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Phytochemical studies on herbal plants commonly used for processing and preserving meat and milk

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ABSTRACT

Objective: The study aims at identifying and collecting herbal plants commonly used in milk processing and preservation by the Maasai community in Kajiado district and to determine the phytochemical and mineral composition.

Methodology and Results: Twenty-three herbal plants were identified; three plants were selected through community prioritization using a structured questionnaire. Analysis for phytochemical composition was done using Sofowara (1993), Trease and Evans (1989) and Harborne (1998) methods composition by AOAC method 923.03 (AOAC, 1995) and pH. Tannins, saponins, flavonoids, alkaloids, steroids, sterols, terpenoids, flavones aglycones and reducing compounds were present in all the herbal plants. The herbal plants were significantly different ($P<0.05$) in mineral content. The highest mineral content was calcium 90.0 mg/100 g followed by magnesium, zinc and iron.

Conclusion and application of the findings: this indicates that these plants are rich in phytochemicals and minerals therefore, they can be exploited to develop nutritive food preservatives because phytochemicals have both antimicrobial and antioxidant properties. These plants can also be processed to obtain a product that will substitute the chemical preservatives in the market now that consumers are showing greater preference for products preserved with natural products.

Keywords: phytochemicals, herbs, minerals, antimicrobial

INTRODUCTION

The Maasai community in Kajiado district has been known to use herbal plants in milk processing and preservation since the beginning of the 19th century (Hollis, 1905; Merker et al, 1910). However, their phytochemical composition has not been studied despite the continued use. This has therefore led to this study of phytochemical composition of three herbal plants used by the Maasai community in Kajiado district. Livestock keeping is the main source of livelihood for the people living in Kajiado district (KDDT, 2007). These communities depend mainly on milk and meat for food. Milk being high moisture, nutrient dense food in addition to high temperatures in this region makes it highly susceptible to spoilage and deterioration in quality. The modern methods of processing and preservation of milk are very

expensive and inaccessible to the Maasai community in Kajiado district. Herbal knowledge is widespread in the Maasai community where many different plants are used for different uses. *Osinon, Olkingiri* and *Oloirien* are used in processing and preserving milk where it is claimed to extend the shelf life of fresh milk to four days without fermenting and one month after fermentation. The stem barks of the herbs namely *Oltepesi, Osokonoi, Osilarei, Olkiloriti* and the roots of *Oltepesi Olkiloriti, Iseketek, Oltimingomi, Olkinyie, Olmakutukut, Olosessiyia, Olkokola, Olodonganayi, Esananguruti, Olporakwai* are boiled separately and used singly and taken with meat soup for various ailments or just for good health. *Olkiloriti* root and stem are taken mostly for appetite. This information was obtained from the discussions held in various community meetings and focus groups in Kajiado Central division, Sajironi and Bissil locations. There is therefore the need to exploit the traditionally available herbal methods of milk preservation to form a basis of developing preservatives that would positively transform the lives of the community members economically.

MATERIALS AND METHODS

Field survey, Identification and Samples collection: The information on the types of plants used and the way of preservation of milk, was obtained by personal observation and focus groups discussions both in the villages and in the market area guided by a questionnaire. The main survey areas were Kajiado district; Central division, Sajironi and Bissil locations. The main aim of this field survey was to find the use of herbal plants in food processing and preservation. Twenty-three herbal plants samples (Table 1) were collected from the field and taken to Nairobi National Museum of Kenya for identification. Samples of the plants were transported to JKUAT Food Science laboratories for chemical and physical analyses.

Table 1: Plants collected and parts mostly used

Plant local name[1]	Parts used	Plant local name[1]	Parts used
Osinon	Stems	*Olmakutukut*	Roots
Olkingiri	Stems	*Olosessiyia*	Roots
Oltepesi	Stem barks	*Olodonganayi*	Roots
Osokonoi	Roots	*Olkokola*	Roots barks
Osilarei	Stem barks	*Olporakwai*	Roots
Olkiloriti	Stem barks	*Oloirien*	Roots
Iseketek	Berries	*Olosessiyia*	Roots barks
Oltimingomi	Roots	*Oltimingomi*	Roots barks
Olmakutukut	Roots	*Olkinyie*	Roots barks
Olkinyie	Roots	*Olmakutukut*	Roots barks
Olkiloriti	Stem barks	*Esananguruti*	Roots
Olkinyie	Roots		

[1]plant local names were obtained from the residents of the Sajironi and Bissil locations

Preparation of plant extracts: The plant materials were chopped into small pieces, air dried ground into coarse powder using an electric grinder (model M10R Japan) and stored until use for the phytochemical and mineral analysis.

Mineral content: Dry ashing of the above prepared plant samples was done according to AOAC method 923.03 (AOAC, 1995). Analysis was done using Atomic Absorption Spectroscopy. The minerals analyzed were Calcium, Magnesium, Iron, Zinc and Copper.

Phytochemical screening: The powdered samples were sequentially extracted with petroleum ether, methanol and distilled water. The crude extracts were concentrated *in vacuo*, properly labeled and stored in the refrigerator at 4 °C. The extracts obtained were subjected to qualitative chemical screening for the presence of various chemical constituents including tannins, saponins, flavonoids, alkaloids, steroids, sterols, terpenoids, flavones, aglycones and reducing compounds. Methods used were as described by Sofowara (1993), Trease and Evans (1989) and Harborne (1998).

RESULTS AND DISCUSSION

The plants that were identified by the National Museums of Kenya are shown in Table 2.

Table 2: Plants identification: local, botanical and family and common names

Local name	Botanical name	Family	Common name
Osinon	*Lippia javanica (Burm. F.) Spreng*	Verbenaceae *	Fever tea
Oltepesi	*Acacia tortilis (Forssk.) Hayne*	Mimosoidae*	Umbrella thorn
Olkiloriti	*Acacia nilotica (l.) Del.*	Mimosoidae*	Prickly acacia
Osokonoi	*Warburgia ugandensis Sprague*	Canellaceae*	Pepper bark, East African greenheart, *Ol-msogoni, Muthiga*
Osilarei	*Commiphora Africana (A. Rich.)*	Burrseraceae*	African myrrh
Oltimingomi	*Pappea capensis*	Sapindaceae+	Jacket plum
Esananguruti	*Scutia myrtina*	Rhamnaceae+	Cat thorn, Sweet prickly pear
Olodonganayi	*Mystroxylon aethiopicum*	Celastraceae+	Transvaal *kooboo* berry
Olkokola	*Rhamnus staddo*	Rhamnaceae+	Staddo, *Buck thorn*
Olkinyie	*Euclea divinorum*	Ebenaceae+	Magic Guarri, Diamond-leaved euclea
Iseketek	*Myrsine africana*	Myrsinaceae+	Cape myrtle, African boxwood

*National museums of Kenya (2007) +Kokwaro (1993)

The pH of the herbal plant extracts: Most of the herbal water extracts were acidic except for Olmakutukut powdered root bark extract and *Olkinyie* root water extract, which were close to neutral pH while Osokonoi stem bark water extract was extremely alkaline (Table 3). The low pH exhibited by some of the extracts may be the factor imparting the antimicrobial property attribute to these extracts and hence their wide use as herbal cures and food preservatives.

Table 3: pH of different herbal plant water extracts

Local plant name	Part used	pH
Osinon	Stem	6.6±0.1
Osokonoi	Stem bark	9.0±0.1
Iseketek	Seeds	4.9±0.1
Oltimingomi	Root	5.2±0.1
Oltimingomi	Powdered roots' bark	4.8±0.1
Olkinyie	Root	6.8±0.1
Olmakutukut	Powdered roots' bark	7.8±0.1
Olosessiyia	Powdered roots' bark	5.0±0.1
Olosessiyia	Root	6.3±0.1
Olkokola	Powdered roots' bark	5.5±0.1
Olodonganayi	Root	5.2±0.1
Esananguruti	Root	5.5±0.1
Water herbal extract (from the field)	Roots	5.2±0.1

Mineral content: All the plant materials had a reasonable amount of minerals with the highest mineral being calcium followed by magnesium. Zinc and iron were also present in considerable amount. The results indicated

that the root barks generally had higher mineral content in comparison to the roots from the same herbal plant (Table 4). This considerable amount of minerals in the herbal plants was a good indication that beside preservation the plants could be a good source of the vital minerals in human nutrition. The high concentration of these minerals is advantageous since certain inorganic mineral elements (zinc, calcium.) play important roles in the maintenance of normal glucose tolerance and in the release of insulin from beta cells of islets of Langerhans (Choudhary and Bandyopadhyay, 1999).

Table 4: Minerals composition of different herbal plants used by the Maasai community in Kajiado district

Mineral element	**Mg**	**Ca**	**Zn**	**Cu**	**Fe**
Plant local name/Part used	**mg/g**	**mg/g**	**µg/g**	**µg/g**	**mg/g**
Oltimingomi –Root	3.8±0.3	39.6±0.2	1.3±0.1	12.1±0.1	0.2±0.01
Oltimingomi – Powdered roots' bark	4.2±0.3	260±0.2	8.4±0.1	10.4±0.1	0.3±0.01
Olporakwai – Root	4.3±0.3	60±0.2	22.7±0.1	15.6±0.1	0.1±0.01
Olosessiyia- Root	5.4±0.3	48.8±0.2	14.1±0.1	4.4±0.1	0.1±0.01
Olosessiyia- Powdered roots' bark	3.5±0.3	22.3±0.2	15.9±0.1	5.1±0.1	0.5±0.01
Esananguruti – Root	2.9±0.3	11.9±0.2	15.5±0.1	11.7±0.1	0.02±0.01
Olodonganayi – Root	4.3±0.3	28.4±0.2	5.0±0.1	2.9±0.1	0.1±0.01
Olodonganayi – Powdered roots' bark	3.0±0.3	10.0±0.2	20.5±0.1	17.4±0.1	0.3±0.01
Olkokola – Root	3.8±0.3	128.4±0.2	3.2±0.1	8.9±0.1	0.2±0.01
Olkokola – Powdered roots' bark	4.2±0.3	99.8±0.2	4.7±0.1	6.8±0.1	0.3±0.01
Olmakutukut – Root	3.0±0.3	112.8±0.2	41.5±0.1	9.1±0.1	0.3±0.01
Olmakutukut –Powdered roots' bark	4.1±0.3	19.2±0.2	49.8±0.1	4.9±0.1	0.6±0.01
Olkinyie – Root	3.7±0.3	90.6±0.2	2.5±0.1	8.9±0.1	0.3±0.01
Olkinyie - Powdered roots' bark	3.7±0.3	99.8±0.2	11.3±0.1	6.5±0.1	0.5±0.01
Olkiloriti – Root	4.4±0.3	127.6±0.2	8.6±0.1	8.7±0.1	0.1±0.01
Olkiloriti – Stem bark	5.3±0.3	90.2±0.2	5.3±0.1	20.7±0.1	0.1±0.01
Iseketek – Seeds	4.2±0.3	33.6±0.2	16.5±0.1	6.4±0.1	0.3±0.01
Osilarei- Stem bark	2.5±0.3	358.2±0.2	17.5±0.1	5.5±0.1	0.1±0.01
Oltepesi -Stem bark	5.1±0.3	154.8±0.2	9.8±0.1	12.6±0.1	0.2±0.01
Osokonoi -Stem bark	2.2±0.3	238.2±0.2	20.7±0.1	4.8±0.1	0.3±0.01
Osinon –Stem	4.3±0.3	89.0±0.2	26.2±0.1	28.9±0.1	0.1±0.01
Oloirien	2.7±0.3	20.4±0.2	10.9±0.1	12.3±0.1	0.04±0.01

Phytochemical composition: From the results shown in Table 5, the herbal plants from the Maasai community in Kajiado district had several groups of phytochemicals, which included tannins, saponins, flavonoids, alkaloids, steroids, sterols, and terpenoids. All the water, methanol and ether plant extracts with the exception of Osinon-*stem, Olkingiri - Stem* had sterols and terpenoids. Most of the plants did not have steroids in aqueous and methanol extracts.

Table 5: Phytochemical composition obtained using water, methanol and ether as extracting solvents

	Phytochemicals								
Plant local name	**T**	**S**	**F**	**A**	**SE**	**ST**	**TE**	**R C**	**F A**
***Osinon*-Stem**									
Water	+	+	+	-	+	-	-	+	-
Methanol	+	-	+	+	+	-	-	+	-
Ether	+	-	+	-	+	+	+	-	-
***Oltepesi* –Stem bark**									
Water	+	+	+	+	-	+	+	-	+
Methanol	-	-	+	+	-	+	+	-	+
Ether	-	-	+	+	+	+	+	-	-
***Osokonoi* -Stem bark**									
Water	+	+	-	-	+	+	+	+	+
Methanol	+	+	-	-	-	+	+	+	-
Ether	-	+	+	+	+	+	+	+	+
***Osilarei*- Stem bark**									
Water	+	+	+	-	-	+	+	+	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	-	-	-	-	+	+	+	-	-
***Iseketek* – Seeds**									
Water	+	-	+	-	-	+	+	+	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	-	-	+	-	+	+	+	-	+
***Oltimingomi* – Powdered roots' bark**									
Water	+	+	+	-	-	+	+	-	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	-	-	+	-	+	+	+	+	-
***Oltimingomi* – Root**									
Water	+	+	+	-	-	+	+	+	+
Methanol	+	+	+	-	-	+	+	+	+
Ether	-	-	+	-	+	+	+	+	+
***Olkinyie*- Root**									
Water	+	+	+	+	-	+	+	+	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	+	-	-	-	-	+	+	+	+
***Olkinyie* – Powdered roots' bark**									
Water	+	+	+	+	-	+	+	+	+
Methanol	+	+	-	+	-	+	+	+	-
Ether	+	-	+	+	-	+	+	-	+
***Olmakutukut* – Root**									
Water	+	+	+	+	-	+	+	+	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	+	-	-	+	+	+	+	-	+
***Olmakutukut* – Powdered**									
Water	+	+	+	+	-	+	+	-	+
Methanol	+	+	-	+	-	+	+	+	-
Ether	+	-	+	-	+	+	+	+	+
***Oloirien*– Root**									
Water	+	+	+	-	+	+	+	-	-

Methanol	+	-	+	+	-	+	+	+	+
Ether	+	-	+	-	+	+	+	-	-
***Olosessiyia*- Powdered roots' bark**									
Water	+	-	-	-	-	+	+	+	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	-	-	-	-	+	+	+	+	+
***Olosessiyia* – Root**									
Water	+	+	-	-	-	+	+	+	+
Methanol	+	+	-	+	-	+	+	+	+
Ether	-	-	-	+	+	+	+	-	+
***Olkokola* –Root**									
Water	+	+	+	+	-	+	+	+	+
Methanol	+	-	+	+	-	+	+	+	+
Ether	+	-	+	-	+	+	+	+	+
***Olkokola* – Powdered roots' bark**									
Water	+	+	+	+	+	+	+	+	+
Methanol	+	-	+	+	-	+	+	+	+
Ether	+	-	+	+	-	+	+	+	+
***Olodonganayi* – Root**									
Water	+	+	+	+	-	+	+	+	+
Methanol	+	+	-	-	-	+	+	+	+
Ether	-	-	+	-	+	+	+	+	+
***Olodonganayi* – Powdered roots'**									
Water	+	+	+	-	-	+	+	+	+
Methanol	+	+	-	+	-	+	+	-	+
Ether	-	-	-	-	-	+	+	+	+
***Esananguruti* – Root**									
Water	+	+	+	-	-	+	+	+	+
Methanol	+	+	+	-	-	+	+	+	+
Ether	+	-	+	-	-	+	+	-	+
***Olporakwai* – Root**									
Water	+	+	+	-	-	+	+	+	+
Methanol	+	+	+	+	-	+	+	+	+
Ether	-	-	-	+	+	+	+	+	+
***Olkiloriti* – Root**									
Water	+	+	+	+	-	+	+	+	+
Methanol	+	+	+	-	-	+	+	+	+
Ether	+	-	+	-	-	+	+	-	+
***Olkiloriti* –Stem bark**									
Water	+	+	+	-	-	+	+	+	+
Methanol	+	+	-	+	+	+	+	+	+
Ether	-	-	+	-	+	+	+	+	+
Olkingiri - Stem									
Water	+	-	-	-	-	-	-	-	-
Methanol	+	-	+	+	-	+	+	+	+
Ether	+	-	-	-	+	-	-	-	-
Herbal extract From the field									
	+	+	+	-	-	+	+		

T=Tannins, S=Saponins, F=Flavonoids, A=Alkaloids, SE=Sterols, ST=Steroids, TE=Terpenoids, RC= Reducing compounds, FA= Flavone aglycones.

Tannins and saponins were mostly found in water and methanol extracts while flavonoids were found in water extracts and alkaloids in methanolic extracts. Reducing compounds were present in all plant extracts. Studies on phytochemicals have showed that, plants are rich in a wide variety of secondary metabolites, such as tannins, terpenoids, alkaloids, and flavonoids, which have been found *in vitro* to have antimicrobial properties (Cowan, 1999). Besides being antioxidants, tannins have antimicrobial activity, they have been found to form irreversible complexes with proline-rich proteins (Hagerman and Butler, 1981). Some of the most commonly occurring polyphenols are the flavonoids. They are multifunctional, acting as reducing agents, hydrogen-donating antioxidants and singlet oxygen quenchers (Wilmesen *et al*, 2005). The phenolic fraction of plant extracts has been linked to their antioxidant capacity and antimicrobial activity (Proestos *et al*., 2006). The best extracting solvent was distilled water; which extracted most phytochemicals followed by methanol and lastly petroleum ether. Distilled water yields ranged from 11.3-12.3%, methanol yields ranged 8.4-10.53%, whereas ether yields ranged 5.6-7.6%. This therefore may provide a basis of exploitation and possible use of these herbal plants in food industry as preservatives.

CONCLUSION

The herbal plants commonly used by the Maasai community in Kajiado district are rich in phytochemicals and minerals, further research should be carried to investigate their potential in food industry as preservatives.

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