

Drying, Storing and Handling Dry Edible Bean

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Research has shown pinto beans should be stored at temperatures of 40 F or cooler to maintain color and cooking quality. The Hunter-L values, a measure of the lightness, for beans stored at specific temperatures and moisture contents are shown in Table 27. Lower numbers indicate a darker color.

After 10 months of storage, pinto bean cooking times of 16 and 18 percent moisture beans stored at 20 F were 1.2 times longer than before storage and at 40 F were 1.7 times longer, as shown in Table 28. Pin cooking time is the elapsed time from initiation of cooking until the piercing tip of the rod placed in contact with the surface of each bean has penetrated the seeds in the cooker.

If beans cannot be kept cool, the moisture content must be low enough to permit storage without deterioration at typical summer temperatures. The recommended moisture content for edible beans to minimize the growth of mold is about 13 percent at 70 F. Pinto beans darken rapidly when exposed to light, so they should be stored in a dark environment.

Table 27. Hunter-L values (whiteness) for specified storage conditions of temperature and moisture content.

Date	Time Weeks	20 F			40 F			60 F			80 F		
		14%	16%	18%	14%	16%	18%	14%	16%	18%	14%	16%	18%
10/11/00	0	52.5	52.4	51.6	52.5	52.4	51.6	52.5	52.4	51.6	52.5	52.4	51.6
7/31/01	41	50.9	51.6	51.1	51.2	51.0	50.4	48.6	47.5	46.7	43.6	42.1	40.8
Change		-1.6	-0.8	-0.5	-1.3	-1.4	-1.5	-3.9	-4.9	-4.9	-8.9	-10.3	-10.8

Table 28. Median pin cooking times for beans stored for 10 months at specified moisture contents and temperatures. Median cooking time before storage was 18.4 minutes. Shorter cooking times are preferred.

Storage Temperature	Bean Moisture Content			Pin Cooking Time (minutes)		
	14 percent	16 percent	18 percent	14 percent	16 percent	18 percent
20 F	29.6	22.6	22.8			
40 F	36.0	29.7	30.6			
60 F	36.0	32.7	38.0			
80 F	66.2	93.0	168.5			

Following good storage management practices, such as measuring the temperature and moisture content of the beans at least monthly, is important. Whenever more than a 10-degree differential occurs between the average outdoor temperature and the bean temperature during the fall, the beans should be cooled with aeration. This should continue until the beans are cooled at least to 40 F for short-term storage and about 25 F for long-term storage.

To minimize the potential for mechanical damage, beans should be handled at moisture contents of about 16 percent or greater and at warm temperatures. Research shows that the potential for mechanical damage of pinto and navy beans increases at bean moisture contents of about 15 percent or lower (see Table 29). Research also shows that the potential for mechanical damage of pinto and navy beans increases at lower bean temperatures (see Table 30).

Belt conveyors are preferred due to their gentleness in conveying. A bean ladder should be used inside storage bins to reduce impact damage. The speed of auger rotation should be reduced and augers operated "full" to minimize damage. Elevator legs need to be adapted for handling beans, including reducing the discharge velocity and utilizing a method of gently slowing the beans at the bottom of sprouts.

Natural air drying will work well for edible beans during mid-September to mid-October in North Dakota.

Table 29. Mechanical damage: cracks in the seed coat of pinto and navy beans at selected moisture contents at a temperature of 75 F.

Moisture Content	Pinto Beans Damage	Navy Beans Damage
(%)	(%)	(%)
18	4	4
17	5	4
16	6	5
15	9	15
14	16	22
13	20	37
12	26	49

Table 30. Mechanical damage: cracks in the seed coat of pinto and navy beans at 16 percent moisture content and selected temperatures between 10 and 75 F.

Temperature	Pinto Beans Damage	Navy Beans Damage
(F)	(%)	(%)
75	6	5
60	11	13
45	16	15
30	21	18
20	29	26
10	41	32

Based on average climatic conditions, the beans are expected to dry to about 12 to 14 percent moisture if the fans are operated continuously. Shutting fans off during the warmest and driest part of the day will permit drying the beans to about 15 to 16 percent but will lengthen the drying time. Fans should run during the night with higher humidity to permit drying the beans nearer to the desired final bean moisture content.

Adding supplemental heat reduces the final moisture content of the beans and likely will result in beans dried to a moisture content lower than desired. Shut fans off during foggy or rainy weather, but do not leave the fan off for more than a couple of days to minimize the potential for bean spoilage. Recommended minimum airflow rates for various moisture contents and the corresponding estimated drying times are shown in Table 31.

The static pressure associated with moving air through pinto and navy beans is equivalent to that of soybeans. Design the drying system using the data for soybeans.

Table 31. Minimum recommended airflow rates and estimated drying times for dry edible beans using a natural air drying system from mid-September to mid-October in North Dakota.

Moisture Content	Airflow Rate	Airflow Rate	Estimated Drying Fan Time
	cfm/bu	cfm/cwt	
22%	2.5	4.2	23
21%	1.6	2.7	30
	2.0	3.3	24
20%	1.5	2.5	28
	2.0	3.3	22
19%	1.5	2.5	28
	2.0	3.3	22

Edible beans require special care when drying with a high-temperature column dryer. The relative humidity of the drying air should not be lower than about 30 percent. Normally, the drying should occur with the air heated less than about 20 F above the outdoor air temperature to keep the relative humidity above 30 percent.

The beans need to be monitored continuously to assure they are not being damaged. The drying process needs to be slow to minimize damage to the beans and will be slow in comparison with drying cereal grain.