HIBISCUS

Post-harvest Operations

INPhO - Post-harvest Compendium

Food and Agriculture Organization
of the United Nations

HIBISCUS: Post-Production Management for Improved Market Access

Organisation: Food and Agriculture Organization of the United Nations (FAO), AGST
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1. Introduction

Hibiscus sabdiriffa var. sabdariffa, commonly known as hibiscus or roselle, grows in many tropical and sub-tropical countries and is one of highest volume specialty botanical products in international commerce. Roselle is an annual herbaceous shrub of the Malvaceae family. The leaves are used extensively for animal fodder and fiber, but the swollen calyces are the plant part of commercial interest. As the flowers fall off, the bright red calyces swell. These are harvested by hand, dried, and sold whole into the herbal tea and beverage industry. The flavor is a combination of sweet and tart, similar to cranberry. In addition to international markets, there are extensive local and regional markets as well where it is processed into hot and cold herbal beverages, jellies, confectionaries and other products.

Figure 1: Hibiscus plants (Hibiscus sabdariffa)[10]

1.1 Economic and Social Impact of Hibiscus

Roselle is an ideal crop for developing countries if market demand is favorable. It is drought tolerant, relatively easy to grow, not suitable for mechanized harvest, labor intensive to process, and can be grown as part of multi-cropping system. In addition to fodder and fiber, it is used for other purposes as well. In China the seeds are used for their oil and the plant is used for medicinal properties, and in West Africa the leaves and powdered seeds are a local foodstuff. It has many other local names including sorrel, l'oiselle (French), jamaica (Spanish), bissap (Wolof/Senegal) and dâ (Bambara) among others. In North Africa and the Near East roselle is called karkade (Arabic), the name also used in the pharmaceutical and food flavoring trade in Europe.

Like many specialty botanical products, market information is not readily available for roselle. Prices and production are not tracked like a conventional agricultural commodity and there are few, if any, published market reports [1].

Figure 2: Hibiscus flowers[11]

1.2 World trade

1.2.1 Global Production

Demand has steadily increased for roselle over the past decades. Currently approximately 15,000 metric tons enter international trade each year.[3] Many countries produce roselle but the quality markedly differs. China and Thailand are the largest producers and control much of the world supply. Thailand invested heavily in roselle production and their product is of superior quality, whereas China's product, with less stringent quality control practices, is less reliable and reputable. The world's best roselle comes from the Sudan, but the quantity is low and poor processing hampers quality. Virtually all of Sudan's production is exported to Germany. US importers also prefer the Sudanese product, but due to a trade embargo, importers there are forced to source this product through Germany at a considerable mark-up in price. As such, the Sudanese product is used much less in the US, and China and Thailand are the main suppliers. Mexico, Egypt, Senegal, Tanzania, Mali and Jamaica are also important suppliers but production is mostly used domestically.

Figure 3: Hibiscus plantation[12]

1.2.2 Main consumption areas and trends

Germany and the United States are the main countries importing roselle. The biggest German buyer (as well as for the whole of Europe and the world) is Martin Bauer, one of the oldest and largest companies in the herb industry [2]. Roselle is used in numerous products there including herbal teas, herbal medicines, syrups and food coloring. Tables 1 and 2 list German imports of plants used in herbal teas, medicines and perfumes from 1993-1997. The data indicate an increase of 41% in volume and 72% in value over the 5 year time period. Specific information on roselle is not available, however importers estimate that that raw materials intended for the herbal tea industry account for roughly one quarter of the total volume.[9]

Table 1: German Imports of Plants and Plant Parts used in Herbal Teas, Medicines and Perfumes (t)

HS Code 12119080/95	**1993**	**1994**	**1995**	**1996**	**1997**
Bulgarie	1,360	2,728	3,890	3,641	5,605
Poland	2,168	2,067	1,761	2,879	4,684
India	4,295	4,248	5,993	5,588	4,456
Sudan	2,881	3,561	3,005	2,557	3,157
Chile	2,441	1,711	2,378	3,099	2,902
Egypt	1,352	1,729	1,637	1,881	2,646
US	787	1,173	1,073	1,087	2,138
Hungary	2,040	2,185	3,153	2,574	1,844
China	1,305	1,549	1,661	1,701	1,821
Albania	1,158	1,471	1,373	1,897	1,487
Argentina	1,477	1,129	1,665	932	1,399
Austria	1,186	1,136	1,360	544	952
Turkey	500	609	608	817	820
Brazil	659	278	477	551	600
Australia	419	372	168	560	542
Thailand	651	444	366	358	422
Mexico	205	92	104	354	200
Other	5,508	6,053	7,237	7,311	7,160
TOTAL	**30,392**	**32,535**	**37,909**	**38,331**	**42,835**

Source: EUROSTAT

Table 2: German Imports of Plants and Plant Parts used in Herbal Teas, Medicines and Perfumes (ECU 000s)

HS Code 12119080/95	**1993**	**1994**	**1995**	**1996**	**1997**
Poland	3,024	2,861	3,064	4,910	11,279
Chile	3,692	2,713	4,693	7,715	8,404
Austria	7,522	7,175	10,617	5,052	8,267
Bulgaria	1,410	2,573	4,193	3,843	7,385
US	3,215	3,426	5,304	5,381	7,118
Egypt	2,276	3,187	3,334	4,060	5,697
India	3,039	2,958	4,228	4,809	4,111
Argentina	3,400	2,879	3,809	2,242	3,539
China	2,106	2,291	2,398	3,077	3,483
Hungary	2,542	2,843	4,282	3,634	3,322

HS Code 12119080/95	**1993**	**1994**	**1995**	**1996**	**1997**
Sudan	2,176	3,698	3,244	2,956	3,099
Albania	1,447	1,817	2,134	3,376	2,843
Brazil	1,578	844	1,323	1,621	2,054
Australia	983	958	591	1,959	1,997
Turkey	694	823	851	1,052	1,390
Fiji	518	480	1,023	671	1,335
Thailand	1,011	956	784	710	971
Mexico	325	248	314	588	436
Other	11,331	11,903	12,769	11,743	13,002
TOTAL	**52,289**	**54,633**	**68,955**	**69,399**	**89,732**

Source: EUROSTAT

Main importers in the United States are Celestial Seasonings and Lipton, both tea companies.[3] Roselle is also used in ready to serve beverages made by Knudson, Whole Foods and other food and beverage manufacturers. Like Germany, there has been a steady increase in imported products used in the US herbal tea industry. The data in Tables 3 and 4 show that between 1994 and 1998 there was a 78% increase in volume and a 156% increase in value.

Table 3: US Imports of Plants and Plant Parts for Use in Herbal Teas (t)

HS Code 1211908080	**1994**	**1995**	**1996**	**1997**	**1998**
China	1,062	1,341	1,692	1,639	1,760
Mexico	103	116	354	629	669
Chile	271	378	395	333	629
Germany	267	330	433	396	326
India	173	137	203	173	200
Thailand	138	200	223	163	154
Peru	26	255	86	26	148
Spain	93	88	53	93	99
Canada	13	10	3	3	98
South Korea	52	53	24	28	88
Egypt	24	56	79	106	54
Sudan	37	-	-	-	-
Other	659	988	860	1,488	958
TOTAL	**2,918**	**3,952**	**4,405**	**5,077**	**5,183**

Source: RAISE.org

Table 4: US Imports of Plants and Plant Parts for Use in Herbal Teas (US$'000s)

HS Code 1211908080	**1994**	**1995**	**1996**	**1997**	**1998**
China	2,290	3,527	4,972	4,727	7,330
Chile	670	1,104	1,322	1,087	3,136
Taiwan	446	636	803	1,102	1,263
Mexico	268	337	601	1,046	1,193
Spain	631	982	683	997	1,070
Germany	1,003	1,204	2,204	1,921	983
Canada	178	141	39	33	909
South Korea	482	520	303	305	903
India	211	310	685	815	716
Thailand	330	633	514	537	415
Egypt	73	163	237	304	132
Sudan	48	-	-	-	-
Other	2,114	3,889	3,359	4,821	4,374
TOTAL	**8,744**	**13,446**	**15,722**	**17,695**	**22,424**

Source: RAISE.org

1.2.3 Trends in international prices

The market for roselle is notoriously volatile and prices can fluctuate dramatically. Due to the fact that it grows in many places, the market is easily oversupplied. When demand and price increase, more suppliers come online, causing prices to drop and supply to outstrip demand. This causes farmers to switch to other crops, which may induce a shortage the next year. This kind of fluctuation can happen over the course of a single year and is often related to climate and quality control problems.

The year 2003 is indicative. Prices are at an all time high of US$ 4000/t due to a decrease in quality supply from China and Thailand brought on by unseasonably rainy and humid weather. This prohibited the product from being sun dried, and much was lost to mold and rot.

In general prices range from 1200-3600 US$/t depending on quality, time of year, and amount purchased[3]. Quality is a function of taste and color primarily, followed by cleanliness and other factors. The best quality is dark red in color with a sour-fruity taste.

The table below gives an indication of price ranges per metric ton over the past year for dried hibiscus[9], as well as variations in the liquid product from country to country. Prices include freight and insurance costs (CIF).

Table 5: Price Ranges for Dried Hibiscus (CIF, US$ per ton), 3/97-4/98

Supplier	Liquid Color	Liquid Taste	US	Germany
Sudan	Orange-red	Acidic	$1,500-$1,700	$1,200-$1,300
Egypt (organic)	Burgundy red	Acidic	$1,200-$1,500	No quote
Thailand	Purplish-red	Sweet	$1,000-$1,200	$1,000-$1,100
China	Dark purple	Tart	$800-$1,000	$900-$1,000
Mexico	Orange-red	Salty	$600-$700	No quote

Source: Interviews with importers

1.2.4 Assessment of Future Opportunities

While China and Thailand control much of the world supply, there are opportunities to penetrate this market with better quality and reliable production. The humid climate in China and Thailand make production susceptible to the vagaries of climate, and importers often complain about the unreliable quality of the Chinese product. And even though the Sudanese cultivar ("El Rahad") is considered superior, there are significant quality control issues as well as obstacles created by the US trade embargo.

Roselle is easy to grow, but it is hard to produce high quality. Opportunities may exist for producers who can procure Sudanese seeds, or who can grow in geographical regions with the right climatic conditions (for example in drier areas of the tropics and subtropics), or who can grow off-season in order to provide buyers with year-round sourcing options.

The main constraints to production are many producers, volatile markets, and unorganized and poorly monitored growth, harvest and post-harvest handling operations. Product quality (especially taste) and seller reputation are key criteria for accessing international markets. New producers can rarely expect to sell anything but whole material, as once processed it almost impossible to clean. Due to its well-organized production system and sound reputation, Thailand is the only country that has been able to add value locally by cutting and sifting the calyces into tea bag size. At this time there is only a small demand for organic roselle, although this could change with time.

Local and regional markets may offer additional opportunities for expansion through product diversification and better market linkages. In many ways, these markets are preferable for the small farmer as they are less volatile and represent a more even playing field. Locally, regionally and internationally, the market for roselle will continue to remain strong.

1.3 Primary Products

Fresh hibiscus

Roselle fruits are best prepared for use by washing, then making an incision around the tough base of the calyx below the bracts to free and remove it with the seed capsule attached. The calyces are then ready for immediate use. They may be merely chopped and added to fruit salads. In Africa, they are frequently cooked as a side-dish eaten with pulverized peanuts. For stewing as sauce or filling for tarts or pies, they may be left intact, if tender, and cooked with sugar. The product will be almost indistinguishable from cranberry sauce in taste and appearance. For making a finer-textured sauce or juice, syrup, jam, marmalade, relish, chutney or jelly, the calyces may be first chopped in a wooden bowl or passed through a meat grinder. Or the calyces, after cooking, may be pressed through a sieve.

The young leaves and tender stems of roselle are eaten raw in salads or cooked as greens alone or in combination with other vegetables or with meat or fish. They are also added to curries as seasoning. The leaves of green roselle are marketed in large quantities in Dakar, West Africa. The juice of the boiled and strained leaves and stems is utilized for the same purposes as the juice extracted from the calyces. The herbage is apparently mostly utilized in the fresh state though it can be evaporated and compressed for export from the Philippines.

Figure 4: Hibiscus calyces[13]

1.4 Secondary and derived product

Dried and frozen Hibiscus

The calyces are either frozen or dried in the sun or artificially for out-of-season supply, marketing or export. In Mexico today, the dried calyces are packed for sale in imprinted, plastic bags. It is calculated that 11 lbs (5 kg) of fresh calyces dehydrate to 1 lb (0.45 kg) of dried roselle, which is equal to the fresh for most culinary purposes. However, dried calyces as sold for "tea" do not yield high color and flavor if merely steeped; they must be boiled. For retailing in Africa, dried roselle is pressed into solid cakes or balls. In Senegal, the dried calyces are squeezed into great balls weighing 175 lbs (80 kg) for shipment to Europe, where they are utilized to make extracts for flavoring liqueurs. In the United States, Food and Drug Administration regulations permit the use of the extracts in alcoholic beverages.

Juice and wine

Juice made by cooking a quantity of calyces with 1/4 water in ratio to amount of calyces, is used for cold drinks and may be frozen or bottled if not for immediate needs. In sterilized, sealed bottles or jars, it keeps well providing no sugar has been added. In the West Indies and tropical America, roselle is prized primarily for the cooling, lemonade-like beverage made from the calyces. In Egypt, roselle "ade" is consumed cold in the summer, hot in winter. In Jamaica, a traditional Christmas drink is prepared by putting roselle into an earthenware jug with a little grated ginger and sugar as desired, pouring boiling water over it and letting it stand overnight. The liquid is drained off and served with ice and often with a dash of rum. A similar spiced drink has long been made by natives of West Tropical Africa. The juice makes a very colorful wine.

Figure 5: Hibiscus juice[14]

Sauce or syrup

Roselle sauce or syrup may be added to puddings, cake frosting, gelatins and salad dressings, also poured over gingerbread, pancakes, waffles or ice cream. It is not necessary to add pectin to make a firm jelly. In fact, the calyces possess 3.19% pectin and, in Pakistan, roselle has been recommended as a source of pectin for the fruit-preserving industry.

Seeds

The seeds are somewhat bitter but have been ground to a meal for human food in Africa and have also been roasted as a substitute for coffee. The residue remaining after extraction of oil by parching, soaking in water containing ashes for 3 or 4 days, and then pounding the seeds, or by crushing and boiling them, is eaten in soup or blended with bean meal in patties. It is high in protein.

1.5 Requirements for export and quality assurance

Table 6: Common Guidelines and Specifications for Dried Hibiscus sabdariffa

Guidelines	Specifications
Description	Hibiscus sabdariffa
Packaging	Item must be packed in 50 lb. poly (or less) lined boxes or multi-walled sacks (adequately protecting product for shipment) with clear markings indicating the item contained. Shipment must be accompanied by packing list clearly indicating the consignment, weight and country of origin.
Raw ingredient sample:	
(a)Visual	Purple-red color.
(b)Aroma	Floral, berry-like aroma. Free from objectionable off odors.
(c)Texture	Lump free, free flowing particles
Prepared sample:	
(a)Visual	Clear, deep red solution with some background purple hues. Blue hues are undesirable.
(b)Aroma	Slight berry aroma.
(c)Flavor	A well balanced, tart and astringent flavor. Some cranberry notes as well as a slight drying effect. Not excessively tart, acidic or bitter. Should be free of off-flavors and other undesirable spice/botanical notes.
Testing Parameters:	

Test Units:	*Specifications*
(a) Free Flow Density	G/CC Minimum 0.45, Maximum 0.60
(b) Moisture	12%
(c) Total Ash	10%
(d) Acid Insoluble Ash	1.50%
(e) Sieve Analysis	Thru US#20 95.0%
5 Min Rotate	Thru US#60 5.0%
(f) Insect Fragments each	400
(g) Whole Insects (field/storage) each	25/5
(h) Salmonella	Negative
(i) Coliform	2 of 5 over 10 CFU, 0 of 5 over 100 CFU
(j) E. coli (MPN)	2 of 5 over 3 CFU, 0 of 5 over 20 CFU
(k) E. coli (Film)	0 of 5 over 10 CFU
(l) S. Aureus	1 of 5 over 100 CFU, 0 of 5 over 1000 CFU
(m) Standard Plate Count	0 of 5 over 1,000,000 CFU
(n) Yeast/Mold	0 of 5 over 10,000 CFU

Source: Rural and Agricultural Income with a Sustainable Environment Program of USAID

Shipping and Customs

Germany and US regulations regard roselle as safe by virtue of it being dried. No special import permits are necessary and producers do not need to be registered

Contract Logistics

Most product is purchased in advance by mid-September. Buyers may request either FOB (freight on board), CIF or CNF quotes from suppliers. FOB refers to the cost at the shipping port, without freight or insurance costs. CIF includes freight and insurance costs to a specific port, and CNF includes freight but not insurance.

Accessing Export Markets

Quality and reputation are everything in the specialty botanicals marketplace. In order to gain market share and develop a trustworthy reputation, producers must be able to consistently product a reliable quantity and quality. It does not necessarily have to be the highest quality product, but it needs to be of a reliable quality, and of course, clean. (Buyers interested in receiving samples are listed in Appendix 2).

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[1]The information below is based mostly on interviews with buyers, traders and industry experts.

[2] German herbal products dominate the European market.

[3] Lower prices are typically negotiated for larger orders.

2. Post-Production Operations

2.1 Pre-harvest Operations

Roselle is an annual bushy shrub that grows to approximately 2.4 meters in one growing season. While it is relatively easy to grow, it is more difficult to produce consistently high quality. This is a function of seed stock, local growing conditions, harvest time, and post-harvest handling, in particular the drying process.

Roselle is quite hardy and grows in most well drained soils. It can tolerate poor soil, and is often grown as a supplemental rather than a primary crop. It requires 4-8 months with nighttime temperatures not below 21oC. In addition, it requires 13 hours of sunlight during the first 4-5 months of growth to prevent premature flowering.

Roselle requires a monthly rainfall ranging from 5-10" (130-250 mm) in the first 3-4 months of growth. Dry periods can be withstood and are desirable in the last months of growth. Rain or high humidity during the harvest time and drying can downgrade the quality of the calyces and reduce the yield.

2.1.1 Planting

Hibiscus sabdariffa is very sensitive to changes in the length of day. This photoperiodic quality of blooming, when the days become shorter, require the planting time to be set according to the day length and not according to the rainfall requirements. It is a deep-rooted crop, therefore deep plowing is recommended in preparing the seedbed. To produce a large calyx 1,000-2,000 pounds of manure are added per acre (1-2 tonnes/ha).

Seeds are planted at a rate of 6-8 pounds or less per acre (6-8 kg/ha) and approximately one inch (2.5 cm) deep. Seeds are usually planted in the spring at the beginning of the rainy season, 2-3 feet (0.60-1 m) between rows and 18-24 inches (45-60 cm) within the rows. The reduced planting rate produces a larger calyx. Sowing can be done by hand, or with a modern grain drill. A good alternative tool would be a corn planter small enough to accommodate the hibiscus seeds. Thinning is done by hand as well.

There are over 100 cultivars or seed varieties of *Hibiscus sabdariffa*. The major commercial varieties are those grown in China, Thailand, Mexico and Africa, principally Sudan, Senegal and Mali. In most other countries, small farmers carry out the bulk of production, but in the Sudan, nomadic goat herders are known to pick the product from semi-wild sources.

2.1.2 Growth

Flowering of the hibiscus is induced as the days become shorter and light intensity reduces. Flowering begins in September or later depending on the country in question, and continues through October or later when the entire field is in bloom. Flowers begin to drop at the end of October or later. Flowers are diurnal and last only a day. The seedpods begin ripening towards the bottom and proceed to the top. In Sudan, growers will sometimes allow the seed to completely ripen and the leaves drop prior to harvest.

2.2 Harvesting

Hibiscus sabdariffa is harvested from late December onwards. The harvest is timed according to the ripeness of the seed. The fleshy calyces are harvested after the flower has dropped but before the seedpod has dried and opened. The more time the capsule remains on the plant after the seeds begin to ripen, the more susceptible the calyx is to sores, sun cracking, and

general deterioration in quality. All harvesting is done by hand. Total yield is about half a ton per hectare.
Special care must be taken during harvesting operation to avoid contamination by extraneous material. At no time should the calyx come in contact with the ground or other dirt surfaces. Clean bags or containers should be used to transport from the field to the drying location.
Different harvesting methods are in use today. In Mexico the entire plant is cut down and taken to a nearby location to be stripped of the calyces. In China only ripe calyces are harvested with clippers leaving the stalks and immature calyces to ripen in the field. The field is harvested approximately every ten days until the end of the growing season. The calyx is separated from the seedpod by hand, or by pushing a sharp edged metal tool through the fleshy tissue of the calyx separating it from the seedpod.
Thailand has perhaps the most sophisticated production system. Growers and collectors are more organized, and during the growing season collectors monitor the crop and estimate the yield for the whole country.

2.3 Drying

The time between harvest and drying should always be kept at a minimum. Drying can be accomplished by different methods. Drying with adequate ventilation, using woven nylon mats for example, prevents sun baking, which can reduce quality. A clean sheet of plastic placed on the ground can also be used with the hibiscus spread thinly on top. This method is still prone to insect infestation and mold. Spreading the calyces on screens or frames would improve ventilation further and reduce drying time. Such frames could also be stacked or hung in a well-ventilated building. The drying ratio is 10:1.1. That is, for every 100 pounds of fresh calyx, 11 pounds of dry calyx is produced.
But often color, texture and flavor of these calyces are not up to standard, neither of the internal consumers nor of the international market. An improvement of product quality can be achieved by using more adequate methods. Hot air dryers as used in developed countries are rather expensive but for instance the "Solar drying tunnel" provides a cost-efficient alternative.

Figure 6: Solar drying tunnel [15]

This dryer basically consists of an air collector, solar cells, a drying tunnel and several axial fans. Inside the drying tunnel the product is spread and passed by the hot air. For efficient conversion of solar irradiation into heat, the bottom of the collector as well as the dryer is

painted with black lacquer. To prevent the product from rain, the machine is spanned by a plastic foil.

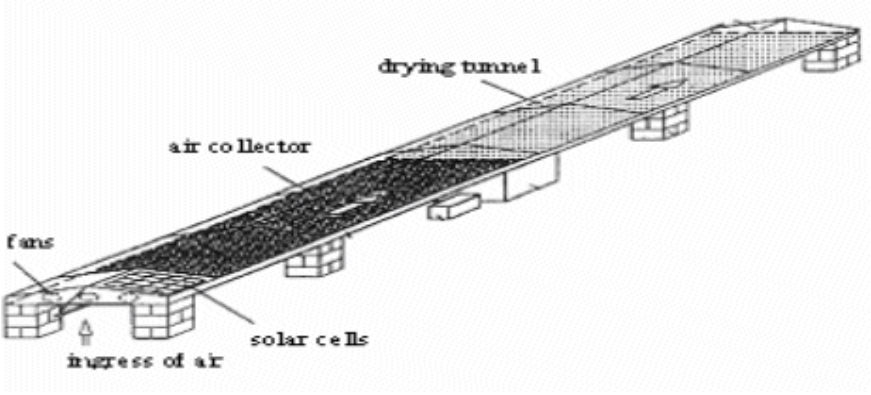

Figure 7: Description of solar drying tunnel[16]

To permit using the machine all-the-year even during long periods of rain, it is possible to install an additional heater between the collector and the dryer. Experiences in the field show that generally the time to dry spices is only half as long using the solar dryer then using conventional methods. Advantageously concerning storage is the permanent drying achieved by using the solar dryer. Possible differences in moisture can be cleared by storing all products together in one box for a few days after the drying process.
While drying the product is protected against climatic influence, insects, birds, rodents and dust. Insects that get together with the product into the dryer while filling the machine, are killed during the drying process.[5]

2.4 Packaging and Processing

Roselle is mainly sold whole and dried, packaged in bales. As mentioned earlier, Thailand is the only country that has been able to carry out value-added processing (cutting and sifting) because of its superior reputation for cleanliness.
Each buyer typically has his/her own product specifications. Table 6 contains common guidelines and specifications for dried roselle and Appendix 1 contains a sample technical specification sheet used by the leading specialty tea company in the US, Celestial Seasonings. Cleanliness is key and in general, no pesticides should be used.

3. Pest Control

Major diseases of hibiscus are mostly stem and root rot. Prevention techniques can include monitoring water in an irrigated field as well as avoiding the planting of crops that are also prone to these diseases. Damage done to hibiscus by insects is minor but it does exist. Pests include the stem borer, flea beetles, abutilon moth, cotton bollworm, and the cutworm. Mealy bugs and the leafhoppers are minor concerns, as is the cotton strainer.
Plant enemies usually do not compete in a cultivated field. Weeding can increase yield and calyx size, but may also reduce profit for the farmer. Because of differences in available land and labor prices, Chinese hibiscus fields are generally weeded and even hand watered if necessary, for maximum yield, while those in Thailand are given less attention. Quality is comparable.

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Annex 2: Technical Quality Specification

U.S. Herb Importer (country of origin: China, Thailand, Sudan, Mexico, Central America)

ATTRIBUTE	LIMIT/RANGE	TEST METHOD
1. CHARACTERISTICS		
Form	Tea bag cut, pre-processed	Visual inspection
Plant part(s)	Calyx	Visual inspection
Moisture	<12.0%	AOAC 967.19
Water activity	<0.62%	AOAC 978.18
U.S. Sieve size	(not applicable on whole herbs)	AOAC 965.22
# 8 mesh	0% on this screen	
# 10 mesh	<1% on this screen	
# 100 mesh	< 3 through this screen	
# 120 mesh	< 1% through this screen	
Color	Characteristic	Visual inspection
Kosher	Pareve	Star K approval
2. CONTAMINANTS OF ANIMAL ORIGIN		
Excreta	None	AOAC 945.88 & 981.22
Feathers	< 1 per Kg	Visual inspection
Rodent hairs	< 3 per 50 g sample	Visual inspection
Animal parts	None	Visual inspection
Filth	< 1%	AOAC 945.83
Glass or metal	None	Visual inspection
Paper, string, cloth, plastic	< 1%	Visual inspection
3. Insect Infestation		
Live insects	None	Visual inspection
Dead whole storage	None	Visual inspection
Dead whole field	< 20 per 10 g sample	Visual inspection
Fragments	< 100 per 10 g sample	Visual inspection
Insect damaged	< 5% damaged pieces by weight	Visual inspection
4. Adulterants of Plant Origins		
Extraneous plant parts	< 1%	Visual inspection
Non-toxic foreign plants	< 1%	Visual inspection
Toxic plant parts	None	Visual inspection
5. Adulterants of Mineral Origin		
Heavy metal content	< 50 ppm	USP <231>
ATTRIBUTE	**LIMIT/RANGE**	**TEST METHOD**
Ash	< 5.0%	ASTA 3.0

Acid insoluble ash	< 1.0%	ASTA 4.0
6. Microbiological		
Aflatoxins	< 20 ppm	FDA BAMA/AOAC
Mold & Yeast	< 100,000 cfu per gram	FDA BAMA/AOAC
Standard Plate Count	< 10,000 cfu per gram	FDA BAMA/AOAC
E. coli	< 3 mpn cfu per gram	FDA BAMA/AOAC
Salmonella	Negative	FDA BAMA/AOAC
7. Chemicals		
Pesticides and Fumigants	By country	EPA PAM
Sterilants	No residue	EPA PAM

Source: Celestial

Annex 3: List of Figures and Tables

Annex 4: Importers Interested in Receiving Samples [4]

USA

Celestial Seasonings
4600 Sleepytime Drive
Boulder, CO 80301-3284
Tel: (303) 530-5300
Fax: (303) 581-1249
Contact: Ms. Kay Wright
Email: kwright@celestialseasonings.com

FMALI Herbs Co. and Gooder's Teas
Santa Cruz, CA 95060-5899
Tel: (831) 423-4463
Fax: (831) 423-7913 x 213
Contact: Mr. Chang
Email: info@fmali.com
Operations Manager

Sanbar Trading
1705 14th Street
Boulder, CO 80302-6321
Tel: (303) 499-7480
Fax: (303) 727-4026
Contact: Ms. Kirsten Augustad
Email: sna.kaugustad@ibm.net

Chia I Foods Co. Ltd.
1711 Floradale Avenue
South El Monte, CA 91733
Tel:(626) 401-3095
Fax: (626) 401-9519
Contact: Mr. Steve Huang
Email: annhuange@chia-i.com

R. C. Bigelow Inc.
Fairfield, CT 06432-5512
Tel: (203) 334-1212 or 1-800-243-5587
Fax: (203) 382-5509
Contact: Ms. Denise Ferris
Email: dferris@bigelowtea.com

San Francisco Herb and Natural Food Company
Fremont, CA 94538-7319
Tel: (510) 770-1215
Fax: (510) 770-9021
Contact: Mr. Eli Meltzer

Stash Tea Inc.
9040 SW Burnham Street
Tigard, OR 97223
Tel: (503) 684-4482 or 1-800-547-1514
Fax: (503) 684-4424
Contact: Ms. Joy Edlund
Email: stash@stashtea.com
WWW: http://www.stashtea.com/

Starwest Botanicals Inc.
11253 Trade Center Drive
Rancho Cordova, CA 95742
Tel: (916) 638-8100 or 1-800-273-4372
Fax: (916) 638-8293
Contact: Ms. Bonnie Sadkowski
Email: bonnie-s@starwest-botanicals.com
Whole Herb Company
P.O. Box 1203
Sonoma, CA 95476
Tel:(707) 935-1077
Fax: (707) 935-3447
Contact: Ms. Rena Jaracek
Email: rena@wholeherbcompany.com

GERMANY

Heinrich Klenk GmbH
Postfach 16
Schwebheim
Tel: +49-9723-60933
Fax: +49-9723-60944
Contact: Mr. Klaus Brandt
Head, Purchasing Department
Martin Bauer GmbH
Dutendorferstr. 5-7
D-91487 Vestenbergsgreuth
Tel: +49-9163-88230
Fax: +49-9163-88219
Contact: Mr. Martin Weder
Email: monica.unger@martin-bauer.de
Purchasing Manager
J. G. Schüter & Co.
Bornstr. 1617
28195 Bremen
Tel: +49-421-3042330
Fax: +49-421-3042210
Contact: Mr. Michael Gable
Email: gae@jgs.de

[4] Source: RAISE.org