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Factors Affecting Development of a Tea Industry in Hawaii

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The production and consumption of tea worldwide has increased over the past decade, and this increase is expected to continue, according to Chang and Yabuki (see *References*). While the tea plant (*Camellia sinensis*) grows well in Hawaii, high costs of production have impeded commercial development of tea as a crop and commodity here (Tipton et al.). Increasing consumer interest in products with purported health benefits, as well as in Hawaii-grown products, may provide prospective tea producers here with incentive to reexamine economic opportunities in tea and consider supporting further market-related research, development of new varieties of tea for Hawaii, and investigations into innovative production practices.

This publication provides a brief summary of the production and consumption of tea worldwide. It focuses in particular on the U.S. mainland and Hawaii markets so as to provide a relevant market overview. Results of a survey of Hawaii consumers are presented to identify the characteristics of one of the market segments that could be targeted by a high-value tea product. We also summarize implications of the information presented and suggest specific steps needed to assess the economic feasibility of commercial tea production in Hawaii.

Types of tea

Green, oolong, and black teas are all produced from the young leaves of *Camellia sinensis*. These variations in type result from the processing used to ferment, heat, and dry the leaves (see CTAHR's *Small-scale tea growing and processing in Hawaii* by Zee et al.). The fermentation is a chemical reaction induced in the leaves to start oxidation, which is stopped by heat and followed by drying.

Green teas are not fermented and are considered unoxidized; white and yellow teas are types of green tea. White tea is dried immediately after harvest, and yellow tea is dried more quickly than other green teas. Paochong and oolong teas are partially oxidized, while black, red, and English teas are referred to as being fully oxidized.

The rich history of tea's cultural significance around the world includes wide variation in processing methods and consumer taste. This variation offers growers and processors an opportunity to differentiate their products to attract consumers and add value.

The market situation

Worldwide tea production in 2001 was over 3 million tons (Table 1, data in metric tons). The greatest production was from China and India, which generated about half of the total world production. Indonesia, Sri Lanka, and Kenya together account for another quarter of the total production. In 2000, India was the leading black tea producer (815,000 tons, 38% of total black tea production), while China produced the most green tea (500,000 tons, 73% of total green tea production) (FAO 2001). Exports totaled 1.4 million tons in 2001, with the top four exporting nations, Sri Lanka, Kenya, China, and India, accounting for (respectively) 21, 18, 18, and 13 percent of the exports.

Information on the amount of land used to grow tea in particular countries is available only for the Asia-Pacific region, which has 84 percent of the world's harvested tea area (Table 2). China harvested nearly twice as much area as India, and these two countries accounted for 58 percent of the world's tea acreage in 2000. India's average tea yield was nearly 2.4 times larger than that of China in 2000 (Table 3), while the average yield for

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Table 1. Major tea producing and exporting nations (1000 metric tons*).

	1996–98 Average		2000		2001	
	Production	Exports	Production	Exports	Production	Exports
World[1]	2811	1208	2959	1311	3033	1374
India	820	190	846	201	854	180
China	647	200	700	231	721	253
Sri Lanka	272	252	308	281	295	295
Kenya	257	235	236	207	296	251
Indonesia	162	79	159	106	159	100
Japan	88		89		89	
Bangladesh	54	25	52	18	57	13
Argentina	53	52	57	50	57	56
Malawi	41	42	42	38	37	38
Tanzania	22	20	24	23	25	22
Uganda		20		26		30

*1000 metric tons = 1102 U.S. tons = 2,204,000 pounds. [1]Excluding re-exports. Source: Chang and Yabuki.

the Asia-Pacific region as a whole was 60 percent of the average yield for the rest of the world. The yield differences may be due to the tea varieties, according to Tipton et al., because the varieties grown China have lower yields than those grown in India. In general, little information on the yield potential of *Camellia sinensis* is available. On the high end is the yield of over 4000 pounds per acre obtained in Sri Lanka, mentioned by Tipton et al.

Annual world production increases projected for 2000 to 2010 are 1.2 percent for black tea and 2.6 percent for green tea (Table 4). Both of these estimated growth rates are slightly higher than the actual growth rates from 1990 to 2000 (FAO 2001). Approximately 77 percent of the tea produced worldwide is black, 21 percent is green, and 2 percent is oolong (Blumberg).

The European Community and the Commonwealth of Independent States were the largest tea importers in 2001 (each with 17 percent of the total tea imported) followed by Pakistan and the United States (8 percent each) (Table 5).

Tea consumption in the United States

Between 1991 and 2001, per capita tea consumption in the United States increased from 0.79 pounds to 0.87 pounds per year (ERS 2002). The increase was not steady, however; it reached a low of 0.77 pounds in 1997, fol-

Table 2. World tea area harvested (1000 hectares*).

	1998	1999	2000
China	879	929	952
India	470	420	420
Sri Lanka	189	195	195
Indonesia	110	110	110
Japan	51	51	51
Bangladesh	49	49	49
Asia-Pacific total	1944	1947	1958
Rest of world total	379	372	378
World	2323	2319	2337

*1 hectare is about 2.5 acres
Source: http://www.fao.org/DOCREP/004/AB987E/ab987e0c.htm

Table 3. Average tea yield (kg/ha*).

	1998	1999	2000
China	782	751	758
India	1852	1784	1784
Sri Lanka	1482	1452	1458
Indonesia	1514	1526	1526
Japan	1613	1746	1746
Bangladesh	1041	1153	1153
Asia-Pacific	1182	1146	1155
Rest of world	1958	1926	1929
World	1309	1271	1280

*1 kilogram per hectare = 0.892 pounds per acre
Source: http://www.fao.org/DOCREP/004/AB987E/ab987e0c.htm

Table 4. World production of black and green tea (1000 metric tons*) in 2000 and projected for 2010.

	Black tea		Green tea	
	2000	2010	2000	2010
World	2145	2443	681	900
India	815	1070		
Sri Lanka	305	329		
Kenya	236	304		
Bangladesh	54	62		
Malawi	42	42		
Uganda	29	29		
Tanzania	24	24		
China	65	54	500	671
Indonesia	131	147	38	49
Japan			90	91
Vietnam			38	50

*1000 metric tons = 1102 U.S. tons = 2,204,000 pounds.
Source: FAO 2001.

Table 5. Major tea importing nations (1000 metric tons).

	1996–98 Average	2000	2001
World[1]	1180	1251	1293
EC	227	208	216
CIS[2]	193	212	217
Pakistan	108	111	107
Unites States	89	88	97
Egypt	72	63	56
Japan	49	58	60
Morocco	35	42	38
Iran	29	47	40
Syria	18	20	22
Australia	16	15	15

[1]Excluding re-exports. [2]Including the Russian Federation.
Source: Chang and Yabuki.

lowed by a peak in 1998 at 0.88 pounds. During the same period, per capita coffee consumption in the USA was also erratic, although it did not rise or fall relative to tea consumption. In 1997, U.S. per capita tea consumption (converted to its liquid equivalent) accounted for 4.5 percent of the total beverage consumption (Figure 1).

Consumption of canned iced tea was not tracked until 1987, but annual per capita consumption increased steadily from 0.1 gallons in 1987 to 0.8 gallons in 1997, an increase of 880 percent over the period (Putnam and Allshouse). Total U.S. consumption of coffee and tea is expected to increase by an additional 20 percent by 2020 (Lin et al.).

In 1998, the average household spent $5.48 per year on tea, which was about 6 percent of its total spending on beverages. The highest individual tea expenditures were by single people over 35. Expenditures were higher for households without children and those with incomes in the lower-middle and highest income brackets. Households with young children spent the least, with expenditures increasing as the children aged. People in the Northwest spent the most on tea, averaging $7.68 dollars per household per year. Household spending was higher in rural areas ($6.21) than urban areas ($5.38) (Blisard).

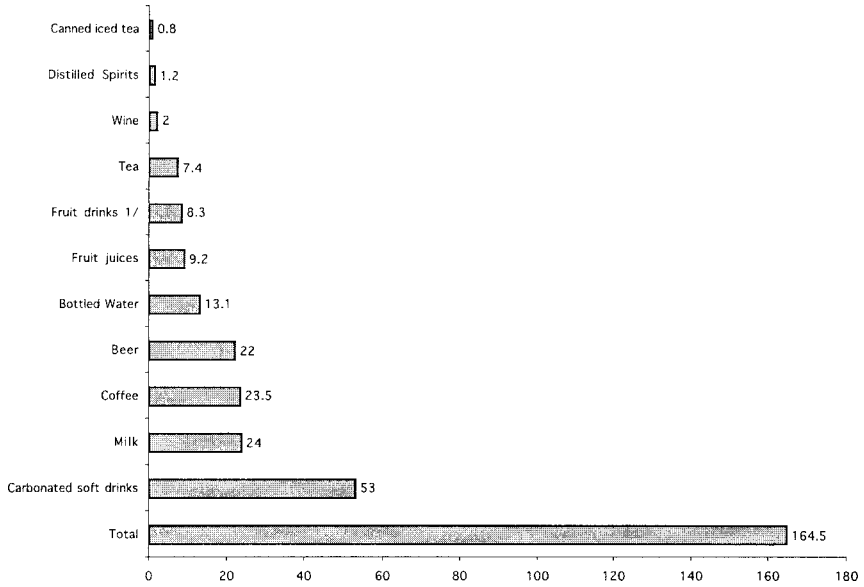
Tea prices

World tea prices are volatile. Prices from three major auctions, Calcutta, Colombo, and Mombasa, varied widely during 1985–1998 with no specific pattern to the movements (Figure 2). Prices at these auctions were not well correlated, differing in level, volatility, and direction. If the prices of tea are deflated by the manufactured unit value, then the real price of tea decreased from 1985 to 1998 (Figure 3). The movements of real prices relative to the purchasing power of the tea exporting countries indicates that price margins fluctuate randomly, thereby increasing the price risk associated with tea production (Chang and Yabuki).

Reported health benefits of tea relative to marketing

In marketing tea to health-conscious consumers, sellers will likely strive to inform consumers about the benefits of tea consumption. Recent research addressing the range of health benefits of tea may assist potential producers in Hawaii in developing marketing strategies. If a business intends to market a product as a nutraceutical, then careful attention must be given to the quality of the product and the statements in promotional materials.

Figure 1. U.S. per capita beverage[1] consumption (gallons) in 1997.



[1]Includes fruit cocktails and ades. Source: Putnam and Allshouse.

Figure 2. Tea price movement at three major auctions, 1985–1998 (nominal prices, U.S. cents/kg). Source: FAO 1999.

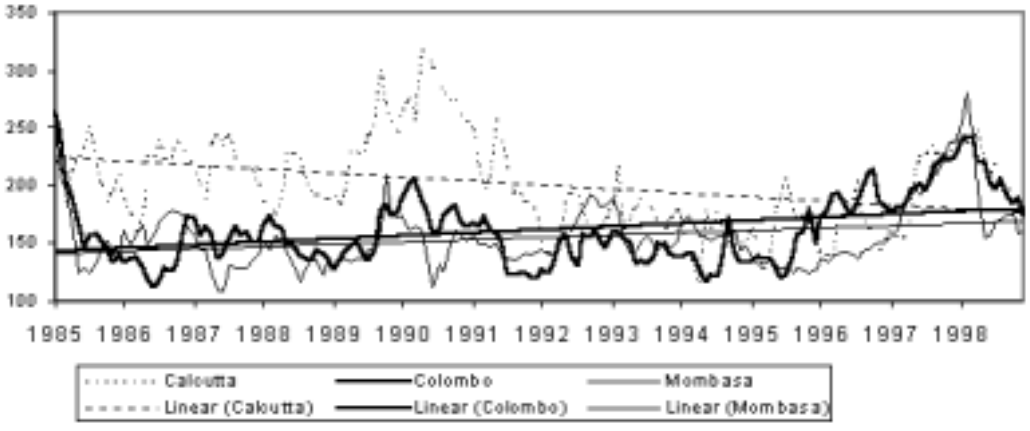
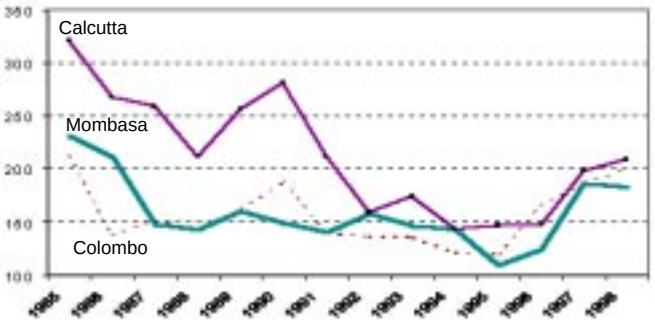


Figure 3. Terms of trade of tea, 1985–1998) (1990 = 100 constant prices, U.S. cents/kg). Source: FAO 1999.



Nutraceutical is a term coined a decade ago that is defined as a foodstuff, such as a dietary supplement or fortified food, that provides medicinal or health benefits, including the prevention and treatment of disease (Merriam-Webster).

The U.S. Food and Drug Administration (FDA) has regulatory authority to assess the accuracy of claims made by manufacturers about the health benefits of their products. Currently the FDA does not provide detailed information about healthful patterns concerning beverage consumption (Blumberg). If a tea producer claims that a tea product prevents or cures a disease, then the FDA would consider the tea a drug and regulate it as such. This would mean that the tea would need FDA approval as safe and effective for its intended use (Snider).

Teas from *Camellia sinensis* have been shown to be beneficial in the prevention of cancer, cardiovascular disease, dental caries, osteoporosis, and diabetes, along with positive effects in improving cognitive function and weight maintenance. Many of these benefits have been attributed to the presence of phytochemicals, particularly polyphenolic flavonoids, that have antioxidant properties. Regardless of the degree of fermentation, teas from *C. sinensis* contain phytochemicals, although the flavonoid concentration depends on the type of tea and its preparation. Brewed hot tea has the highest concentration, followed by instant or decaffeinated, and then iced and ready-to-drink teas (Bliss; Blumberg).

Polyphenols have been shown to stop the damage that free radicals do to cells, neutralize enzymes essential for tumor growth, and deactivate cancer promoters (Chung et al.; Fei and Higdon; Hakim et al.). Several experiments have demonstrated tea's potential in the prevention of cancer. Research conducted in Russia concluded that women who drank more than 160 grams (dry weight) of black tea per month had a 60 percent lower risk of rectal cancer, and those who drank 80–160 grams per month had a 52 percent lower risk compared to a group that did not drink tea. A study of men and women who were heavy smokers showed that those who drank four cups of decaffeinated green tea per day lowered their levels of 8-OhdG, a measure of overall damage to DNA. Those smokers who drank black tea and those who drank water showed no benefits (Third International). In another study, mice that were predisposed to developing tumors were given a concentration of tea that was comparable to that consumed by humans. The mice not given tea developed an average of 30 tumors, but those given green tea developed 43 percent fewer tumors. White tea, which has higher levels of polyphenols, reduced the number of tumors to 13, a 57 percent reduction (Orner et al.).

Tea has also been shown to help reduce cholesterol levels and the chance of heart attack (Hollman et al.; Tijburg et al.; Knekt et al.; Liu). In one study, adults with mildly high cholesterol levels took five servings of black tea per day for three weeks. In comparison to those who took a placebo without caffeine, cholesterol was reduced by 4 percent and LDL, or "bad" cholesterol, was reduced by 8 percent. Compared to the group who took the placebo with caffeine, total cholesterol was reduced by 7 percent and LDL cholesterol was reduced by 11 percent. In a similar study, men and post-menopausal women with slightly elevated cholesterol levels were put on a diet of lower-cholesterol meals and drank either five servings of tea or a tea-flavored beverage. Those who drank the tea had lower overall cholesterol levels and a 10 percent decrease in LDL cholesterol. A 1 percent decrease in cholesterol reduces the risk of heart attack by about 2 percent. Thus the consumption of five cups of black tea daily could reduce the risk of heart attack by 8–13 percent. Other research showed that people who drank two to four servings of tea per day had a significantly lower risk of dying following a heart attack (Davies et al.).

Tea also helps with oral health. It contains fluoride, which sustains healthy, strong teeth (Kendall). When

used in combination with toothpaste, green tea may help to fight off viruses. Toothpaste alone does not destroy viruses, but the green tea extracts could eliminate bacteria, allowing the toothpaste to fight off the viruses (Wu and Wei; Jones, et al.).

Tea production in Hawaii

Tea was introduced to Hawaii in 1887. It can be grown anywhere in the state from sea level to 6000 feet elevation, but attempts to commercialize tea production on Kauai and in the Kona region of the island of Hawaii were largely unsuccessful. In the 1980s, sugar producers considered tea as a potential crop replacement for sugarcane. In 1999–2001, tea was planted on the island of Hawaii at Waiakea, Mealani, and Volcano as part of a research project to examine the possibilities for commercial production of tea. In each of the three areas, the tea grew well, was ready for harvest about 18–20 months after planting, was of excellent quality, and had few pest and disease problems (Zee et al.).

Tea production is highly labor intensive, with labor costs accounting for around 60 percent of the total cost of production (Chang and Yabuki). Given the high cost of farm labor in Hawaii compared to the major production regions of India and China, labor costs appear to be the primary reason for the failure of commercial tea production in Hawaii. However, Zee et al. stated that mechanical harvesting of clonal tea plants should be possible, which would reduce labor costs and make tea produced in Hawaii more competitive.

If tea is produced as a commodity in Hawaii, world price variations may introduce substantial price risks for Hawaii producers. Zee et al. suggest that a niche market for a "Hawaiian tea blend" may exist. Prices in a niche market are expected to fluctuate less than in a broader commodity market because consumers would be willing to buy a particular premium product more consistently than those who purchase tea as a commodity. However, experienced producers across the globe are also expected to continue their efforts to develop niche markets for their tea as a means of reducing price risk and increasing the average price they receive. Therefore, the premium tea market is also expected to be competitive.

In addition to the risk introduced by price variability, tea production in Hawaii faces climatic challenges. In order to be of superior quality, tea requires a specific set of growing conditions. Strong winds, excessive rainfall, and frequent frosts reduce the quality of tea (Zee et al.). These risk factors may limit the geographical area in which tea production is feasible, because strong winds and high rainfall are common in parts of Hawaii.

A survey on tea consumption in Hawaii

We have mentioned data on tea consumption in the United States, but no specific tea consumption statistics have been available for Hawaii. Therefore, a telephone survey was conducted from October to December 2003 during the morning (9 a.m. to 12 p.m.) and evening (7–9 p.m.) to develop information for potential tea producers about the tastes and preference of Hawaii residents. The questionnaire can be found in the Appendix (p. 10).

Five hundred residential phone numbers were selected at random from the telephone directories of all the Hawaiian Islands. If the resident declined to participate, another number was selected. The questionnaire asked about the respondent's tea purchasing habits, beverage consumption habits, and demographic characteristics. In order to verify the reliability of the telephone interviews, 50 more residents were interviewed in person, and the results of those interviews were compared to the results of the telephone interviews; no inconsistencies were found.

Ninety percent of the respondents were tea consumers, with 41 percent drinking daily (Table 6). Of those who drink tea, 44 percent consume it at night and 24 percent consume it in the morning. Respondents indicated that taste (55%), health reasons (40%), and religious reasons (5%) were the major motivational factor in their tea consumption. Juice was the beverage most frequently consumed (33%), followed by tea (26%), soft drinks (24%), and coffee (17%).

The average tea consumption across all survey respondents was two cups per day. Based on respondents' estimated monthly consumption of 60 tea bags per month, an average household size in Hawaii according to the 2000 U.S. Census of 2.92 people (U.S. Census Bureau), and an average cost per bag of $0.067, those that drank tea spent about $141 per year on tea prepared at home. Compared to the national average in 1998 of $5.48 per year (Blisard), Hawaii households, assuming that all household members consumed tea as described here, are spending much more than the average U.S. household on tea.

Table 6. Tea consumption habits of survey respondents.

Consumption	Percentage of respondents
Frequency	
Daily	41
Every other day	16
Weekly	31
Monthly	12
Time of day	
Morning	24
Noon	10
Afternoon	16
Night	44

Table 7. Average importance of tea attributes for survey respondents.

Attribute	Average score*
Consistency in taste	1.35
Quality	1.40
Health benefits	1.60
Nutrition content	1.70
Price	1.74
Organically produced	2.00
Brand name	2.30
Source of production	2.30
Naturally produced	2.30

*1 = important, 3 = not important.

The type of tea consumed varied with the age of the respondent. Respondents over 44 consumed primarily hot green and black tea, while those 44 and younger were more likely to consume tea beverages. Most respondents (71%) purchased tea mainly from supermarkets, followed by "natural food" stores (16%) and specialty food stores (8%). Internet and catalog sales accounted for only 2 percent each. The form of tea purchased by the respondents varied, with 54 percent buying bags, 24 percent buying tea leaves, and 22 percent buying concentrate.

Respondents were asked to rate various tea attributes with a rank of 1 for very important, 2 for important, and 3 for not important. As shown in Table 7, consistency in taste was the most important attribute, followed by quality, health benefits, nutritional content, and price. Factors related to production methods were less important, on average, to respondents.

To determine whether or not this sample is representative of Hawaii residents, the sample results were compared to the 2000 U.S. Census for the State of Hawaii (U.S. Census Bureau). Ethnic distribution, age, and educational attainment were similar for the sample and the 2000 census (Table 8). Therefore, the sample appears to be representative of Hawaii's population. The time of day at which a questionnaire was completed was not recorded and therefore, the effect of this variable cannot be analyzed.

No question was included in the survey about willingness to substitute a tea produced in Hawaii for an imported product because no Hawaii product is now readily available statewide. However, some products now being sold in the Hawaii market have been blended here from imported materials and are marketed as though they are a local product. Further consumer research will be undertaken as Hawaii-grown products become more available.

Table 8. Characteristics of survey respondents compared to U.S. population (%).

	Sample	U.S. census*
Ethnic background (%)		
Caucasian	32	24
Asian	51	42
Pacific islander (Hawaiian)	14	9
Black	0	2
Others[1]	2	23
Age		
Less than 20	21	27
20–44	36	37
45+	43	36
Educational level		
Some high school	13	15
High school	33	29
Some college	27	22
College graduate	27	26

*Percentages rounded for ease of comparison. [1]Census allows respondents to identify themselves with two or more races.
Source: U.S. Census Bureau, 2000 Census for the State of Hawaii.

Conclusions and implications

The demand for tea is expected to increase worldwide, with the European Community, the United States, and Japan being major importers. Given that many visitors to Hawaii are from these parts of the world, the visitor market may be a niche market for a Hawaii specialty tea. Also, we expect tea consumers to be relatively insensitive to price changes, because tea purchases do not account for a large percentage of the consumer's total budget. These two factors combined will help Hawaii find a competitive position in the specialty tea market.

Our telephone survey found that relative to the U.S. average a large proportion of Hawaii residents drink tea frequently. Survey respondents ranked quality and health benefits as more important in their tea-purchasing decision than price. While the residents surveyed were not asked about their willingness to substitute a local product for an imported product, the attributes they deemed most important do not indicate that country of origin is an important factor in the tea-purchasing decision. No evidence was found to suggest that import substitution (i.e., buying a local product instead of an imported one) would not occur if a product produced in Hawaii had comparable attributes. Therefore, residents also may be a likely segment of the niche market for a Hawaii specialty tea.

The challenge for prospective tea producers is to develop a marketing strategy that will ensure success. The use of Hawaii's image and the fact that the product is grown in the United States can help boost a product's image as a safe, fresh, and healthy one that brings the beautiful Hawaii landscape and spirit of aloha to the mind of the consumer. The strategy must include the four marketing "Ps"—price, place, promotion, and product—such that the product will be attractive and accessible to the target markets (for more information, see CTAHR's *This Hawaii product went to market* by Hollyer et al.).

To develop such a marketing strategy, additional quantitative and qualitative information is needed about potential producers and consumers. Cost of production must be used as a starting point for estimating price, to ensure feasibility. A thorough understanding of the targeted consumers is needed so that the product can be placed in appropriate markets. At the same time, producers who want to export will need information about potential trade barriers and logistics associated with the export destinations (see CTAHR's *Preflight checklist for shipping your quality agricultural product* and other publications in the Entrepreneur's Toolbox at www.ctahr.hawaii.edu/freepubs). Promotional efforts must be considered as a major part of the larger marketing strategy and must compliment the other components of price, place, and product so that the consumer is convinced that Hawaii teas are premium products.

The product itself will require attention as producers strive to arrive at a consistent, high level of quality. The type, form, or blend of tea that will be most attractive to consumers will need to be identified.

In-depth research and analysis will be required to collect the information described above for each consumer segment that may take part in the niche market. Other goods and services that may interest visitors, such as tea blending seminars, tea production tours, tea tasting, gardening with tea, tea as fabric dye, and culture or art related to tea, including tea ceremonies, may contribute to the feasibility of a tea industry in Hawaii. Incidentally, because the tea plant makes a desirable landscape plant, producers may also be able to market potted tea plants. Given the many health benefits of tea that are described here, nutraceuticals produced from tea may be of interest to consumer segments in niche markets, although these types of products will require a significant amount of product development and strict quality standards.

References

Blisard, N. 2001. Food Spending in American Households, 1997–98. ERS/USDA.

Blumberg, J. 2003. Introduction to the Proceedings of the Third International Scientific Symposium on Tea and Human Health. Journal of Nutrition 133: 3244S–3246S

Bliss, R.M. 2003. Brewing up the latest tea research. USDA-ARS Agricultural Research 51(9):11–13.

Chang, K., and N. Yabuki. 2003. Tea Commodity Notes: Production declined in 2002. Food and Agriculture Organization of the United Nations. www.fao.org/es/ESC/en/20953/21035/highlight_28649en_p.html.

Chung, F.-L., J. Schwartz, C.R. Herzon, and Y.-M. Yang. 2003. Tea and cancer prevention: Studies in animals and humans. Journal of Nutrition 133:3268S–3274S.

_____, b. 2003. Tea fights bad breath, mouth bacteria. WebMD Health. Referencing: Abstracts, American Society for Microbiology General Meeting, Washing-

ton, D.C., 2003.

Davies, M., J.T. Jud, D.J. Baer, B.A. Clevideine, D.R. Paul, A.J. Edwards, S.A. Wiseman, R.A. Muesing, and S.C. Chen. 2003. Black tea consumption reduces total and LDL cholesterol in mildly hypercholesterolemic adults. Journal of Nutrition 133:3298S–3302S.

ERS. 2002. Coffee, tea, and cocoa: Per capita consumption. Economic Research Service of the U.S. Department of Agriculture.

Frei, B., and J.V. Higdon. 2003. Antioxidant activity of tea polyphenols in vivo: Evidence from animal studies. Journal of Nutrition 133:3275S–3284S.

FAO. 1999. Dealing with price risks. Committee on Commodity Problems, Intergovernmental Group on Tea, Thirteenth Session. Food and Agriculture Organization of the United Nations.

FAO. 2001. Medium-term outlook for tea. Committee on Commodity Problems, Intergovernmental Group on Tea, Fourteenth Session. Food and Agriculture Organization of the United Nations.

Hakim, I., A. Robin, B. Harris, S. Brown, H-H. Sherry Crow, S. Wiseman, Sanjiv, and W. Talbot. 2003. Effect of increased tea consumption on oxidative DNA damage among smokers: A randomized controlled study. Journal of Nutrition 133: 33035–33095.

Habib, L. 2002. More good news on tea. WebMD Health. Referencing the Third International Scientific Symposium on Tea & Human Health, hosted by the USDA.

Hollman, P., E. Feskens, and M. Katan. 1999. Tea flavonols in cardiovascular disease and cancer epidemiology. Proceeding from the Society of Experimental Biological Medicine 220:198–202.

Hollyer, J.R., J.L. Sullivan, and L.J. Cox (eds.). 1996. This Hawaii product went to market. Univ. of Hawaii, College of Tropical Agriculture and Human Resources. 168 pp.

Jones, C., K. Woods, G. Woods, H. Whittle, H. Washington, and G. Taylor. 1999. Sugar, drinks, deprivation and dental caries in 14-year-old children in the north west of England in 1995. Community Dental Health 16:68–71.

Kendall, Pat. 2000. Finding health benefits in tea leaves. Nutrition News. Colorado State Univ. Cooperative Extension.

Kenkt, P., J. Kumpulainen, R. Jarvinen, H. Rissanen, M. Heliovaara, A. Reunanen, T. Hakulinen, and A. Aroma. 2002. Flavonoid intake and risk of chronic disease. American Journal of Clinical Nutrition 76:560–568.

Lin, B.-H., J.N. Variyam, J. Allshouse, and J. Cromartie. 2003. Food and agricultural commodity consumption in the United States: Looking ahead to 2020. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture.

Liu, R.H. 2003. Protective role of phytochemicals in whole foods: Implications for chronic disease prevention. Applied Biotechnology Food Science Policy 1:39–46.

Merriam-Webster Online. 2204. www.m-w.com.

Putnam, J.J., and J.E. Allshouse. 1999. Food consumption, prices, and expenditures, 1970–97. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture.

Orner, G.A., W.-M. Dashwood, C.A. blum, G.D. Diaz, Q. Li, and R. Dashwood. 2003. Suppression of tumorigenesis in the APCmin mouse: Down-regulation of (-catenin signaling by combination of tea plus sulindac. Carcinogenesis 24(2): 263–267.

Snider, Sharon. 1991. Herbal teas and toxicity. FDA Consumer. http://www.fda.gov/bbs/topics/CONSUMER/CON00007.html

Third International Scientific Symposium on Tea and Human Health: Role of Flavonoids in the Diet. 2002. New study provides evidence that tea consumption reduces low density lipoprotein (“bad” cholesterol) levels. Tea Association of the United States.

Tijburg, L., T. Mattern, J. Folts, U. Weisgerber, and M. Katan. 1997. Tea flavonoids and cardiovascular diseases: A review. Critical Review of Food Science and Nutrition 37:771–785.

Tipton, T.V., K.M. Yokoyama, K. Wanitprapha, and S.T. Nakamoto. 1990. Tea. Economic Fact Sheet no. 8, Univ. of Hawaii, College of Tropical Agriculture and Human Resources. 4 pp.

U.S. Census Bureau. 2000. factfinder.census.gov/servelt/BasicFactsTable

Wu, C.D., and G-X Wei. 2002. Tea as a functional food for oral health. Nutrition 18:443–444.

Zee, F., D. Sato, L. Keith, P. Follett, and R.T. Hamasaki. 2003. Small-scale tea growing and processing in Hawaii. Univ. of Hawaii, College of Tropical Agriculture and Human Resources, New Plants for Hawaii no. 9. 14 pp.

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Appendix: Survey questionnaire

Participation and demographic information

Do you drink tea?

- ❑ Yes
- ❑ No

Which of the following categories best describes your ethnicity? (Which of the following categories does the respondent identify with ethnically?)

- ❑ Caucasian
- ❑ Asian
- ❑ Pacific Islander
- ❑ Other:_____.

Which of the following age groups do you belong to?

- ❑ Less than 21 years old
- ❑ 21–44 years of age
- ❑ 45+ years of age

What was your highest level of education completed?

- ❑ Some high school
- ❑ High school
- ❑ Some college
- ❑ College graduate

Beverage consumption

Excluding water, what type of beverages do you drink most frequently? (Check one)

- ❑ Tea
- ❑ Coffee
- ❑ Soft drink
- ❑ Juice
- ❑ Other:_____.
- ❑ Do not know / No response

When do you drink tea? (Check all that apply)

- ❑ In the morning
- ❑ At noon
- ❑ In the afternoon
- ❑ At night
- ❑ Never (Interview is concluded.)
- ❑ Do not know / No response

Tea consumption

In what form do you buy tea? (Check all that apply)

- ❑ Tea bags
- ❑ Tea leaves
- ❑ Tea concentrate (e.g., Lipton's Ice Tea).
- ❑ Other: _____.

Where do you usually buy tea? (Check one)

- ❑ Supermarket
- ❑ Specialty store
- ❑ Natural food store
- ❑ Internet
- ❑ Catalog (mail order)

How often do you drink tea? (Check one)

- ❑ Daily
- ❑ Every other day
- ❑ Weekly
- ❑ Monthly
- ❑ Do not know / No response

What type of tea and how much do you consume per day?

What is your main reason for drinking tea?

- ❑ Religious beliefs
- ❑ Taste
- ❑ Health
- ❑ Other:_____.
- ❑ Do not know / No response

Which of the following attributes do you consider when purchasing tea? Rate the attribute below according the the following scale:

1 = Very important
2 = Important
3 = Somewhat important
4 = Not very important
5 = Of no importance

Attribute

___ Price
___ Consistency of taste
___ Quality
___ Brand name
___ Source of production
___ Nutritional content
___ Health benefits
___ Organically produced
___ Naturally produced