

## Usage and Consumption of Spices in Milk Preservation: A Case Study of Zanzibar

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### Abstract

*Milk, as a highly nutritious food, serves as an ideal medium for the growth, and multiplication of spoilage microorganisms in areas with limited cooling storage and irregular supply of electricity in Tanzania. On the other hand, consumers are concerned about possible health effects from the use of chemical preservatives. However, number of plants have been used in food and in natural remedies for food preservation and curing various diseases for many eras, respectively. Nevertheless, there are many natural plant extracts rich in several phytochemical compounds including antioxidants which play important roles in both food system and human body tissues (Jayasinghea et al., 2013). Zanzibar is known as a spice island in Africa due to favourable climatic condition and soil. Therefore, the preliminary study was conducted assessing usage, consumption and effect of spices and herbs in milk. A cross sectional study involving direct observation and in-depth interviews was conducted in Zanzibar. Results show that 96.4% ( $P < 0.05$ ) of the respondents use spices and herbs in milk for food and traditional medicinal purposes. The most commonly spices and herbs added in milk were cardamom, cinnamon, ginger, lemon grass, clove, turmeric and vanilla. Normally, the spices and herbs are purchased from markets and shops 87.5% ( $P < 0.05$ ). 75% of respondents did not experience side effects of spices and herbs used in milk while 25% did. The majority reported microorganisms (73.2%) and poor storage (39.3%) are the major causes of milk spoilage. Respondents were aware with causes of milk spoilage. Most of the households, used refrigeration (55.4%), boiling (42.9%), freezing (23.2%), thermos (21.4%) and only few (7.1%) used spices to control spoilage. Therefore, the effect of the spices and herbs on preservation of milk could be studied scientifically to explore their potential in milk preservation.*

**Keywords:** Spices, Herbs, Milk Spoilage, Traditional Medicine, Zanzibar

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## 1.0. Introduction

Spices are dried parts of aromatic plants whose qualities are perceived through smell and taste. The use of spices is recorded far back 2600BC when the Egyptians used to give strength to the labourers building the great pyramid of Cheops (Pitcher, 2004). Zanzibar is known as a spice island in Africa due to favourable climatic condition and soil. Tanzania was among the top three countries which exported spices between 1995 and 1999. However there is dramatic drop has been reported (Maerere & van Noort, 2014).

Asians are famous for using a whole or combination of spices in food for preventing diseases and healing purposes (Raghavan, 2006). Therefore, incorporation of natural products into the diet is encouraged as natural food additives (Alenisan et al., 2017). Spices and herbs are normally added in foodstuffs such as milk to impart flavour, aroma and colour (Takeda et al., 2007). Addition of spices and herbs in ayuverdic cooking makes food taste better and improves therapeutic effect (Raghavan, 2006).

In Tanzania most of spices and herbs are commonly used in several foodstuffs including tea, meat, rice (*pilau*) and other traditional foods in Tanzania. Less is known about the usage and consumption of spices and herbs in milk. Therefore, this study aimed at assessing usage, consumption and effect of spices and herbs in milk with special reference to Zanzibar where spices and herbs are highly produced and consumed.

## 2.0. Materials and Methods

### Data Collection

Baseline survey was conducted in Zanzibar assessing the households' knowledge on the use of spices and herbs in milk. According to the 2012 Population and Housing Census, the total population of Zanzibar was 1,303,569 of which 630,677 were males and 672,892 were females. Due to limited resources, a cross sectional study design involved direct observation and in-depth interviews was conducted in Unguja only assessing the people's knowledge, attitude and practices on the use of spices and herbs in milk.

### 2.1. Sample Size

Sample size was calculated as per Lameshow *et al.*, 1990.

$$\text{Unlimited population: } n = \frac{z^2 \times \hat{p}(1-\hat{p})}{\epsilon^2}$$

$$\text{Finite population: } n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\epsilon^2 N}}$$

Where

$z$  is the z score = 1.67

$\epsilon$  is the margin of error = 14%

CL is confidence level = 95%

$N$  is population size = 1,303,569

$\hat{p}$  is the population proportion = 50%

Therefore, 49 or more respondents were needed to have a confidence level of 95% that the real value is within  $\pm 14\%$  of the measured/surveyed value.

## 2.2. Data Analysis

Data for the knowledge assessment were verified, coded and entered in Statistical Package for Social Sciences (SPSS) version 16.1 and Microsoft excel 2010 software. Analysis for proportions was achieved by using SPSS while graphs were generated by Microsoft excel database. To compare the proportions (%) of respondents between categories, chi square test was used at 95% confidence interval (CI) at  $P < 0.05$ .

## 3.0. Results and Discussion

### 3.1. Demographic Data

Fifty six respondents were interviewed; number of female participants was higher compared to male participants (Table 1). This might be attributed by the nature of African societies, whereby women are more informed about the food handling and preparation than men (Li-Cohen & Bruhn, 2002; NIN, 2006). However there was no statistical significant difference ( $P > 0.05$ ) between female and male participants. On the other hand, most of the participants were younger with age ranged from 15 to 30 years (Table 1). According to Sudershan et al. (2007), most of the younger people are normally eager and willing to acquire new knowledge in different matters.

Table 1

Demographic data (n = 56)

Factor	Variable	Proportions (%)	P value
Sex	Male	42.9	0.2482
	Female	57.1	
Age	15-20	19.6	
	21-30	60.7	
	31-40	14.3	
	40 and above	5.4	
Level of education	Primary	5.4	
	Secondary	44.6	
	High school	3.6	
	Vocational	3.6	
	Certificate	26.8	
	Diploma	8.9	
	Degree	5.4	
	Masters	1.8	
Occupation	House wife	1.8	
	Peasant	10.7	

<b>Origin</b>	Business Man/Woman	1.8
	Student	62.5
	Employee	23.2
<b>Marital status</b>	Pemba	35.7
	Unguja	55.4
	Others	7.1
	Single	67.9
	Married	28.6
	Widowed	1.8

### 3.2. Information on Use of Spices and Herbs in Milk

Most of the respondents (96.4%) ( $P=0.0001$ ) declared using spices and herbs in milk while only 2 (3.6%) were not. The majority (68.5%) experienced using spices and herbs since their childhood (Table 2).

Table 2

#### *Information on Spices Use in Milk*

Factor	Variable	N	Proportion of respondents (%)	P value
<b>Awareness of spice use in milk</b>		56		
	Aware		96.4	
	Not aware		3.6	0.0001
<b>Source of information on spice use in milk</b>		54		
	Parents		68.5	
	School / college		11.1	
	Traditional healers		7.4	
	Nobody		5.5	
	Friends		3.7	
	Relatives		3.7	
	Others Fellow		1.8	

	villagers		
	Others	1.8	
<b>Users of spices/ herbs in milk</b>		56	
	Yes	96.4	
	No	3.6	0.0001
<b>Place where spices are obtained</b>		54	
	Markets /shop	85.2	
	Farms / gardens	14.8	0.0097

Among the 54 respondents, the majority reported using cardamom (96.3%) and cinnamon (88.5%) followed distantly by ginger (57.7%), lemon grass (26.6%) and other spices in milk ( $P < 0.05$ ) (Table 3).

Table 3

*Commonly used spices in milk in Zanzibar (n = 54, P=0.001)*

<b>Common Name</b>	<b>Swahili Name</b>	<b>Scientific Name (Species)</b>	<b>Family</b>	<b>Proportion of respondents (%)</b>	<b>Part Used</b>
Cardamom	<i>Hiliki</i>	<i>Elettaria cardamomum</i>	Zingiberaceae	96.3	Seed
Cinnamon	<i>Mdallasini</i>	<i>Cinnamomum zeylanicum</i>	Lauraceae	88.5	Bark
Ginger	<i>Tangawizi</i>	<i>Zingiber officinale</i>	Zingiberaceae	57.7	Rhizome
Lemon Grass	<i>Mchaichai</i>	<i>Cymbopogon citrates</i>	Gramineae	26.9	Leaf
Clove	<i>Karafuu</i>	<i>Eugenia caryophyllis</i> or <i>Syzgium aromaticum</i>	Myrtaceae	13.46	Flower bud
Vanilla	<i>Vanilla</i>	<i>Vanilla planifolia</i>		11.5	Pods

Star anise	<i>Nyota</i>	<i>Illicium Verum</i>	Magnolia	3.8	Seed and pods
Black tea	<i>Chai nyeusi</i>	<i>Camellia sinensis</i>	Theaceae	3.8	Leaves
Nutmeg	<i>Kungumanga</i>	<i>Myristica fragrans</i>	Myristicaceae	1.9	Seed
Turmeric	<i>Binzari</i>	<i>Curcuma longa</i>	Zingiberaceae	1.9	Rhizome
Basil	<i>Rihani</i>	<i>Ocimum basilicum</i>	Lamiaceae	1.9	Leaves
Black pepper	<i>Piipili manga</i>	<i>Piper nigrum</i>	Piperaceae	1.9	Berries

The majority (82.1%) preferred ground spices/ herbs while the rest preferred whole or fresh. The amount added in one litre of milk ranged from a half to one and a half teaspoon which is equivalent to 4.6 - 8.6 g (Table 4).

Table 4

*Amounts of Spices and Herbs Added in Milk (N = 54)*

Factor	Proportion of respondents (%)					P value
Weight in grams	Cardamom	Cinnamon	Ginger	Lemon grass		
0.5 - 4.5	7.4	11.1	1.8	1.8		
4.6 - 8.6	27.7	42.5	25.9	3.7		
8.7 - 12.7	14.8	12.9	14.8	3.7		
12.8 - 16.8	3.7	5.5	0.0	1.8		
Others	42.5	12.9	12.9	14.8		0.01

Most of the spice and herbs used by the households are purchased from markets and shops 87.5% ( $P < 0.05$ ). However most of the spices and herbs available in market are cultivated in Zanzibar with exceptional to cardamom. Cardamom is less cultivated in Zanzibar, therefore huge amount is imported from India and thus why its price is higher compared to other spices and herbs which are sold in markets and shops. Moreover, Takeda + (2007) reported that cardamom is the “third most expensive” spice in the world after saffron and vanilla due to its higher production and pleasant scent.

### 3.3. Effects of Spices and Herbs in Milk

Results have shown that 96.4% ( $P < 0.05$ ) of the respondents use spices and herbs in milk to add flavour, colour and for other uses such as traditional medicine (Table 5).

Table 5

*Desirable effects of spice and herbs use in milk (n = 56)*

Factor	Variable	Proportion (%)
<b>Awareness on desirable attributes of spices in milk</b>		
	Yes	96.4
	No	3.6
<b>Desirable effects</b>		
	Mask animal smell	25.0
	Impart aroma	82.1
	Avoid gut bloating	5.4
	Extend milk shelf life	7.1
	Medicinal	16.1
	Increase appetite	17.9
	Enhance bone and/ or Muscles strength	10.7
	Enhance blood circulation	7.1
	Add nutrients	1.8

It was found that spices and herbs play important roles in health apart from their primary use of adding flavour and colour in milk. In India, cardamom is used by traditional healer to treat cold, bronchitis, fevers, inflammatory conditions of the oropharynx and liver complaints (Takeda et al., 2007). Similarly, Raghavan (2006) reported that curcumin and curcumene in turmeric is anti-inflammatory, anti-tumor; gingerol from ginger for digestive aid and gastric ulcers.

Results in Table 6 show that, 75 percent of respondents did not experience side effects of spices and herbs used in milk while 25 percent did.

Table 6

*Adverse Effects of Added Spices in Milk (N=56)*

Factor	Variable	Proportion (%)
<b>Awareness of respondents regarding adverse effects</b>		

Yes	25.0
No	75.0

**Adverse effects**

Cardamom causes sleep sickness in men	1.8
Some cause lesion in gut	1.8
Appendicitis if cardamom is not well sieved	1.8
High blood pressure	3.6
If you put powdered cinnamon alone milk coagulate fast	1.8
Increase body temperature	1.8
Irritation in throat e.g clove	3.6
Remove natural flavour of milk	5.4
Some contain ant nutritional factors when used in excess e.g cinnamon	1.8
Can cause nausea to some people	1.8
Too much ginger cause milk to coagulate	1.8
Too much spice might spoil milk e.g. ginger curdle milk	3.6
Too much spice may cause dizziness	1.8

Some participants reported on the adverse effects they experienced regarding the use of particular spice or herb for instance clove, cinnamon and ginger (Table 7).

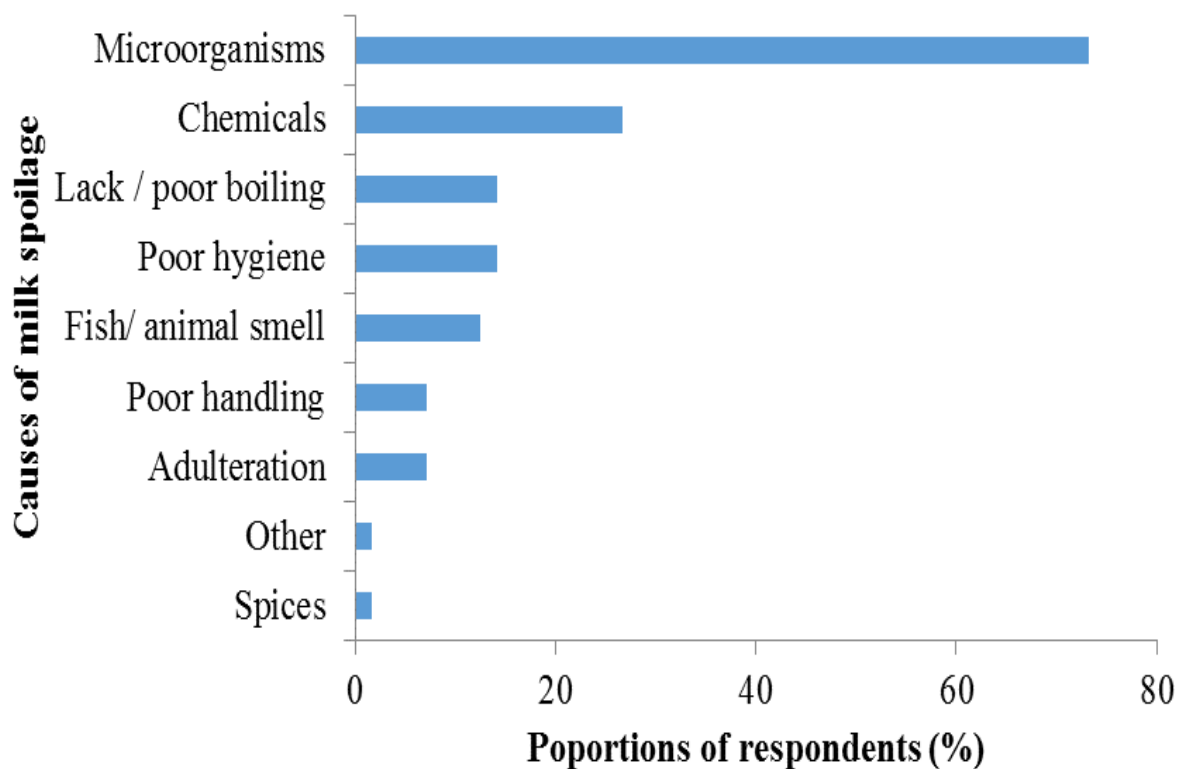
The aromatic oils of the clove have a stimulant and irritant effect. Over use of clove may result in increased blood circulation and slightly raised body temperature (Bhowmik et al., 2012). On the other hand, the usefulness of spice and herbs, differ from one individual to another, depending on experience and desired effect in the food product. Moreover, clove oil has been known to stimulate and disinfect the body, and stimulates both saliva flow and gastric juices (Bhowmik et al., 2012). However individuals suffering from gastric ulcers reported to avoid use of cloves in milk due to its relation to over secretion of gastric juice which induces pain immediately after use.

**3.4. Households' Knowledge on Milk Spoilage**

The majority reported microorganisms (73.2%) and poor storage (39.3%) are the major causes of milk spoilage (Figure 1).

Figure 1

Households' Knowledge on Causes of Milk Spoilage



Almost all of the respondents were aware of what caused milk spoilage depending on what they observed from home or learnt from school/colleges. Respondents mentioned about poor storage and handling, lack or/ improper boiling, poor hygiene and contaminants from animal and chemicals such as adulterants, salts, acids from fruits and some spices. Lore et al. (2005) reported about milk spoilage in East Africa, the major causes of spoilage were associated with poor hygiene during storage and handling, use of poor technology, poor infrastructures and adulteration. The same was reported by FAO (2005) that most losses of the dairy products were due to a combination of poor production/handling practices and lack of technical knowledge. Some respondents were aware of causes of milk spoilage of which, bacteria such as *Lactobacillus* species, *E. coli* and fungi were among the mentioned microorganisms. That awareness was acquired from relatives, friends, parents, media, school/college and other sources including internet and extension officers.

Most of the households, used refrigeration (55.4%), boiling (42.9%), freezing (23.2%), thermos (21.4%) and only few (7.1%) used spices to control milk spoilage (Table 7).

Table 7

*Households' Knowledge on Milk Spoilage (N = 56)*

<b>Factor</b>	<b>Variable</b>	<b>Proportion (%)</b>
<b>Awareness on microorganisms as source of milk spoilage</b>	I know	73.2
	I don't know	26.8
<b>Do you know any of them?</b>	Yes	41.1
	No	58.9
<b>Where did you get the information about it?</b>	Public health officer	14.3
	Fellow villagers	1.8
	Relatives	1.8
	Friends	8.9
	Parents	37.5
	Media	12.5
	School/ College	28.6
	Others	3.6
<b>Techniques of preventing milk from spoilage</b>	Boiling and leave at room temperature	42.9
	Boiling and put in thermos	21.4
	Refrigerator	55.4
	Freezing	23.2
	Adding spices	7.1
	Others	7.1

### **3.5. Importance of Some Spices and Herbs in Milk and Their Related Health Benefits**

#### **3.5.1. Cardamom**

Cardamom *Elettaria cardamomum* a member of Zingiberaceae family is primarily cultivated in Southern India, Sri Lanka, Guatemala and Tanzania. Normally, its darker seeds from a pod are used in cooking varieties of food at the household level (Rakshit & Ramalingam, 2010).

Apart from its direct purpose of adding flavour and aroma in milk, some households in Zanzibar use the mixture of milk, cardamom and honey as a natural remedy to help patients with higher blood pressure. Similar practice had been reported in India. For instance, crushed cardamom seeds are normally boiled with milk and honey and used as an excellent remedy for impotence and depression (Takeda, 2000; 2004). Cardamom is also used in Chinese and Indian traditional medicine to improve digestion and to treat gastrointestinal problems such as diarrhoea and gas (Agaoglu, 2005; Mahady et al., 2005; Raghavan, 2006; Takeda et al., 2007). Cardamom is also used in aromatherapy as a rub to promote blood circulation (Fabio et al., 2003; Chaudry & Tariq, 2006). Combination of Chile pepper and milk is used to treat swellings and tumors while turmeric paste to reduce cough and colds (Raghavan, 2006).

#### **3.5.2. Cinnamon**

Cinnamon, *Cinnamomum cassia* a member of Lauraceae family, contains important essential oil in leaves, fruits and barks. Cinnamon is used in medicine, pharmaceutical, perfumery, cosmetics and several other industries apart from its primary role in adding flavor in food and beverages (Rakshit & Ramalingam, 2010).

Some households in Zanzibar reported to add cinnamon in milk to mask the animal smell. On the other hand, it was reported that addition of cinnamon in beverages such as milk, provides a lot of health benefits such as improved blood circulation and male sex drive. It is believed that cinnamon is one of the natural products, which is an aphrodisiac spice (Takeda et al., 2007). The cinnamon cultivated in Zanzibar has a distinctive characteristic from that imported from India. It was reported that Indian cinnamon is sweeter compared to the one cultivated in Zanzibar, therefore Zanzibarian's cinnamon is more preferred by traditional healers. It was experienced by one of the key informants that adding a half teaspoon of Zanzibar cinnamon in a glass of milk is sufficient enough to provide a relief to an individual suffering from gastric ulcers.

#### **3.5.3. Ginger**

Ginger (*Zingiber officinale* Roscoe, Zingiberaceae) is a medicinal plant that has been widely used in Chinese, Ayurvedic and Tibb-Unani herbal medicines all over the world. It has been used as natural remedy since ancient times for arthritis, rheumatism, sprains, muscular aches, pains, sore throats, cramps, constipation, indigestion, vomiting, hypertension, dementia, fever, infectious diseases and helminthiasis (Ali et al., 2008).

Ginger is a horticultural crop cultivated in Zanzibar throughout the year and marketed in a fresh and dried state. Ginger is a hot spice used in milk and other beverages as a tastemaker, a drug and an appetizer. It is also used to flavour sauces, curry dishes, confections, pickles, and ginger ale. In clinical trials, ginger has demonstrated stimulant effect in the intestines and saliva glands, digestive juices, and bile. It also tends to trigger the pumping action of the heart. Ginger is also regarded as aphrodisiacs spice in Asia (Raghavan, 2006; Takeda et al., 2007).

### 3.5.4. Lemon Grass

Lemon grass belongs to the section of Andropogon called *Cymbopogon* of the family Gramineae (Gramineae or Poaceae). It is a very large genus which includes about 500 described species (NISCIR, 2005).

Lemon grass is used alone as a beverage or in a combination with other herbs such as tea leaves. In milk, lemon grass is used to impart its pleasant aroma and green colour. Lemon grass is used as a natural remedy through inhalation of the crushed grass in order to get relief from headache and flu or cold. It is also used as natural remedy in promoting male sex drive. Pharmacological investigations proved that, the essential oils of lemon grass demonstrate the antidepressant effect on the Central Nervous System (CNS) (Ayandele, 2007). Furthermore, the oil of lemon grass reported to contain male sex hormone (Gupta et al., 1993).

### 4.0. Conclusion

Most of the people are not aware on the antimicrobial activities of spices and herbs which are added in milk. Spices and herbs play important roles in health apart from their primary use of adding flavour in milk. The spices and herbs which are added in milk for flavour, medicinal use and other uses, can also contribute to extend the shelf life of milk by inhibiting the growth of spoilage bacteria. However there are some side effects reported to some spices such as clove and ginger. Therefore, further toxicological studies are recommended in order to validate and authenticate the side effects mentioned.

Extracts from essential oils and non-essential oil components from the reported spices and herbs are to be studied and identified for their chemical structures and antibacterial characteristics in order to expand the database of potential sources of natural milk preservatives. Therefore, the effect of the spices and herbs on preservation of milk could be studied scientifically to explore their potential in milk preservation.

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