COMMON STORAGE FOODS

Herein is covered a range of foods suited for incorporation into home storage programs.

As you review them there are several considerations you should keep in mind when deciding on what foods you want to include.

The first is *variety in the diet*. This is of great importance but many do not give it adequate thought. Some simply buy however much wheat, corn, rice, or beans they think is necessary to meet their needs and leave it at that. Others rely on pre-packaged decisions made for them by their storage food retailer who put together a "year's supply of food" to buy all at once. Either decision could possibly be a mistake.

There are many food storage plans one may use as a guide. Some are based on the so-called "Mormon Four" of wheat, milk, honey and salt, with as many additional foods as the planner found desirable. This plan was developed in the 1930's and we've learned a great deal about workable food storage in the decades hence. Among which are the food allergies that an unfortunate number of people in our society develop.

One of the more common food allergens is wheat. Even more unfortunate is the fact that many who have such an allergy are unaware of it. They won't become aware until they try to live with whole grain wheat as a large part of their diet and their latent allergy reveals itself. Another thing we have learned is that many adults suffer from an intolerance to the milk sugar lactose, especially those of certain ethnic backgrounds. For these reasons and more you should always make it a practice to ***store what you eat*** AND TO ***eat what you store***, so that ugly surprises such as these do not arise after it's too late to easily avoid them.

A second reason to think about storing a wide variety of foods is *appetite fatigue*. There are those who think providing variety in the diet is relatively unimportant and that if and when the time comes they'll eat what they've got and that will be that. For healthy, well-adjusted adults under ordinary circumstances or for those who have the vital *survival mindset* this might be possible without too much difficulty. However, the reason for having a home food storage program in the first place is for when circumstances aren't ordinary.

Times of crisis produce stress - possibly physical, but always mental. If you are suddenly forced to eat a diet both alien and monotonous, it is going to add that much more stress on top of what you are already dealing with. If your planning includes the elderly, young children, and/or infants there is a significant risk they will quit eating or refuse to eat sufficient amounts of the right foods leaving them

unable to survive. *This is not a trivial problem and should be given serious consideration.* When it's wheat, day in and day out, wheat's going to start becoming unpopular fast. Far better to have a variety of foods on hand to forestall appetite fatigue and, more importantly, to *use those storable foods in your everyday diet so that you'll be accustomed to eating them.* In his book, Making the Best of Basics, James Stevens mentions a post-WWII study by Dr. Norman Wright, of the British Food Ministry, which found the people of England and Europe were more likely to reject unfamiliar or distasteful foods during times of stress than under normal conditions. *Consider the positive aspects of adding variety and comfort foods to your storage program.*

A last thought that I want to give for ALL foods you might put into your program. Unless you are already familiar with and eating a particular type ***and*** brand of food do not put large quantities of it into your pantry until you – preferably everyone who will be depending on that food – have ***eaten*** some of it first. It's not always as easy to pick up a new food as it may first appear. Differences between brands of foods alone can sometimes be enough to disappoint you when consumed. You'd hate to discover that you cannot abide a particular food item after you've brought home a case of Brand X. Seriously relying on any food that you are not already familiar with is making a fools bet.

A. GRAINS AND LEGUMES

A.1 GRAINS & GRAIN PRODUCTS

ABOUT GLUTEN: As you read through the grain descriptions below you will come across frequent mention of "gluten". Gluten is a combination of proteins found in some grains which enables the dough made from them to rise by trapping the gasses produced by yeast fermentation or chemical reaction of baking powder or soda. The amount of these proteins varies depending on the species of grain and varieties within a species. Some grains such as rice have virtually no gluten at all and will not produce a raised loaf by itself while others like hard winter wheat have a great deal and make excellent raised bread. As a general rule yeast raised breads need a fair amount of gluten to attain good dough volumes while non-yeast raised breads may need little or none at all. Whether gluten content is of importance to you will depend upon the end uses you intend for your grain.

Some of the common and relatively uncommon types of grains are listed below.

AMARANTH: Amaranth is not a true cereal grain at all, but is a relative of the pigweeds and the ornamental flowers we call "cockscomb". It's grown not only

for its seed, but for its leaves that can be cooked and eaten as greens. The seed is high in protein, particularly the amino acid lysine which is limited in the true cereal grains. It can be milled as-is, or toasted to provide more flavor. The flour lacks gluten, so is not suited for raised breads by itself, but can be made into any of a number of flat breads. Some varieties can be popped like popcorn, boiled and eaten as a cereal, used in soups, granolas, and the like. Toasted or untoasted, it blends well with other grain flours.

NOTE: Like some other edible seeds, *raw* amaranth contains biological factors that can inhibit proper absorption of some nutrients. For this reason amaranth seeds or flour should always be cooked before consumption, whether for human food or animal feed.

BARLEY: Barley is thought by some to be the first grain intentionally cultivated by man. It has short, stubby kernels with a hull that is difficult to remove. Excluding barley intended for malting or animal feed, this grain is generally consumed directly by humans in two forms. Most common is the white, highly processed *pearl barley* with much of its bran and germ milled off along with its hull. It is the least nutritious form of barley. The second offering is called *pot* or *hulled* barley and it has been subjected to the same milling process as pearled, but with fewer trips through the polisher. Because of this, it retains more of the nutritious germ and bran, but does not keep as well as the more refined product without special packaging. Unless you are prepared to try to get the hulls off I don't recommend buying unhulled barley. Although it can be milled into flour, barley's low gluten content will not make a good loaf of raised bread. It can be combined with other flours that do have sufficient gluten to make leavened bread or used in flat breads. Barley flour and flakes have a light nutty flavor that is enhanced by toasting. Whole barley is commonly used to add thickness to soups and stews.

Recently, a hull-less form has become available on the market through a few suppliers. This is whole grain barley with all of its bran and germ intact and should have the most nutrients of any form of this grain available. I don’t know yet how suitable it is for long term storage.

BUCKWHEAT: Buckwheat is another of those seeds commonly considered to be a grain, but which is not a true cereal. It is, in fact, a close relative to the docks and sorrels. The "grain" itself is a dark, three cornered seed resembling a tiny beechnut. It has a hard, fibrous hull requiring a special buckwheat huller to remove. Here in the U.S., buckwheat is most often used in pancakes, biscuits and muffins. In Eastern Europe and Russia it is known in its toasted form as *kasha*. In the Far East, it's often made into *soba* or noodles. It's also a good bee plant,

producing a dark, strongly flavored honey. The flour is light or dark depending on how much of the hull has been removed before grinding. Dark flour is much more strongly flavored than lighter flour, but because of the high fiber and tannin content of its hull, which can interfere with nutrient absorption, it is not necessarily more nutritious. Buckwheat is one of those foods with no middle ground in peoples opinions -- they either love it or they hate it. Like amaranth, it's high in lysine, an amino acid commonly lacking in the true cereal grains.

CORN (maize): Corn is the largest grain crop in the U.S., but is mostly consumed indirectly as animal feed or even industrial feedstock rather than directly as food. As one of the *Three Sisters* (maize, squash and beans) corn was the staple grain of nearly all of the indigenous peoples of the American continents before the advent of European colonization. This American grain has an amazing variety of forms. Major classes are the flint, dent, flour, and popcorns. To a certain extent, they're all interchangeable for milling into meal (sometimes known as polenta meal) or flour (very finely ground corn, not cornstarch). The varieties intended to be eaten as sweet corn (fresh green corn) are high in sugar content so do not dry or store well relative to the other corns but instead are usually preserved as a vegetable. There are a number of lesser corn varieties with specialized uses that do not lend themselves to direct food use, but these are seldom found in the open market.

As a general rule of thumb, the flint varieties make better meal as they have a grittier texture than most other corns. If meal, hominy and hominy grits (commonly called just "grits") are what you are interested in then use the flint type if you can find a source. If you intend to make corn masa for tortillas and tamales, then the flour corns are what you want, but these are fairly uncommon on the commercial market so the dent corns are next best. Yellow dent seems to be the most commonly available and will work for almost any purpose except popping.

Popcorn is for snacks or used as a cold cereal after popping or can be ground into quite acceptable meal. In my experience I have found it difficult to hull popcorn with alkali treatment for making hominy (posolé, nixtamal) though your mileage may vary. Popcorn is one form of a whole grain available to nearly everyone in the U.S. It is so common a snack food, particularly at movie theaters, fairs, and ball games, that the smallest of towns will often have at least one business selling it cleaned, dried, and ready to pop in twenty-five or fifty pound bags. Popcorn is harder than other varieties of corn so if your mill is not of the heavy duty sort you may want to consider cracking the kernels into coarse pieces first then grinding into finer textured meal. The Family Grain Mill states that it should not be used to mill popcorn at all and the Back To Basics mill should not be used for any great quantity. All other manual and electric mills that I am aware of will mill popcorn without problem.

Once you've decided on your preferred corn type you may also be able to choose your preferred color. There are yellow, white, blue, red, and multicolored varieties. The yellow and whites are the most common by far with the blues, reds, and parti-colored varieties mostly being relegated to curiosities, though the blue and red corns have been gaining in popularity these last few years. These would be worth investigating if you can find a good source. It should be kept in mind that white corn does not have the carotene content (converts into vitamin A) of yellow corn. As vitamin A is one of the major limiting nutrients in long term food storage, any possible source of it should be utilized. For this reason I suggest storing yellow rather than white corn. Additionally, much of the niacin content of corn is chemically bound up in a form not available for human nutrition unless it has been treated with an alkali. This is really of importance only if most of your sustained daily calorie intake will come from corn, but grits, hominy (posolé) or corn masa (for tortillas and tamales) are traditional uses of this grain and can go a long way toward increasing the number of recipes you can make with corn. Give them a try, they're quite good.

Any grain as widely grown as corn is naturally going to be processed into many products. Here are a few suited for use in home storage programs.

Corn Meal (polenta meal): This is simply dry corn ground into a meal. Corn meal intended for polenta may be found in either a coarse or a fine grind. In the U.S. corn meal for making corn bread and most other uses is typically ground to a fairly fine meal. Very finely milled corn is often used for breading foods to be fried and is known as corn flour to distinguish it from coarser meals. This sometimes causes confusion because *corn starch* (see below)is also known as *corn flour* in Great Britain - a very different product and not really interchangeable.

The germ of the corn kernel contains about twice the oil content of wheat and is highly susceptible to rancidity once the kernel is broken in the milling process. Because of this most commercially available corn meal will have had the germ and hull removed to extend shelf-life then nutritionally enriched to make up for some of the vitamins and minerals lost with the grain germ. This is desirable for the miller and the grocer, but for the diner it comes at a cost of flavor and some of the nutrition of the whole grain. Some grocers may offer a whole grain corn meal that keeps the grain germ and bran which gives a superior flavored product and retains the full nutrition of the grain but makes for a more perishable commodity. If you go this route be sure of your product's freshness then store it in your refrigerator or freezer.

The grocer's corn meal is mostly milled from yellow or white corn, but some suppliers are now offering blue or even red corn meals.

The flavor of the degerminated yellow and white meals are largely indistinguishable from each other, but blue and red corns are interestingly different. Might be worth investigating if you can find them.

Storage life of degerminated corn meal is about one year in average conditions in store packaging and a good deal longer if you repackage it for long term storage. Whole grain meal is good for about four weeks on the shelf, months in the refrigerator, and several years in the freezer or if carefully put up in oxygen free packaging. If you have a grain mill I recommend storing your corn meal in the form of whole corn and milling it as needed. This is what we do, milling a few weeks worth of meal at a time then keeping it in the freezer until needed. The fresh whole grain meal has a much fuller corn flavor than the degerminated meal from the grocery store.

Hominy (posole'): This is corn with the hull, and possibly the germ, removed. Hominy cooks faster than unhulled whole corn, is easier to digest, and in some circumstances the alkali peeled varieties can present a superior nutritional profile to whole corn. There are two methods of producing hominy: Mechanical dehulling in a wet milling process or by treating with one of a number of various alkalis such as industrial lye (sodium hydroxide), wood ash lye (mostly potassium hydroxides) or by using some form of lime (calcium hydroxide).

Dry lye peeled hominy is now seldom found for sale, but canned white or yellow hominy is still common across the Southern U.S. and many other areas as well as in Latin American groceries. Generally speaking hominy produced using lime is known by its Spanish name – *posole'* – but this will not always be clear on labels. I have seen can labels of lime peeled hominy simply called hominy. Whether this is important to you depends on the particular flavor you are trying to achieve in the dish you are preparing. Freshly hulled corn using the lime process that is to be ground to make masa (dough) for corn tortillas is called *nixtamal*. Dry posole' can be found in Latin American groceries or ordered from the Internet in nearly any color that corn offers. There's a world of things that can be done with hominy other than simply heating it up and serving with butter and salt. A few minutes spent searching the Internet will produce dozens of recipes using hominy as a major ingredient. It's an excellent ingredient in hearty soups and stews.

Hominy Grits: Usually just called "grits" this coarsely ground meal can be either simple whole corn ground coarse or corn that has been hulled in a process using a form of lye to make hominy then dried and coarsely ground. Grits produced from lye peeled corn typically cook faster, have a longer shelf life, and presents a different, possibly superior, nutritional profile than the whole grain product. Grits produced from whole corn take much longer to cook, have a short shelf life if not refrigerated or put up in special packaging, a superior flavor to the lye peeled product, and retains the nutrition of the whole grain. Very coarsely ground grits is also known as *samp*.

Hominy grits in the U.S. must be enriched like many other refined grain products and are now typically industrially produced. They are usually what you will find at your local grocers. Whole grain grits are primarily the product of grist mills making stone ground products and are often found in living history demonstrations, heritage fairs, pioneer day celebrations, and so on. Both yellow and white corns are commonly milled for grits and which one you should buy probably depends on what you ate growing up. If you're indifferent as to the color of your grits then I suggest buying yellow corn grits as the beta carotene content of yellow corn can be converted by our bodies into Vitamin A whereas white corn has none.

Masa Harina: In Spanish “masa” means “dough” and “harina” means “flour” which is a straight forward description of what masa harina is: A lime peeled corn that has been dried and milled into meal to be made into tortilla dough. It's flavor is distinctively different from either corn meal or hominy grits and is used in making tortillas, tamales, and many other Southwestern, Mexican, Central and South American dishes. Can often be found in mainstream grocery stores and grocers catering to a Latin American trade. Will store on the shelf for about a year and even longer if refrigerated or put up in good storage packaging. If you have a mind to try making your own tortillas you will save yourself much time and effort by using a tortilla press. These can be found in some groceries catering to a Latin American clientele or ordered over the Internet.

Corn Starch: A common starch used as a thickener. Made by a roller milling process removing the hull and germ leaving behind a nearly pure starch. Storage life is indefinite if kept dry. In the United Kingdom and some other areas it is known as *corn flour* which occasionally causes confusion with very finely milled corn

also known as corn flour here in the States. The two products are largely not interchangeable.

MILLET: Millet is an important staple grain in North China and India, but is little known in the U.S, where we mostly use it as bird feed. The grain kernels are very small, round, and usually ivory colored or yellow, though some varieties are darker. A lack of gluten and a rather bland flavor may account for the anonymity of this cereal. Millet has a more alkaline pH (and a higher iron content) than other grains which makes it very easy to digest. A major advantage of millet is that it swells a great deal when cooked and supplies more servings per pound than any other grain. When cooked like rice millet makes an excellent breakfast cereal. It has little gluten of its own, but mixes well with other flours. Adding whole millet kernels to the dough can add a pleasant crunch to your home made breads.

OATS: Though the Scots and the Irish have made a cuisine of oats, it is mostly thought of in the U.S. as a bland breakfast food. Seldom found as a whole grain, it's usually sold processed in one form or another. Much like barley, the oat is a difficult grain to separate from its hull. Besides its longtime role as a breakfast food, oats make an excellent thickener of soups and stews and a filler in meat loafs and casseroles. Probably the second most common use for oats in America is in cookies and granolas. A little creative thought can really increase their culinary range.

Listed below are the forms of oats found in the U.S. Rolled and cut oats retain both their bran and their germ.

Oat groats: These are whole oats with the hulls removed. They are not often found in this form, but can sometimes be had from natural food stores and some storage food dealers. Oats are not the easiest thing to obtain a consistent grind from so producing your own oat flour takes a bit of experience. If you have a roller mill or attachment you can produce your own oatmeal using whole oat groats.

Steel cut oats: Also known as Irish, pinhead or porridge oats. They are oat groats cut into chunks with steel blades. They're not rolled and look like coarse bits of grain. Steel cut oats can be found in many supermarkets and natural food stores. They take longer to cook than rolled oats, but retain more texture. They need oxygen free packaging to be kept at their best for long term storage.

Rolled oats: These are also commonly called old fashioned, thick cut or porridge oats. To produce them, oat groats are steamed and then rolled to flatten. They can generally be found wherever oats are sold. They take slightly longer to cook than do the quick cooking oats, but they retain more flavor, texture and nutrition. This is what most people will call to mind when they think of oatmeal.

Quick cooking rolled oats: These are just steamed oat groats rolled thinner than the old fashioned kind above so that they will cook faster. They can usually be found right next to the thicker rolled oats.

Instant rolled oats: These are the "just add hot water" or microwave type of oat cereals and are not particularly suited for a storage program. They do, however, have uses in "bug out" and 72 hour food kits for short term crises.

Whole oats: This is with the hulls still on. They are sold in feed & seed stores and sometimes straight from the farmer who grew them. Unless you have some means of getting the hulls off, I don't recommend buying oats in this form. If you do buy from a seed supplier, make certain that they have not been treated with any chemicals that are toxic to humans.

QUINOA: Quinoa is yet another of the grains that is not a true cereal. It's botanical name is *Chenopodium quinoa* (pronounced "keen-wah"), and is a relative of the common weed Lambsquarter. The individual kernels are about 1.5-2 mm in size and are shaped rather like small flattened spheres. When quinoa is cooked, the germ of the grain coils into a small "tail" that lends a pleasant crunch when eaten. Some forms of this grain have a bitter tasting water soluble component that should be removed by a thorough washing unless this was already done by the processor as most of the quinoa sold in the U.S. apparently has. There are several varieties of quinoa that have color ranging from near white to a dark brown. The larger white varieties are considered superior and are the most common.

RICE: Rice is the most widely consumed food grain in the world with the U.S. being the leading exporter of this important staple, though we actually only produce about 1% of the global supply. The majority of the world's rice is eaten within five miles of where it was grown.

Much like wheat and corn, rice comes in a number of varieties, each with different characteristics. They are typically divided into classes by the length of their kernel grains; short, medium and long.

> ***Short grain rice:*** The short grain variety is a little softer and bit moister when it cooks and tends to stick together more than the longer rices. It has a sweeter, somewhat stronger flavor than long grain rice.
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> ***Medium grain rice:*** The medium grain variety is not very common in the States. It has flavor like the short variety, but with a texture more like long.
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> ***Long grain rice:*** The long grain variety cooks up into a drier, flakier dish than the shorter types and the flavor tends to be blander. It is the most commonly found size of rice on American grocery shelves.

Each of the above may be processed into brown, white, parboiled or converted, and instant rice. Below is a short discussion of the differences between the various types.

Brown rice: This is whole grain rice with only the hull removed. It retains all of the nutrition and has a pleasant nutty flavor. From a nutritional standpoint it is by far the best, but it has one flaw: The essential oil in the germ is very susceptible to oxidation and soon goes rancid. As a result, brown rice has a shelf life of only about six months unless given special packaging or storage. Freezing or refrigeration will greatly extend this. It's possible to purchase brown rice from long term food suppliers already specially packaged in air tight containers with an inert nitrogen atmosphere or you can do it yourself. In this kind of packaging, (if properly done), the storage life can be extended for several years.

Converted rice: Converted rice starts as whole rice still in the hull which undergoes a process of soaking and steaming until it is partially cooked. It is then dried, hulled and polished to remove the bran and germ. The steaming process drives some of the vitamins and minerals from the outer layers into the white inner layers. This makes it more nutritious than polished white rice, but also makes it more expensive. Its storage life is the same as regular white rice.

White rice: This is raw rice that has had its outer layers milled off, taking with it about 10% of its protein, 85% of its fat and 70% of its mineral content. Because so much of the nutrition is lost, white rice sold in the U.S. has to be "enriched" with vitamins to partially replace what was removed. It stores very well and is generally the cheapest form of rice to be found in the market place making it a very common storage food.

Instant rice: The type of rice is fully cooked and then dehydrated needing nothing more than the addition of water to reconstitute it. In a pinch, it's not even necessary to use hot water. It's not particularly suitable for inclusion in storage programs, but may have a place in "seventy-two hour" and other short-term emergency kits. The white variety is by far the most common, but in the last few years instant brown rice has made an appearance on the market.

RYE: Rye is well known as a bread grain in the U.S. It has dark brown kernels longer and thinner than wheat, but less gluten. Rye flours can be found in varying stages of refinement from dark whole grain flour to semi-refined medium to pale fully refined offerings. Bread made from this grain tends to be dense unless gluten is added (often in the form of a lot of wheat flour). German pumpernickels and Russian black breads, made with unrefined rye flour and molasses, are two of the darkest, densest forms of rye bread. Many sourdoughs are built upon a rye base with a resulting interesting, intense flavor.

SORGHUM: Sorghum is probably more widely known here in the States for the syrup made from the sweet juice squeezed from the stalks of some varieties of this grain. Also known as "milo", it is one of the principle cereal grains of Africa. Its seeds are somewhat round, a little smaller than peppercorns, of an overall brown color with a bit of red and yellow mixed in. The varieties called "yellow endosperm sorghum" are considered to have a better taste. It is a major feed grain in the Southwestern U.S. and is where the vast majority of the national production goes. Like most of the other grains, sorghum is low in gluten, but the seeds can be milled into flour and mixed with higher gluten flours or made into flat breads, pancakes or cookies. In the Far East, it is cooked and eaten like rice, while in Africa it is ground into meal for porridge. It's also fermented for alcoholic beverages.

TEFF: Easily the smallest of the grains, teff kernels are only about 1/32nd inch in diameter. The name itself means "lost" because if dropped on the ground, it's too small to recover. It's been very little known until recently, but has been a staple grain in Ethiopia for nearly five millennia. Small amounts are now being grown in South Africa and the United States. This grain ranges in color from reddish brown to near white. It has a protein content in the 10-12% range, good calcium and a useful source of iron. It is traditionally used in making the Ethiopian flat bread "injera", but has no gluten content of its own. It'll combine well with wheat flour though and has something of a sweetish flavor.

TRITICALE: Triticale is not a creation sprung from the smooth brows of *Star Trek* script writers. It is, in fact, a cross between durum wheat and rye. This youngest of grains combines the productivity of wheat with the ruggedness of rye and has a high nutrition value. The kernels are gray-brown, oval shaped larger-than-wheat and plumper than rye. It can be used in much the same way as either of its two parents. It will make a raised bread like wheat does, but its gluten is a bit weak so wheat flour is frequently added to strengthen it. Because of the delicate nature of its gluten, excessive kneading must be avoided.

WHEAT: The most widely consumed grain in the United States and along with rice and corn one of the three most widely grown in the world. Wheat is also one of the most intensively processed to turn into food of all the grains. It comes in a number of different varieties each more suitable for some purposes than others based on its particular characteristics. The most common classifications of these varieties are based on their respective growing season, hardness of kernel, and color of their bran layers - spring or winter, hard or soft, red or white.

The hard wheats have kernels that tend to be small, hard in texture, and with high protein (primarily gluten) contents. As a general rule, hard varieties have more protein than soft varieties. Yeast raised breads that need a lot of gluten are where it's at for the hard wheats.

The soft wheats have kernels tending to be larger, plumper and softer in texture than hard wheats. As their gluten content is lower they are primarily used in biscuits, pastries, quick breads, some pastas, and breakfast cereals where a higher gluten content would contribute an undesirable tougher texture. Soft wheats do not produce as fine a loaf of yeast raised bread as high gluten hard wheat, though it can still be used for yeast breads by combining with higher gluten flours or using methods suitable for its protein level. Many traditional European yeast raised breads are made with lower protein flours.

Durum wheat also has a very hard kernel and a high protein content, but of a somewhat different nature than the other hard wheats. Durum is not primarily used for breads but is instead consumed mostly in the manufacture of pasta where it lends its characteristic yellowish color to the finished product. There are some specialty breads that call for durum/semolina flour so it can be used for bread making even if it’s not best suited to the task.

Winter wheats are planted in the Fall, over winter in the field, grow through the Spring and are harvested early the next Summer. Spring wheats are planted in the early Spring and are harvested the following Fall. Red wheats comprise most of the hard varieties while white wheats comprise most of the soft. Recently, hard white wheats have been developed that are very suitable for yeast raised bread making. Some feel the hard white varieties make a better tasting whole wheat

bread than the hard reds and I am inclined to agree. When milled, whole grain hard white wheat flour looks somewhat like unbleached refined white flour in appearance.

The hard red varieties, either spring or winter, are commonly chosen for storage programs because of their high protein content which should be no less than 12% with 14% or more being excellent. The hard white spring wheats are still relatively new and not yet as widespread but are steadily growing in popularity. They have the same excellent storage characteristics as the hard red wheats and should be selected with the same protein contents as well.

With so many different varieties of wheat it should come as no surprise that there are a number of different types of wheat flour offered to the home baker. Distinguishing between the array of products available through both retail grocery stores and commercial supply houses catering to bakers nearly requires the knowledge of a professional baker or a cereal chemist and would take up page after page to explain it all. Instead I will briefly cover only those flours or flour products that one can usually find in supermarkets in the U.S. and elsewhere. If you need more advanced knowledge in order to purchase through commercial or institutional food channels I recommend taking your questions to the Usenet newsgroups rec.food.baking, sci.bio.food-science, or alt.bread.recipes where you may be able to get answers from professionals in the field.

> ***All Purpose Flour:*** Of all the flours in the retail market all-purpose flour is the one most subject to major differences between brands, regions of the U.S., and/or other nations. This refined flour is typically made from a blend of hard and soft wheats with a protein content that can range from as low as 8% to as high as 12%. The regional brands of the Southern U.S. have traditionally been on the lower end of the protein scale. This is due to the fact that historically only soft wheats were grown in the South and the resulting flour was best used is in making biscuits and other types of non-yeast raised breads that did not require high gluten levels. The regional brands of the Northern U.S., and Canada are typically at the high end of the protein scale at or approaching 12%. This is because hard wheats are primarily northern grown and are well suited to making yeast raised breads which need higher gluten levels as were customarily made there. The national brands either differ by region or are in the 10-11% range in an effort to try to satisfy all markets.
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> In the U.S. all-purpose flour is enriched and can be had either bleached or unbleached and may possibly have small quantities of malt added as well (see below about enrichment, bleaching and malting).

As the name implies all-purpose is meant to serve as a general all-around flour from which you can make anything from cakes and pie crusts to sandwich bread. So far as it goes you can, but it's a lot like one-size-fits-all clothing in that chances are it won't work as well for a given project as a flour milled with that particular use in mind. The lower protein all-purpose flours sold in the Southern U.S. will produce a more tender biscuit, cake, or pie crust than the higher protein all-purpose flours of the Northern U.S. and Canada, but unless you use some special techniques (like how true French bread is made) it won't produce a very satisfying loaf of yeast bread. The flours in 10-11% range try to strike a happy medium between the two, but still won't serve as well as flour produced specifically with a given end use in mind. If you want to limit the number of types of flour you put into your storage program I'd recommend going with the 10-11% flours and either plan on adding gluten as needed to make the best yeast raised breads or cornstarch to produce more tender cakes and pie crusts.

In the United Kingdom and Canada all-purpose flour is oft times labeled as "plain flour", "top patent", "general purpose", or "family flour."

Bread Flour: A refined white flour with a higher protein (gluten) content than most all-purpose flours to achieve better performance in making yeast raised breads. Protein levels should be at least 12% with 13-14% better still.

As this is a refined flour in the U.S. it will be enriched with added vitamins and iron, and can be found either bleached or unbleached. Because it is intended primarily for use in yeast raised breads this flour will usually have other additives such as small amounts of malt to improve yeast performance and vitamin C (ascorbic acid) to improve dough volume and texture. Some bread flours may also be treated with potassium bromate to improve gluten qualities, but concerns over possible toxicity of this additive is leading to its diminished use.

A high gluten refined bread flour is commonly added to whole wheat doughs to strengthen them which can improve loaf rises and volume. Bread flour is most commonly used in the production of yeast raised breads, pizza crusts, and some specialty baked goods. In Great Britain bread flour is often labeled as "Strong Flour" meaning it has a high protein content.

Whole Wheat Flour: Real whole wheat flour should include 100% of the bran and germ so read your ingredient labels carefully

to be sure this is so. This flour is mostly milled from hard red wheats, but whole grain hard white flour is available from some mills and will produce a bread that looks closer to refined white bread if that is what you are accustomed to eating. Protein contents can vary, but as most whole wheat flour is used in yeast bread making it should be at least 12% with 13-14% being better still. This is good because the bran and the germ can interfere with good gluten development as the dough is mixed and kneaded. Some do not mind this while others strengthen their flour by adding vital wheat gluten or high protein refined bread flours to achieve the rise and volume they are accustomed to in yeast breads. Approximately 90% of the total protein of a kernel of wheat is gluten with the remaining 10% other proteins being mostly found in the grain germ. Refined flours have had the germ removed so a statement of protein content can be taken as an indication of that flour's suitability for making raised yeast breads. With whole wheat flours one must remember that ten percent of non-gluten germ proteins and judge that flour's protein content accordingly. Whole wheat flour milled from lower protein soft wheats may be offered as "whole wheat pastry flour" so be sure of what you are buying. Some whole-wheat flours are also enriched.

Whole wheat flour may also be called "Graham Flour", sometimes simply "Stone Ground Wheat Flour" and in Great Britain, Canada, and Australia may be known as "Whole Meal Flour." In Britain there is also a "Brown Flour" which is midway between whole meal and white flour in that it retains about 85% of the wheat kernel rather than only the 72-75% that is typical of refined white flours.

The real disadvantage to storing whole wheat flour is that like other processed grain products that includes the oil rich germ it wants to go rancid. How fast this can happen depends upon temperature, moisture, etc, but four to six weeks is generally enough time for rancidity to become noticeable. One can, of course, package the flour in good containers with oxygen absorbers and the like, but better still would be to buy the flour in the form of whole wheat berries and mill them yourself. This is exactly what I and many other folks with food storage programs do. Baking with fresh, whole wheat flour is something of an art so the time to get good with it is right NOW while you can toss your failures to the chickens rather than having to eat them regardless because you can't afford to waste the food.

Vital Wheat Gluten: Sometimes labeled as simply "wheat gluten." This is the purified gluten of hard wheat extracted from

flour. It is generally 75-80% protein and is used to strengthen weak or whole grain flours for making yeast raised breads or made into "seitan" a wheat protein meat substitute. Somewhat confusing the issue is "High Gluten Flour" which is available in some markets. Careful investigation is needed here because this flour can range from a mere high gluten bread flour (approx 14%) to a gluten enriched flour typically 40%+) all the way up to purified wheat gluten (75%+). Be clear as to what it is you're buying and if you're not certain contact the manufacturer. If your whole wheat bread is not rising for you as much as you'd like then an addition of a few spoonsfuls of gluten or some high gluten flour may perk it up a bit.

Cake Flour: Typically the lowest protein content (6-8%) flour available to the home baker. This highly processed flour will make the tenderest cakes, cookies, and biscuits but performs poorly for yeasted breads. The flour is nearly always bleached (chlorinated) both to give it a bright whiteness and to improve its moisture holding capacity for cakes calling for a high ratio of sugars or fats. Unless you make a lot of cakes this is a rather specialized item to store.

Pastry Flour: Similar to cake flour, but generally slightly higher in protein, not chlorinated, and may be found bleached or unbleached. Used to produce tender pie crusts, biscuits, etc. Very similar to the regional all-purpose flours of the Southern U.S. Can also sometimes be found in a whole-wheat version as well. In Great Britain, Canada, and Australia may be known as "soft flour."

Semolina/Durum: Produced from durum wheat this flour is typically high in protein, 12% or more, enriched, unbleached with a distinctive pale yellow color. Texture depends largely on brand and can range from fairly coarse to bread flour fine. Most commonly used in the production of pastas, noodles, and couscous, but some specialty bread types call for semolina flour. May also be known as "alimentary flour", "macaroni flour", or "pasta flour." Farina, a coarse meal used as a breakfast cereal, is made from durum wheat.

Self-Rising Flour: This is ordinary refined and enriched all-purpose flour to which approximately 1.5 teaspoons of baking powder and 0.5 teaspoons of salt have been added to each cup of flour. This flour has its fans, but it's not well suited to long storage as the baking powder wants to go flat over time even with special packaging. Nor is it suited to making yeast raised breads. Most self-rising flours are in the mid to low end of the protein scale (8-

10%) because this is where chemically leavened quick breads perform best to achieve good rises and textures. You can make your own self-rising flour by adding in the requisite amount of double acting baking powder and salt mentioned above which is what I recommend doing rather than trying to store the ready-made product. Self-rising flour is sometimes known as phosphated flour (for the baking powder used in it) and in Great Britain, Canada, and Australia may be known as "self-raising flour" or "raising flour."

Instant Flour: This specialized flour product is also sometimes known as "shaker flour" for the shaker can in which it's usually found This is a low-protein flour in a granular form processed for easy and rapid dissolution into hot or cold liquids for making sauces, gravies, and batters. A fairly specialized item which any worthy cook can use ordinary flour to replace.

FLOUR TREATMENTS AND ADDITIVES

Flour milling companies (and home bakers) use a variety of additives and treatments in their flours to improve or suppress a particular quality in their product. If you read the package labels carefully you can discern quite a lot about what has and has not been done. Here are a few of the more common:

Enrichment: U.S. law (and some other nations) requires that refined flours which have had their bran and germ portions removed to be "enriched" by adding back a portion of the niacin, thiamin, riboflavin, folic acid, and iron that were lost in the refining process. Some milling companies go even further by adding vitamins A & D as well. There are various opinions about the value of this enrichment, but it's there. It has no affect on the taste, color, texture, caloric value, or baking qualities of the flour. Outside of the U.S. refined white flours may or may not be enriched so study your package labels carefully if this concerns you.

Bleaching: White bread and white cakes come by their snowy beauty thanks to bleaching. This is a process by which the yellowish carotenoid pigments that naturally occur in wheat are bleached white in order to improve the appearance of the flour and perhaps to change some of its physical characteristics as well. This would occur naturally by itself were the refined flour allowed to sit around for several months, but it's an uneven process and time is money to the milling companies who cannot afford to have large stocks of product sitting around in their warehouses for long periods of time.

Beyond making naturally off-white flour snowy in appearance bleaching can perform several other functions which the individual baker must decide if they are important to his needs. Until fairly recently much refined flour was also "bromated" using potassium bromate both to lighten the color, and to improve the qualities of the gluten. Concerns over the toxicity of this chemical has led to its gradual decline or outright ban on its use. Other bleaching agents are now used such as chlorine gas, chlorine dioxide, benzoyl peroxide and possibly others as well. Flours treated in this fashion will often exhibit improved loaf volume, finer grain, and look better in the finished product.

Cake flour is generally chlorinated not only whiten but also to improve its moisture holding ability when used in cakes with a high ratio of sugar and fat to flour. This bleaching also further tempers the already low gluten of the flour to produce the tenderest possible texture.

For the folks who do not care to buy bleached flours, small amounts of ascorbic acid (vitamin C) are often added as a dough conditioner and yeast nutrient. Home bakers often add their own vitamin C to their breads when they make them for the same reasons. A mere 1/8 tsp of ascorbic acid per cup of flour is all that is necessary.

All bleached flours must be so labeled in the U.S.

Malting: Many bread flours and some all-purpose flours will have small amounts of malt, malted barley flour, malt flour, or diastatic malt added to them. This additive improves the performance of the yeast by providing enzymes which speed the conversion of some of the flour starches into the digestible sugars the yeast use as fuel which can improve both the rise of the dough and the flavor of the finished product. The malt can also serve to improve the appearance of the bread when baked and lengthen its shelf life. You can add your own diastatic malt in the ratio of about 0.5-1.0 teaspoons for every three cups of flour.

Organic: This is flour produced and processed under the guidelines of the U.S. Department of Agriculture's Organic foods program. Most of the basic flour types (all-purpose, bread, pastry, etc.) can be found in organic forms though you may have to search a bit to find them.

Pre-Sifted: This is flour sifted at the mill before it was packaged. Supposedly this means you do not need to sift it again at home, but

many feel that due to settling during transport and storage if the recipe calls for sifted flour it should be done again.

Other Additives: There are many other potential additives that you may potentially come across in flour which would require more space than is possible here to cover them. Most are for use within the commercial/industrial baking fields and you would need to contact the supplier to determine precisely what it is they can do for you.

STORING FLOUR PRODUCTS:

As already mentioned above whole wheat flour wants to go rancid rather quickly after it has been milled. Once ground it will stay fresh for about four to six weeks sitting on your room temperature kitchen shelf. In a sealed container in the refrigerator the flour will stay good for a year or so. In the freezer it will keep for years. Personally, I think it best to store your whole wheat flour in the form of wheat berries and only mill as much flour as you will use in a week or two and keep that in the refrigerator or freezer until you do. If for some reason you cannot do this then buy the freshest product you can and package it well in Mylar bags, glass jars, or metal cans with oxygen absorbers. Due to the fine texture of flour it will not gas flush very well at all.

Even the refined white flours have limited shelf-lives. In spite of what some would have you believe they are not "dead foods." The bran and germ may have been removed, but a minute portion of the germ oils will remain as well as the naturally occurring enzymes found in the grain. Refined white flour won't noticeably go off on you the way whole wheat flour will, but given sufficient time and exposure to heat and atmospheric humidity the protein content of the flour will slowly breakdown. Your first indications of trouble may be a slowly developing musty smell or degraded dough performance – poor rises and bad loaf volumes. In a sealed, air tight container you should easily achieve six months to a year at room temperatures. Sealed containers in the refrigerator or freezer will last for at least several years. If you want your white flour to stay at its best for the longest possible time then package it in Mylar bags, glass jars, or metal cans air tight with oxygen absorbers. At a decent storage temperature sealed in a low oxygen environment you should easily achieve five years of shelf life or more.

A.2 LEGUME VARIETIES

If you’re willing to spend what it takes on preserved meats and dairy products it’s not necessary to store legumes at all. But most people do choose to keep a

selection of beans, peas, and lentils in their larders either for reasons of economy, because they like them, or both. There are few non-animal foods that contain the amount of protein to be found in legumes with the varieties commonly available in the U.S. ranging from 20%-35%. As with most non-animal proteins, they are not complete in themselves for purposes of human nutrition, but become so when they are combined with the incomplete proteins found in grains. This is why grains and legumes are so often served together the world around.

The legume family, of which all beans, peas, lentils, and peanuts are a part, is one of the largest in the plant kingdom. Because of this and the many thousands of years of cultivation and development that man has given them on several continents the variety of edible legumes available to us is huge. Both their appearance and their names are colorful and varied. They range from "adzuki beans", a type of soybean from the Orient, to "zipper peas", a common field-pea here in the Southern U.S. Their color can range from a clean white, to deep red, dull green to flat black with thousands of mixtures and patterns in between.

In spite of this incredible variety, many legumes are largely interchangeable in cooking, although some dishes just wouldn't be the same if a different type were used. Below is a partial list of common legumes.

ADZUKI BEANS: These small, deep red beans are very popular in Japan, China and other Asian nations, but are not as well known in the U.S. They are actually a cousin of the soybean and are commonly used in producing sweet bean paste for Chinese buns and other dishes. Pressure cooking will sometimes impart a bitter flavor so they are best pre-soaked then boiled in the conventional fashion. Their flavor is somewhat milder than kidney or small red beans, but they can serve as an adequate substitute for either in chili and other dishes in which those beans are commonly used.

BLACK BEANS: Also known as "turtle beans", they are small, dark brownish-black and oval-shaped. Well known in Cuban black bean soup and commonly used in Central and South America and in China. They tend to bleed darkly when cooked so they are not well suited to being combined with other beans, lest they give the entire pot a muddy appearance. The skins of black beans also slip off easily so for this reason they are generally not recommended for pressure cooking for fear of clogging the vent. This can be lessened by not pre-soaking before cooking.

BLACK-EYED PEAS: Also known as “cowpeas” or “field peas” there are many varieties these peas eaten across the Southern United States, Mexico, and Africa with black-eyed peas being the most commonly known in the U.S. The coloring of field-peas is as varied as the rest of the legume family, with black-eyed peas being small, oval shaped with an overall creamy color and, of course, their distinctive black-eye. Dried field-peas cook very quickly and combine very tastily with either rice or cornbread and are often eaten as Hoppin’ John every New Years for luck. They’re also reputed to produce less flatulence than many other beans.

CHICKPEAS: Also known as the "garbanzo bean" or "cecci pea" (or bean), they tend to be a creamy or tan color, rather lumpily roundish and larger than dried garden peas. Many have eaten the nutty flavored chickpea, even if they've never seen a whole one. They are the prime ingredient in hummus and falafel and are one of the oldest cultivated legume species known, going back as far as 5400 B.C. in the Near East. Chickpeas tend to remain firmer when cooked than other legumes and can add a pleasant texture to many foods. I like them in red spaghetti sauces in particular and they are often used in Spanish cuisine in a tomato based sauce. Roasted brown then ground they have also served as a coffee substitute.

FAVA BEANS: Not as well known in the U.S. as in Europe and the Mediterranean favas are also known as "broad beans" or "horse beans" being broad in shape, flat and reddish brown in color. This is one of the oldest legume species in European cultivation, but it does require more effort to consume. The hull of the bean is tough and not conducive to being tenderized by cooking so is often peeled away. The skinless bean falls apart so is made into a puree. A small number of people with Mediterranean ancestry have a genetic sensitivity to the blossom pollens and undercooked beans, a condition known as "favism" so should avoid consuming them.

GREAT NORTHERN BEANS: A large white bean about twice the size of navy beans they are typically bean flavored and are frequently favored for soups, salads, casseroles, and baked beans. One of the more commonly eaten in the U.S. Milled into meal these mild flavored beans can be included in many baked goods as a protein booster or used to thicken soups and stews.

KIDNEY BEANS: Like the rest of the family, kidney beans can be found in wide variety. They may be white, mottled or a light or dark red color with their distinctive kidney shape. Probably best known here in the U.S. for their use in chili and bean salads, they figure prominently in Mexican, Brazilian and Chinese cuisine.

LENTILS: Lentils are an odd lot. They don't fit in with either the beans or the peas and occupy a place by themselves. Their shape is different from other legumes being roundish little discs with colors ranging from muddy brown, to green to a rather bright orangish-red. They cook very quickly and have a distinctive mildly peppery flavor. They are much used in Far Eastern cuisine from India to China. Next to mung beans they make excellent sprouts though their peppery flavor tends to strengthen somewhat so are best mixed with milder sprouts.

LIMA BEANS: In the Southern U.S., they are also commonly called "butter beans". Limas are one of the most common legumes, found in this country in all manner of preservation from the young small beans to the large fully mature type. Their flavor is pleasant, but a little bland. Their shape is rather flat and broad with colors ranging from pale green to speckled cream and purple. They combine very well with rice.

MUNG BEANS: Best known here in the States in their sprouted form, they are quite common in Indian and other Asian cuisines and are a close relative of the field peas (cowpeas). Their shape is generally round, fairly small with color ranging from a medium green to so dark as to be nearly black. They cook quickly and pre-soaking is not generally needed.

NAVY BEANS: Smaller than Great Northerns these petite sized beans are also sometimes knows as pea beans. They are the stars of Navy and Senate Bean Soups, favored for many baked bean dishes, and are most often chosen for use in commercial pork and beans. They retain their shape well when cooked. Ground into meal they can be added to many soups and stews without overpowering them.

PEANUTS (Groundnuts): The peanut is not actually a nut at all, but a legume. They are another odd species not much like the more familiar beans and peas.

Peanuts have a high protein percentage and even more fat. Whatever their classification peanuts are certainly not unfamiliar to U.S. eaters. They are one of the two legume species commonly grown for oilseed in this country, and are also used for peanut butter, and boiled or roasted peanuts. Peanut butter (without excessive added sweeteners) can add body and flavor to sauces, gravies, soups, and stews. Many Central and South American, African, Chinese, and Thai dishes incorporate peanuts so they are useful for much more than just a snack food or cooking oil.

PEAS, GREEN OR YELLOW: More often found as split peas though whole peas can sometimes be had. The yellow variety has become somewhat uncommon but has a milder flavor than the green types which well lends them to blending inconspicuously into other foods. Probably best known in split pea soup, particularly with a smoky chunk of ham added. They are also used in Indian cuisine, especially dals. Whole peas need soaking, but split peas can be cooked as is. Split peas and pea meal makes an excellent thickener for soups and stews. Because splitting damages the pea, this more processed form does not keep for as long as whole peas unless given special packaging.

PINK AND RED BEANS: Related to the kidney bean these are smaller in size but similar in flavor. The pink bean has a more delicate flavor than the red. The are both often favored for use in chili and widely used across the American Southwest, Mexico, and Latin America. They can add nicely to the color variety in multi-bean soups.

PINTO BEANS: Anyone who has eaten Tex-Mex food has likely had the pinto bean. It is probably the most widely consumed legume in the U.S., particularly in the Southwestern portion of the country. Stereotypically bean shaped, it has a dappled pattern of tans and browns on its shell. Pintos have a flavor that blends well with many foods. When ground together with great northern or navy beans they make my favorite home-made version of falafel. When milled into a meal pintos will cook in mere minutes, making a near instant form of refried beans.

SOYBEANS: The soybean is by far the legume with the highest protein content in large scale commercial production and it's amino acid profile is the most nearly complete for human nutrition. Alongside the peanut it is the other common legume oilseed. The beans themselves are small, round, and with a multitude of different shades though tan seems to be the most common that I've seen. Because

of their high oil content, they are more sensitive to oxygen exposure than other legumes and precautions should be taken accordingly if they are to be kept for more than a year in storage, especially if they are to be processed for soymilk or tofu. Although the U.S. grows a large percentage of the global supply, we consume virtually none of them directly. Most go into cattle feed, are used by industry, or exported. What does get eaten directly has usually been intensively processed. Soybean products range from soymilk to tofu, to tempeh, to textured vegetable protein (TVP) and hundreds of other forms. They don't lend themselves well to merely being boiled until done then eaten the way other beans and peas do. For this reason, if you plan on keeping some as a part of your storage program you would be well served to begin to learn how to process and prepare them now while you're not under pressure to produce. This way you can throw out your failures and order pizza, rather than having to choke them down, regardless.

A.3 AVAILABILITY OF GRAINS AND LEGUMES

Grains and legumes of all types may be purchased in a number of different ways depending largely on where you live and the time of year. The following will cover the various steps of the processing chain starting with the forms most immediately suitable for storage and progressing all the way back to the farmer.

Each type of availability has its good and bad points. As you might expect, the more processing a product receives, the higher its price is likely to be. The further back along the processing chain you go the cheaper a product should become in terms of purchase price. It will, however, cost you more in time and effort to get it ready for storage.

The easiest and simplest way to incorporate grains and legumes into your storage program is to purchase your items *pre-cleaned* and *pre-packaged*. These are products that have been harvested, passed through fans and screens to remove chaff, smut balls, insect parts, mouse droppings and other debris, then put up in retail sized bags or other containers - possibly even going so far as to already be packaged for long-term storage. This would be either from your local grocer or a storage food dealer. If you don’t live in the area where what you want is grown it may be your only option.

If you want to purchase in bulk then you may be able to find *pre-cleaned but not yet packaged* products. These sources would be commercial or institutional food suppliers, food co-ops, warehouse grocers like Sam’s Club or Costco, local food companies that package their own product lines, and the like. If what you want is not already in 50-100 lb bags you may have to provide your own container and there may be minimum purchase amounts as well. If the moisture content is in the right range then nothing will need to be done other than to put it up in your

own storage packaging. If you don't buy it from some sort of foods dealer then be certain read the cautionary text below.

Should you happen to live in the area where the type of grain or legume that you are interested in purchasing is grown you may be able to purchase direct from the producer or distributor.

If you are interested in doing this, it may be possible to find your product *field-run* which simply means that it's been harvested and sold shortly thereafter. It will not have been given any cleaning or processing and is likely to be rather dirty depending upon the conditions under which it was grown and harvested.

A second form called *field-run from storage* is product that has been harvested then put into storage for a time. It will have the dirt and debris of field run grain and whatever it may have picked up from the grain elevator as well.

IMPORTANT NOTE: If you have purchased your grains and legumes from a foods dealer then you needn't worry about hidden mold infections, fungicides or insecticides that are unsafe for human consumption. In the U.S., the products will have been checked several times by Federal and State agriculture departments and probably by the major foods dealers as well, to ensure its quality.

This is not necessarily the case when you purchase your grains or legumes directly from the farmer or elevator operator as field-run or field-run from storage grain. Nor is it necessarily the case if you've made the decision to utilize grains marketed as animal feed. Inspection procedures vary from nation to nation, so if you buy outside of the U.S. inquire of your supplier.

If you are buying your grains and legumes from some place other than a foods dealer, you need to know the history of what you are buying. There is the remote possibility that field-run from storage or any grade of grain not specifically sold for human consumption may have had fumigants, fungicides or insecticides not certified as safe for human foods added while it was in the bin. It is important to know what it has been treated with before you buy it.

Straight field-run grain, other than being dirty, is not likely to have had anything added that would make it undesirable for human consumption. There is, however, the also remote possibility it may have been infected with fungi that would make it unsafe for eating.

One of these fungal infections of grain is called "ergot". This fungal disease affects the flowering parts of some members of the grass family, mostly confined to rye. Consuming the fungus causes a nervous disorder known as St. Anthony's Fire. When eaten in large quantities the ergot alkaloids may cause constriction of the blood vessels, particularly in the extremities. The effects of ergot poisoning

are cumulative and lead to numbness of the limbs and other, frequently serious, symptoms.

The fungus bodies are hard, spur like, purple-black structures that replace the kernel in the grain head. The ergot bodies can vary in size from the length of the kernel to as much as several times as long. They don't crush as easily as smut bodies of other funguses. When they are cracked open, the inner broken faces can be off-white, yellow, or tan. The infected grain looks very different from ordinary, healthy rye grains and can be spotted easily. Ergot only rarely affects other grains and will generally afflict rye only when the growing conditions were damp. If you purchase field run rye, you should closely examine it first for the presence of ergot bodies. If you find more than a very, very few pass up that grain and look elsewhere.

Ergot is typically not a problem in the U.S and is easily spotted when it does occur. Other grain fungi, however, are much harder to spot and also have serious consequences should they be consumed. The various species of *Aspergillus* and *Fusarium* molds can be a problem almost anywhere. Please see Section IV.B.3 Molds In Grains and Legumesfor more information.

Animal feed grains or seed grain/legumes are widely available and there are those who want to consider using these sources. Keep in mind that animal feeds are typically dirtier than food grains and may have a higher contaminant level than what is permissible for human consumption. The USDA allows the sale of grain or legumes for animal feed that could not be sold for direct human food use. It may even be mixed varieties of one grain and not all one type. In the case of feed wheat it may have an acceptable protein content but still make miserable raised bread so try milling and baking with a small amount before you put a lot of it away. Seed grains, in particular, must be investigated carefully to find out what they may have been treated with. It is quite common for seed to be coated with fungicides, and possibly other chemicals as well. Once treated, they are no longer safe for human or animal consumption. Be sure to inquire of your supplier.

If you do purchase field-run grain of any sort, examine it closely for contamination and moldy grain. Ask the farmer or distributor whether it has been tested for mold or *mycotoxin* (fungal toxin) content. *This is especially the case if you are buying field-run CORN, RYE, SOYBEANS or RICE.* When you purchase direct from the field, you may be getting it before it has been checked. Be certain of what it is that you are buying and ask questions if you choose to go this route. Know who you are dealing with. Unless you just can't find any other source, I don't recommend using animal feed or seed grains for human food use. Please see section IV.B.3 Molds In Grains and Legumes for further information.

A.3.1 MOISTURE CONTENT

The moisture content of the grain or legume you want to put by has a major impact on how long you will be able to profitably keep it in storage. Some of the available literature states that grain with a moisture content as high as 13% can be safely put up, but there is a risk to keeping it at that level that should be understood.

The outside of every kernel of grain and bean you buy or grow hosts thousands of *fungi* spores and bacteria. This is all perfectly natural and is not a cause for alarm. The problem is that at moisture levels between 13.5% to 15% some fungal species are able to grow and reproduce. Aerobic *bacteria* (needing free oxygen to survive) require moisture in the 20% range. If you have grain with a moisture content as high as 13% you are perilously close to having enough moisture to enable mold growth which could lead to the spoilage and loss of your product. For this reason, I suggest you keep all grains and legumes to a moisture content of no more than 10%. An exception to this is raw peanuts which are particularly susceptible to an *Aspergillus* mold growth that produces *aflatoxin* (a type of mycotoxin) so should be stored with an 8% moisture content or less.

If you do not have a clue as to what the moisture level of your grain is here are several methods to determine it. The first method is quick, simple and will usually give you a close enough idea to work with of how much moisture there is in your grain or legume. The last two require a great deal more time and effort, but give more precise results.

METHOD ONE

This is the method I use myself. It's quick and dirty requiring nothing more than crushing a kernel of grain or a bean between two solid objects like a hammer and a brick. You don't have to hit it like you're driving spikes, just give it a sharp rap. If the grain shatters nicely into powdery debris or many small bits then the moisture level ought to be in the right range and you can package as-is. If the kernel just mashes flat or only reluctantly breaks into pieces it probably has too much moisture. If you're not sure of what you're seeing try drying a small amount overnight at only a warm temperature (100º Fahrenheit) such as you'd get from the pilot light in a gas oven. The next day take another sample from the same container and rinse in warm water for a few seconds, rub dry on a towel and let sit for about ten minutes. Now try the crush test on both samples. One should give you a good result and the other should be much different. Any seed with a high fat content such as soybeans and peanuts will not work well with this method.

COMMON TO METHODS TWO AND THREE

The more precise moisture content measurements require more time and effort. Nevertheless, you can make useful determinations with home equipment and I include them here for those who find Method One to be unsatisfactory.

You'll need some way to measure weight with a fair degree of accuracy. The better the scale you use, the more reliability you'll have in your determinations. Provided that it will weigh accurately to the half-ounce or less, any scale that can be calibrated with a known check weight will do. Postal scales can be made to serve if they are carefully calibrated against a known weight. Many individuals interested in starting storage programs may have grain weight scales used in ammunition reloading that might serve well.

Also necessary is a thermometer capable of withstanding and accurately measuring oven temperatures. As many bakers can tell you, home oven thermostats are often notoriously inaccurate so it is better to rely on a decent thermometer. Most kitchen supply stores can supply one that is oven safe and will accurately measure to the degree Fahrenheit or Celsius.

Proper technique calls for preheating the oven for a half- hour or more before starting the dehydrating process so that it will be of a uniform heat throughout. The sample pan should be placed on the middle rack as close to the vertical and horizontal center of the oven as possible. The bulb or dial of the thermometer should be placed next to the pan.

METHOD TWO

This method is for measuring moisture content in whole grains and legumes. Grain flours or meals, milk powders and any other finely textured foods should use Method Three detailed below.

To be done prior to measuring -- choose a shallow heat resistant container that has a close fitting lid. Clean it thoroughly and dry completely in your oven for 10-15 minutes. Allow it to cool and then weigh it carefully. This will give you the *tare weight* or what your container weighs empty.

Depending on how your scale is calibrated you can use a smaller sample size than what is indicated below. Using the twenty-ounce sample mentioned in the following text will allow for fairly accurate readings with the average postal scale. A scale that will measure to the gram could use as small a sample as 20 grams. A powder scale could use even less, but the smaller your sample size becomes the more finicky care you must exercise not to allow error to creep in. Keep your sample size large enough to easily work with.

Allowing for the weight of the sample pan, measure out a weighed twenty-ounce representative sample of the grain or legumes in question. Ideally, you should thoroughly mix the entire lot immediately before removing the sample, but if this is not possible then take it from the middle center of the container. It is important that you use care in this measurement since it will affect all following determinations.

Put the sample in the container making sure it is not more than an inch deep. Place it in the oven with the lid off and allow to heat. Below is a table giving the oven temperatures and times per grain or legume type:

Time and Temperature Settings for Determining Moisture Contents of Whole Seeds			
Seed	Oven Temperature ° Fahrenheit*	Oven Temperature °Celsius*	Oven Heating Time
Barley	266	130	20
Beans	217	103	72
Corn	217	103	72
Oats	266	130	22
Rye	266	130	16
Sorghum, millet	266	130	18
Soybeans, peanuts	217	103	72
Wheat, rice	266	130	19
*No home oven that I am aware of will allow for such precise temperature control. Try to keep the temperature within ten degrees either way of what is listed and you will still achieve useful results.			

When the dehydration period is over place the close fitting lid on the sample pan and allow to cool in the oven with the door closed. Remove and carefully weigh the pan.

A one ounce loss in weight indicates your grain has a roughly five percent moisture content, 2 ounces indicates that it has a 10% moisture content, etc., etc. You might even be able to cut it as fine as a half-ounce loss, but I wouldn't try to take it further than that.

Obviously, this is only a rough measure, but it works and can be done with postal or dietetic scales that are available virtually everywhere. As I mentioned above, if you have a scale with a finer calibration it is possible to use a smaller sample size and achieve the same result.

METHOD THREE

This method is much faster to use than the first, but greater care must be taken to prevent error. It can be used to determine moisture contents of whole grains and legumes, flours, meals and various food powders.

The same equipment as was used in Method Two will be required here as well as a low-RPM grain mill or some other device that can reduce a quantity of the grain to a meal consistency with only minimal heating of the sample. If the food to be tested is already at a meal consistency or finer then it can be used as-is.

Grind a quantity of product from which you want to measure the moisture content. Take care to grind the sample slowly enough to keep friction heat build up to a minimum (should not be more than mildly warm) or else moisture will be lost due to heat evaporation before it can be weighed.

Immediately upon finishing the grinding, weigh out your sample so as to minimize unmeasured moisture loss.

Place the sample in the oven and dehydrate in the manner used in Method Two for a period of two hours at a temperature setting of 275º F (135º C). When the heating period is finished cover with the tight-fitting lid and allow to cool in the oven. Remove and weigh carefully. Moisture determination is the same as above.

If anyone has a better way of measuring moisture levels which can be done without a lab or special equipment I'd surely like to hear from you.

A.3.2 CLEANING IT YOURSELF

If you've chosen to purchase field-run grain or if the pre-cleaned product you've bought isn't clean enough to suit you it can be given further cleaning.

The fastest and easiest method is "fanning", a form of winnowing. This is done by pouring the grain slowly through the air stream of a fan or blower into a clean, deep container such as a cardboard box or trash can. The wind blowing through the falling grain will blow out most of the broken kernels, chaff, smut balls, mouse droppings, etc. If you're losing too much good grain, try turning the fan down or moving it further back from the container. The deep container will cut down on the amount of kernels that bounce out. Repeat fanning as necessary until the grain is clean enough to suit or you've blown all of the lighter contaminants out.

If the fanning didn't get the grain clean enough it can be further cleaned by running it through a screen or sieve. This should be made with holes just big enough to pass an average sized grain of what it is you're cleaning. Obviously, the size of the holes will necessarily vary depending upon the kernel size of the grain.

Should the kernels still not be clean enough to suit then you'll just have to resort to hand picking out the offending particles. I'd strongly suggest doing this just prior to grinding where it can be done in small batches rather than trying to do your entire storage all at once. It's much easier to do a few pounds at a time than fifty or a hundred.

If you have it in mind to wash the grain, this should not be done prior to storage, but rather just before use. After rinsing, dry the grain immediately in an oven heated to 150º F (117 º C) for an hour in a layer no deeper than 1/2 inch deep stirring often.

A.3.3 STORING GRAINS AND LEGUMES

Now that you have properly prepared your grains and legumes they are ready to be packaged.