
IV	Halves and pieces: shall consist of at least 50% half kernels, with the remaining percentage consisting of pieces with no more than 5% larger than half kernels	Style IV L: kernel size is larger than 16 mm (round caliber). Style IV M: kernel size is between 14-16 mm (round caliber). Style IV S: kernel size is between 10-14 mm (round caliber).
V	Large diced: shall consist of units which are smaller than half kernels	of such size that no more than 5% will pass through a 7.8 mm x 25 mm (5/16 inch x 1 inch) opening, included therein not more than 2% that will pass through a 2.34 mm (3/32 inch) square opening.
VI	Chips: shall consist of units	that at least 95% will pass through a 7.8 mm x 25 mm (5/16 inch x 1 inch) opening but no more than 2% will pass through a 2.34 mm (3/32 inch) square opening.
VII	Bits and diced: shall consist of units	smaller than half kernels and of such size that at least 95% will pass through a 7.8 mm (5/16 inch) square opening but no more than 10% will pass through a 2.34 mm (3/32 inch) square opening.
VIII	Fines: shall consists of broken, chipped or chopped kernels	all units will pass through a 6.25 mm (¼ inch) square opening and most will also pass through a 2.34 mm (3/32 inch) square opening.

If companies follow a standard other than UNECE standard, it is recommended to specify if sizing is determined with a round or square holes sieve

Sources:

- UNECE STANDARD DDP-22 concerning the marketing and commercial quality control of inshell macadamia nuts, Edition 2010.
- UNECE STANDARD DDP-23 concerning the marketing and commercial quality control of macadamia kernels, Edition 2011.