

Nuts and Nutmeats

Revised 2024

Thermal Properties

	Almonds		Filberts	
	English	Metric	English	Metric
Moisture, %	4.42	--	5.42	--
Protein, %	19.95	--	13.04	--
Fat, %	52.21	--	62.64	--
Carbohydrate, %	20.40	--	15.30	--
Fiber, %	10.90	--	6.10	--
Ash, %	3.03	--	3.61	--
Specific Heat Above Freezing	0.53 Btu/(lb*°F)	2.20 kJ/(kg*K)	0.50 Btu/(lb*°F)	2.09 kJ/(kg*K)
Specific Heat Below Freezing	--	--	--	--
Latent Heat of Fusion	6 Btu/lb	15 kJ/kg	8 Btu/lb	18 kJ/kg

	Peanuts, raw		Peanuts, dry roasted with salt	
	English	Metric	English	Metric
Moisture, %	6.50	--	1.55	--
Protein, %	25.80	--	23.68	--
Fat, %	49.24	--	49.66	--
Carbohydrate, %	16.14	--	21.51	--
Fiber, %	8.50	--	8.00	--
Ash, %	2.33	--	3.60	--
Specific Heat Above Freezing	0.53 Btu/(lb*°F)	2.23 kJ/(kg*K)	0.50 Btu/(lb*°F)	2.08 kJ/(kg*K)
Specific Heat Below Freezing	--	--	--	--
Latent Heat of Fusion	9 Btu/lb	22 kJ/kg	2 Btu/lb	5 kJ/kg

	Pecans		Walnuts, English	
	English	Metric	English	Metric
Moisture, %	4.82	--	3.65	--
Protein, %	7.75	--	14.29	--
Fat, %	67.64	--	61.87	--
Carbohydrate, %	18.24	--	18.34	--

Fiber, %	7.60	--	4.80	--
Ash, %	1.56	--	1.86	--
Specific Heat Above Freezing	0.52 Btu/(lb*°F)	2.17 kJ/(kg*K)	0.50 Btu/(lb*°F)	2.09 kJ/(kg*K)
Specific Heat Below Freezing	--	--	--	--
Latent Heat of Fusion	7 Btu/lb	16 kJ/kg	5 Btu/lb	12 kJ/kg

Storage Conditions

Nuts and nutmeats should be stored in the following conditions:

1. Clean, dry room
2. Air free of odors
3. Low relative humidity
4. Provision for air circulation
5. No ammonia gas leakage
6. Separate from odoriferous commodities
7. Tempering facilities, from freezer storage
8. Rodent and insect protection
9. Elimination of moldy nuts

It should be noted that unshelled nuts will store for about twice as long as shelled nuts, but most nuts are shelled to reduce the weight and space by about one half. Shelled nuts absorb moisture and flavors readily, stale easier, and consequently require good packaging and more careful handling.

	Temperature		Relative Humidity (RH %)	Expected Storage Life
	°F	°C		
Almonds				
In shell	32 to 45	0 to 7	60 to 75	1 year or more
Shelled	32	0	60 to 75	1 year
Vacuum or gas pack	32 to 50	0 to 10	*	1 year or more
Frozen	0	-18	**	1 year or more
Brazil Nuts				
In shell	32 to 40	0 to 4	65 to 70	1 year
Shelled	32	0	65 to 70	6 months or more
Vacuum or gas pack	32 to 40	0 to 4	*	1 year
Frozen	0	-18	**	1 year or more
Cashew Nuts				
Shelled	32 to 40	0 to 4	65 to 70	1 year
Vacuum or gas pack	32 to 40	0 to 4	*	1 year or more
Frozen	0	-18	**	1 year or more

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Chestnuts				
In shell	32 to 45	0 to 7	65 to 70	1 year
Shelled	32 to 34	0 to 1	65 to 70	1 year
Frozen	0	-18	**	1 year or more
Filberts (Hazelnuts)				
In shell	25 to 45	-4 to 7	60 to 70	1 year or more
Shelled	32	0	60 to 70	1 year
Vacuum or gas pack	32 to 40	0 to 4	*	1 year
Frozen	0	-18	**	1 year or more
Macadamia Nuts				
In shell	32 to 50	0 to 10	65 to 70	1 year or more
Shelled	32	0	65 to 70	1 year
Vacuum or gas pack	32 to 40	0 to 4	*	1 year
Frozen	0	-18	**	1 year or more
Blanched, salted	32 to 50	0 to 10	*	3 months
	0	-18	*	6 months
Pecans				
In shell	32 to 50	0 to 10	65 to 75	1 year
Shelled	32	0	65 to 70	1 year
Vacuum or gas pack	32 to 50	0 to 10	*	1 year or more
Frozen	0	-18	**	2 years or more
Peanuts				
In shell	32 to 50	0 to 10	65 to 75	1 year
Shelled	32	0	65 to 70	1 year
Vacuum or gas pack	32 to 50	0 to 10	*	1 year or more
Frozen	0	-18	**	3 years
Pistachio Nuts				
In shell	32 to 50	0 to 10	65 to 70	1 year
Shelled	32	0	65 to 70	1 year
Vacuum or gas pack	32 to 40	0 to 4	*	1 year or more
Frozen	0	-18	**	3 years
Blanched, salted	32 to 50	0 to 10	*	3 months
	0	-18	*	6 months
Walnuts				
In shell	32 to 40	0 to 4	70 to 75	1 year
Shelled	32	0	70 to 75	1 year or more
Vacuum or gas pack	32 to 40	0 to 4	*	2 years or more
Frozen	0	-18	**	2 years or more

* Relative humidity does not affect storage stability of nutmeats vacuum- or gas-packed but should be 70% or lower to prevent rusting of metal containers.

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** Relative humidity does not need to be controlled for nutmeats in freezer storage. The RH resulting from standard operating procedure is satisfactory.

*** Separate rooms are not necessary if nutmeats are packed in tin, glass, or moisture-proof containers or if pallets are stretch wrapped.

Like all other foods, nutmeats lose quality in storage. The lower the storage temperature, the longer their good quality is retained. Following is the relative good-quality storage life at various temperatures for pecans and peanuts. The time-temperature relationships are also approximate for other nutmeats.

Relative Storage Life, at Various Temperatures, of Nutmeats in the Shell			
Temperature		Pecans	Peanuts
°F	°C	Months	Months
70	21	4	6
50	10	9	9
32	0	18	24
0	-18	24	48

All nuts are artificially or sun and air dried after harvesting. At the time of harvesting, most nuts have 20 to 50% moisture by weight. With this moisture content, molds will grow on the surface of the shells and inside on the nutmeats. By circulating warm air over and through the nuts, or by drying them in the sun, the moisture content is usually reduced to less than 10% by weight. In some cases, it is desirable to reduce the moisture content below 5% for safe storage. The shell is porous; with this low moisture content, molds will not grow.

Nuts having moisture content above 10% should be stored at relative humidity of 60% or less, particularly if storage temperature is about 40°F (4.4°C). If stored at 0°F (-18°C), moisture content is well below 10% and relative humidity (RH) may be permitted to rise to 75 to 80% or the actual freezer RH.

Refrigeration further retains the good quality of nuts and nutmeats by:

1. Inhibiting color changes
2. Retarding the development of rancidity
3. Delaying staleness
4. Preventing insect growth
5. Preventing growth of most molds

Handling

Inspection of nuts and nutmeats when received at a warehouse is a must. Very few food items can have as many things happen to them that may subsequently be the basis for a damage claim as nuts and nutmeats. Molding and ammonia damage are the most common.

These damages can happen prior to receipt at the warehouse, and the claim can be made against the warehouseman unless damage is identified and recorded at the time of receipt. In most cases it is impossible after storage in a warehouse to determine whether the damage occurred prior to or after refrigeration.

When inspecting nuts and nutmeats at the time of receipt at a warehouse, be sure to look for the following:

Moist or damp bags	This indicates that the nuts have been wet, either by condensation or other means. Mold can develop on and in the nuts unless dried by warm, circulating air before stacking in the warehouse.
Oil-soaked cartons	This indicates that the package has an inadequate oil-proof barrier between the shelled nutmeats and the outer container. Oil-soaked cartons turn rancid very rapidly and transmit the odor to the nutmeats. Repackaging is advised if the rancid odor has not developed. Once the nuts become rancid, the process cannot be reversed.
Evidence of insect infestation	A dozen or more different types of insects can infest nuts and nutmeats. Serious infestation is evidenced by cobwebs and the nuts or nutmeats sticking together. Fumigation and discarding of the damaged pieces are necessary in this case. Probably no shipment of nuts or nutmeats is entirely free of insects, but temperature of below 45°F (7°C) ceases insect activity, thus preventing further damage, and at 0°F (-18°C) and below most insects and larvae die in 72 hours.
Signs of ammonia damage	The seed coats (skin) of nutmeats blacken when exposed to ammonia, while the shells and embryos are not discolored. The seed coats of shelled nuts are about 10 times as sensitive to blackening as those of unshelled nuts. Pecan meats and walnuts are more sensitive than other nuts. Concentrations of ammonia not detected by odor can darken nutmeats over a period of months, even at refrigerated temperatures. Ammonia damaged nuts are unsalable for most uses, though the flavor is unaffected. Packaging nuts and nutmeats in glass, tin, or high gas barrier films protects them from ammonia. Blackening due to ammonia is irreversible and not to be confused with browning due to high moisture and high temperature. Warehouse refrigeration systems using non-ammonia refrigerants are highly desirable for handling and storage of nuts.
Presence of undesirable odors	<p>The fat and/or oil of nutmeats, like butter fat, can go rancid and readily absorb foreign odors. Most nutmeats offered for sale or storage contain large quantities of fat, 40% or more by weight. This large quantity of fat will absorb almost any odor. Since the odor of most nutmeats is distinctive and relatively faint, foreign odors picked up from other foods, or by developing rancidity, are readily detectable. Foreign odors in nutmeats are not removed even by using rapid air circulation around the individual pieces or by using charcoal as an odor absorbing material.</p> <p>If the dock atmosphere is high in humidity or it is raining, nuts and nutmeats should be moved rapidly into the storage room to prevent their picking up excess moisture. If the atmosphere is dry, exposure to elevated temperatures of several hours' duration is not harmful.</p>

Condition of Storage Rooms

Storage rooms for the holding of nuts and nutmeats should have special care, not only to protect the quality of the commodity, but to show the prospective customer that the warehouseman recognizes the perishable nature of nuts and nutmeats and is prepared to protect them. The special care should include:

Clean, dry space	The room should have dry floors and not have free water available to wet the nuts, nutmeats, or the containers. This can result in mold growth. Also, it should be free of dirt and dust that can be picked up or blown onto the nuts.
Air free of odors	Nuts and nutmeats, except those in hermetically sealed metal, glass, or special film containers, will pick up almost any foreign odor because of their high fat content, and in most cases, it cannot be removed. Slip-type cover, metal containers are not air-tight and therefore do not prevent odor transfer to their contents.
Relative humidity controlled	<p>The low moisture content of nuts and nutmeats makes it easy for them to absorb moisture from the air and thus mold, unless the relative humidity of the storage room is kept low. Optimum relative humidity for the storage of each type of nut and nutmeat are shown above.</p> <p>For long-time storage, the moisture content of common nuts in refrigerated storage should be $\pm 2\%$ of the following percentages: Almonds 8%; Brazil nuts 7%; Cashew nuts 8%; Coconut 20%; Filberts 18%; Macadamia nuts 15%; Pecans 6%; Peanuts 7%; Pistachio nuts 15%; Walnuts 7%.</p> <p>Since many nuts upon entering refrigerated storage are higher in moisture than indicated above, they will lose moisture and weight under "good refrigerated storage practice." If the moisture content on entering refrigeration is below the above figures, the nuts will gain moisture and weight. This possible change in weight should be understood by the warehouseman and the owner of the nuts as the nuts are entering storage.</p>
Provision for air circulation	This is to prevent "pockets" of high relative humidity forming in corners of the room, with attendant condensation on the commodity.
No contact with ammonia gas	It is recommended that nuts and nutmeats be stored in refrigerated rooms with a refrigerant other than ammonia (such as brine or Freon). However, this is not always possible and, therefore, they sometimes have to be in a plant that uses ammonia in its refrigeration system. Because of the rapid and extreme blackening that occurs on contact with even small concentrations of ammonia gas, extra care and control of the ammonia system and avoidance of ammonia leaks is necessary. Ammonia damaged nuts and nutmeats cannot be salvaged.
Rodent and insect protection	Rodents and insects may infest nuts and nutmeats. Evidence of their presence in the room with nuts and nutmeats is sufficient cause for condemnation of the product by health authorities. Rooms should be rodent proofed, and this will normally be sufficient to prevent insects from entering. Insects present from previous contamination will cause no further damage if the room is at 45°F (7°C) or below, and most insects die at 0°F (-18°C) or below.

Separation from other commodities	Nuts and nutmeats, except those in hermetically sealed cans, glass, or special films, should not be held in the same room with other foods. This is because of their high fat content which will readily absorb any odor given off by the other foods, and most foods do have an odor, however faint. Nuts also have a lower moisture content than most foods and can pick up moisture from the other foods.
Tempering facilities	Tempering facilities, to prevent condensation when the product is removed to outside atmospheres, are normally not necessary for nuts and nutmeats held at temperatures of 32°F (0°C) or above. However, if the climate is very humid or if it is raining, warming up of the product to 45°F (7°C) before removal from the storage room is advisable. Excess condensation can result in mold growth. Nuts and nutmeats held at 0°F (-18°C) or below should be allowed to warm up to 45°F (7°C) in a 24- to 36-hour period before being exposed to outside temperatures. Also, nutmeats at 0°F (-18°C) are very fragile and will break or chip easily if handled roughly.

Freezing

Lowering the freezing temperatures for storage further enhances the shelf life of nuts, but the energy cost associated with temperature reduction increases significantly. Thus, it is not the normal practice to freeze nuts and nutmeats to preserve their quality, because cooler temperatures are sufficient for the ordinary marketing channels. However, freezing is not injurious to their color, flavor, or texture for their use in the fresh market, for confections, butters, etc. In the case of pecan nutmeats, it has been found that when they are hermetically sealed in cans and stored at -4°F (-20°C), pecan quality is preserved for up to 25 years.

Research evidence indicates that rapid freezing of nuts and nutmeats is not necessary and preventing fluctuations of temperatures during storage is not as critical in maintaining quality as is the case with other frozen foods.

Moisture-proof packaging, too, is not a necessity with this low moisture product, as is the case with other frozen foods where dehydration, commonly called freezer burn, is a problem; however, it protects against condensation upon removal.

When the freezing of nuts and nutmeats is indicated, there is no special preparation or handling necessary. Nutmeats should be in rigid containers to prevent scuffing and breaking. They are merely placed in the freezer room. However, on removal from the freezer room, if the container is not a moisture-proof barrier, care should be taken by tempering to raise the temperature to at least 45°F (7°C) before exposing to outside warm and humid atmospheres.

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