## **Estimates of Shelf-life of Raw Nuts Held at Different Temperatures**

Important factors for nut quality include drying to low moisture content and packaging in moisture proof bags. Since nuts in shells are often handled loose, temperature will be important to maintain quality and shelf-life as summarized in Table 1.

The estimates in **Table 1** take into account information on quality and food safety changes at different temperatures. The main quality concerns are rancidity (oxidation of lipids leading to off-flavors), darkening (related to initial drying temperature and subsequent storage conditions), mold growth (moisture and temperature dependent), brittleness (moisture content too low), insect infestation, and stale flavor (held too long under the given storage conditions). The main food safety concerns for nuts are aflatoxins produced by fungi and human pathogenic bacteria (*Salmonella* sp., *Listeria monocytogenes*); both food safety aspects are affected by the moisture content and temperature of the nut. Some nuts, especially peanuts, may cause allergic reactions in some people.

The moisture content of common nuts in refrigerated storage should be near the following percentages: almonds 6%, Brazil nuts 7%, cashew nuts 8%, coconut 20%, hazelnuts 15%, macadamia nuts 15%, pecans 5%, peanuts 7%, pistachio nuts 7% and walnuts 5%. The optimum relative humidity of storage varies from 55-70% depending on the moisture content of the nuts. Packaging in moisture-proof containers is recommended to maintain quality. The higher the temperature, the more critical is relative humidity and moisture content. Coconuts and chestnuts have high moisture contents and should be considered more as 'fresh fruits'.

Nuts in the shell have 25-50% longer shelf-life than the nutmeats alone; this percentage can vary considerably depending on the particular nut and whether the packaging provides a moisture barrier and/or a low oxygen concentration. Pieces of nutmeats have about half the shelf-life of the intact nutmeats. Some roasted nuts have a shelf-life about one fourth that of the raw nutmeats.

In general the optimal storage temperature is 0-10C with relative humidity at 55-70%, depending upon the original moisture content of the nut.

## **Key Sources of Information**

Bruhn, C., L.J. Harris, M. Giovanni, and D. Metz. 2010. Nuts: Safe Methods for Consumers to Handle, Store and Enjoy Almonds, Chestnuts, Pecans, Pistachios, and Walnuts. UC ANR Publication 8406. http://ucfoodsafety.ucdavis.edu/files/44384.pdf.

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**Table 1.** Estimate of months of shelf-life of raw nuts (in shell or intact nutmeats) at different temperatures. Estimates are derived from the general published reference list and the specific references cited in the table. If the nutmeats are packaged, it is assumed that relative humidity is controlled but oxygen concentrations are not substantially different from air. It is also assumed the nuts were dried adequately before storage.

		Estimate of Shelf-life in months					
Nut	type	-10°C	0°C	10°C	20°C	30°C	References
		(-14°F)	(32°F)	(50°F)	(68°F)	(86°F)	
Almond	nutmeat		10	8	4		Labavitch, 2004;
							Cornacchia et al., 2012
	In shell		20	16	6		Labavitch, 2004
5 '1 '							Cornacchia et al., 2012
Brasil nut	nutmeat		6				WFLO, 2008
	In shell		12				WFLO, 2008
Cashew	nutmeat		12		6		Soares et al., 2012; WFLO, 2008
Chestnut	In shell	Do not freeze	3	0.5	0.25		Kader, 2003; Panagou et al., 2006
Coconut	In shell, no husk		2	0.5			TIS, undated; Siriphanich et al., 2011
	In green husk		2	1	0.5	0.25	Maciel et al., 1992; Siriphanich et al., 2011
Hazelnut	nutmeat		24	12			Maness, 2004
	In shell		24	12			WFLO, 2008
Macadamia	nutmeat	24	12	12	5	0.75	Cavaletto, 2004; Wall, 2013
Peanut	nutmeat	24	12	9	4		WFLO, 2008; Maness, 2004; Calhoun, 2013
	In shell		12	9	6		Maness, 2004; Ortloff ,2009
Pecan	nutmeat	18	10		3		Maness, 2004
	In shell	24	18	9	4		WFLO, 2008; Maness, 2004
Pine Nut	nutmeat						
Pistachio	Nutmeat		10	3	1	0.25	Arena et al., 2013; Kader & Thompson, 2002
	In shell, split		12				Maskan et al., 1999
Walnut	Nutmeat		12		3		Mexis et al., 2009; Kader and Thompson, 2002
	In shell		12		4		McNeil, 2013
Average*		22.5	13.5	10	4	0.5	

<sup>\*</sup>The average excludes high moisture chestnuts and coconuts

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