

## EVALUATION OF HONEY QUALITY WITH RESPECT TO NICOTINE CONTENT IN URAMBO AND SAME DISTRICT

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### **ABSTRACT**

*The study was done to evaluate the quality of honey with respect to nicotine content from tobacco growing and non-growing areas with assumption that nicotine from tobacco crop may affect the quality of honey. Specifically the study was done order to, identify if tobacco is among the bees fodder and to determine the presence and source of nicotine in honey from tobacco and non -tobacco growing area. The study was done in Urambo and Same. Bees fodder was identified in each area and honey sample from same and Urambo were collected and analyzed. The results shows that honey from both areas contained levels of nicotine however the level of Nicotine found was within the allowable level for human health and it was not significant difference between the samples at ( $P > 0.05$ ) using T-test. In identification of bee fodders from Urambo and Same tobacco was not among the bees fodder. This study concludes that the traces of nicotine in the honey samples does not originate from tobacco crop, as tobacco was not among the bee fodders identified. The traces might have been originated from the bees fodder plant which contains alkaloids such as *Tamarindus indica*, *Acacia mellifera*, *Syzygiumguineense*.*

**KEYWORDS:** *Honey, Bees Fodder, Nicotine, Tobacco*

### **INTRODUCTION**

In Tanzania bee keeping plays a major role in socio-economic development and environmental conservation. It is a source of various products including honey, live bees, and beeswax – as well as propolis, bee venom, royal jelly, brood, bee-soup and queen bees (Tanzania., 2002). In developing areas like Tanzania beekeeping is a traditional honey-hunting (Guyo, 2015.). Tanzania is among the countries in the world with the highest potential for production of bee products (Mwakatobe, 2006) (Pinda, 2014) around 7% of its beekeeping capacity is utilized, and about 3% of its honey and beeswax is exported (Pinda, 2014) (Mbeiyerewa, 2014)

Honey from Tanzania is in high demand in many countries (Centre., 2015), (Limited, 2007) and Tanzania is the largest honey supplier to the European Union(Centre., 2015) this is because Tanzanian honey is known for its natural organic state (Tanzania, 2013). The availability of unique plants and vegetation including Moringa (*Moringa oleifera*), Clove (*Syzygiumaromaticum*), Cinnamon and Neem (*Azadirachta indica*) which have therapeutic properties adds to the advantages of Tanzanian hive products. These plants provide both nectar and pollen which can be used to create honey and bee pollen of the highest medicinal value.

It is estimated that the sector generates about US\$ 1.7 million each year from sales of honey and beeswax and employ about 2 million rural people (Kihwele, (1991).). It is an important income generating activity with high potential for improving incomes especially for communities leaving close to forests and woodlands. Beekeeping also plays a major role in improving biodiversity and increasing crop production through pollination.

In Tanzania Beekeeping is carried out using traditional methods that account for 99% of the total production of honey and beeswax in the country. Approximately 95% of all hives are traditional including log and bark hives (Mwakatobe, 2006). Others are reeds, gourds, pots etc. Over 95 % of beekeeping is practiced in Miombo woodlands while the remainder is carried out in banana and coffee plantations where trees are used for hanging hives (Kihwele, (1991).)Bee keeping is ideal in the forests and woodlands which have valuable bees fodder plant. High potential for beekeeping is also found in agricultural land where substantial bee products can be obtained. Honey is a complex mixture composed of water, various sugars (fructose and glucose) which accounts for 85-95% of total sugars, other sugars are present in small quantities are sucrose, maltose, isomaltose and few trisaccharide and oligosaccharides disaccharides) (Kadir, 2013).

There are various constraints that hinder beekeeping development in Tanzania as stipulated in the policy. One of these constraint is the Poor quality of bee products which could be caused by the following; inadequate skills/knowledge to apply improved technologies, use of inappropriate technology in harvesting, processing, storage and packaging and poor storage of products (Mwakatobe, 2006). One of the product from beekeeping is honey. The quality of honey is influenced by various factors including types of bee fodders used, storage abuse (which leads to increased HMF, darkening and loss of aroma and flavor), overheating and adulteration with syrup(B.A., E.B., B.N., & Nnko A, 2004). Good quality honey, that is, honey of value can be judged by five key factors, namely water content, HMF (Hydroxymethylfurfural), inverted sugars, impurities and colour. The contents materials of a good quality honey are water (17.2%), sugar (80%), organic acids (0.6%), enzymes (2%), mineral materials (0.2%) (B.A., E.B., B.N., & Nnko A, 2004). Currently a major issue of concern for the world honey market from Tanzania is contamination of honey with nicotine, presumably honey from tobacco growing areas ((Tanzania, 2013);(Asiyah). This necessitate the need for carrying research in order to determine the effect of tobacco in the quality of honey and find if nicotine in honey comes from tobacco.

### **General Objectives**

The general objective of this research was to determine honey quality harvested from tobacco growing areas and non-tobacco growing with respect to nicotine content.

### **Specific Objectives**

The specific objectives of the study were:

- To identify if tobacco is among the bees fodder identified in the area
- To determine the presence and source of nicotine in honey produced in Same and urambo,

## **METHODOLOGY**

### **Location**

The study was conducted in two District Urambo from Tabora region and Same from Kilimanjaro regions. These two region were selected for its production of tobacco and honey. Urambo was selected because it is the area with high

production of both tobacco and honey. Same District was selected for its high production of honey only (Yanda). All study areas were described by the presence of a mixture of various natural plants for honey making. According to Region socio-economic profile **Same** is one of the seven **districts** of the Kilimanjaro Region of Tanzania. It is bordered to the north by the Mwanga **District**, to the northeast by Kenya, to the south and southeast by the Tanga Region, and to the west by the Manyara Region. The economic activities in the area is agriculture which include farming and animal husbandry.

**Urambo District** is one of the seven districts of the Tabora Region of Tanzania. It is bordered to the north by the Kaliua District, to the east by the Uyui District, to the southeast by the Sikonge District, and to the southwest by the Katavi Region. Its administrative seat is the town of Urambo. Its economic activity is agriculture

### **Identification of Bees Fodder Plant**

The identification of the floral origins (bees fodder plants) of honey samples collected from the study areas were done by beekeeping officers and bee keepers through the available literature on the type of bee fodder in the area and also basing on the frequency of visits of the bees to the flowers for collection of nectar and pollen during flowering (K.H. Bhuiyan, 2002). Flowers and leaves (from the bottom, middle and growing tip) were collected then air dried and later oven dried to attain constant moisture then ground to pass at a 2 mm sieve and sent to Sokoine University of Agriculture Laboratory for nicotine analysis. Variables of nicotine levels in honey samples were validated and analyzed.

### **Collection and Analysis of Nicotine Content**

In determining nicotine content in honey twelve fresh ripe honey samples were direct collected form beehives of Uhindi village, Zugimlolo village and North Ugala forest reserve in Urambo district; and Ruvu, Makanya and Majeju villages in Same district; and four honey sample from the markets in the two districts were collected. The honey samples collected were sent to Sokoine University of Agriculture (SUA) department of food science laboratories where Physicochemical analysis were done to determine the nicotine content in the honey collected. Nicotine was analyzed based on method described by(Carlos, 2011) HMF analysis based on the determination of UV absorbance of HMF at 284nm and the background at 336nm (mg/kg). The results obtained were analyzed using T- test in order to see if the level of nicotine from the sample of honey collected in the two area differ significantly and also find if the nicotine in honey is within the allowable level of nicotine for human health

## **RESULTS AND DISCUSSION**

### **Bee Fodders for Honey Sample**

The result showed that most of the bee fodders from the two areas of the study had different levels of alkaloids. Alkaloids are a class of naturally occurring organic compounds that mostly contain basic nitrogen atoms. This group also includes some related compounds with neutral and even weakly acidic properties ( IUPAC, Compendium of Chemical Terminology, 2nd ed. (the "Gold Book") (1997). Online corrected version: (2006–) "alkaloids". doi:10.1351/goldbook.A00220). Example of these alkaloids include nicotine, cocaine, and caffeine. The results from the present study shows that all the bee fodder identified have some level of alkaloid. Also the results shows that among the bee fodder identified tobacco was not among of them.

**Table 1: Bee Fodder Plants with their Status of Alkaloids**

Urambo District			Same District		
Bee Fodder	Vernacular names (Nyamwezi)	Alkaloids	Bee Fodder	Vernacular Names(Pare)	Alkaloids
Acasiatortilis	Mgunga	+	Acasiamelifera	Mnoa	+
Branchystegiaspecificiformis	Mtundu	-	Acasiatortilis	Mgunga	+
Branchystegiaspp	Muyombo	-	Azadirachta indica	Mkwini	-
Combretum fragrans	Muluzyamizi	+	Faidhebia albida	Mkababu	+
Flacourtia indica	Msingila	+	Lamea schwinfurthii	Msighe	-
Lonchocarpuscapassa	Muvha	-	SclerocaryabirreaSubsp.Caffra	Mng'ong'o	+
Syzygiumguineense	Mwasya	+	Tamarindus indica	Mkwaju	+
Tamarindus indica	Mkwaju	+	Ximenia americana	Mtundutwa	+

+ = Indicates presence of alkaloids, - = Indicates absence of alkaloids

### Nicotine Content for Honey Samples

Laboratory result shows that the levels of nicotine in fresh honey samples collected direct from bee hives of Urambo and Same district ranged from 0.0007 to 0.0037 Mg/Kg (Table 2). Also the nicotine content from the honey samples collected from the local markets in the two districts range from 0.0022 to 0.0057 Mg/Kg (Table 3). From these laboratory results all honey samples collected from both tobacco - growing and non-tobacco growing areas had nicotine levels and according to (AEMSA, 2014) this level is tolerable to human health because the maximum allowable level of nicotine in food product is 4 up to 5. The nicotine contents in honey was from the bees fodder identified because the results shows that all the bee fodder identified contained some level of nicotine, . The T-test result shows that differences between means were non - significant at ( $P > 0.05$ ) (See Table 4).

The nicotine content of the honey from Urambo and Same were low compared to the Nicotine content from Kigoma region which ranges from 0.46 and 0.26  $\mu\text{g/g}$  (Balama, (2018)). Higher Nicotine content in Kigoma might be due to higher nicotine from the bee fodder identified in the area which were Mtundu, muba, Myenzi, mkumbali, mlembele, Mmbanga, mkoyoyo and mlama (Balama, (2018)). These bee fodder differ from those identified at Urambo and Same.

**Table 2: Laboratory Nicotine Analysis for Fresh Honey Sample from Bee Hives**

Urambo District			Same District		
Village	Sample Color	Nicotine Level (Mg/Kg)	Village	Sample Color S1	Nicotine Level (Mg/Kg)
Uhindi	S1 - brown	0.0027	Ruvu	Dark brown	0.0024
	S2 - Brown	0.0032		S2 - Brown	0.0027
Nzugimlole	S1 - brown	0.0023	Majevu	S1 - Brown (with ppt.)	0.0037
	S2 - Brown	0.0017		S2 - Amber light	0.0007
Iteblanda	S1 - brown	0.0020	Makanya	S1 - dark brown	0.0027
	S2 - Brown	0.0022		S2 - dark brown	0.0027

**Table 3: Laboratory Nicotine Analysis for Honey Samples from Local Markets**

Urambo District			Same District	
Sample	Color	Nicotine Level (Mg/Kg)	Sample Color	Nicotine Level (Mg/Kg)
S1	Brown	0.0024	S1 Dark Brown	0.0022
S2	Brown	0.0027	S2 Brown (with residual ppt.)	0.0057

Where S1 – Sample 1, S2 – Sample 2 for both tables.

**Table 4: T-Test Analysis for Honey Samples Collected Urambo and Same District**

	Urambo	Same
Mean	0.00235	0.002483333
Variance	0.000000283	9.61667E-07
Observations	6	6
Pooled Variance	6.22333E-07	
df	10	
P value	0.387851124	

## CONCLUSION AND RECOMMENDATIONS

This study was done in order to evaluate the quality of honey in respect to nicotine content from Urambo and Same district which represented tobacco growing and non-growing areas respectively with an assumption that nicotine from tobacco crop may affect the quality of honey. The results of the study indicated that honey from both areas under study i.e. tobacco growing and non-growing areas contained some levels of nicotine however there were no significant difference between the samples as the differences between means were considered to be non - significant at ( $P > 0.05$ ) using T-test. The study also found that the level of Nicotine found is within the allowable level for human health.

Also among the bee fodders identified from Urambo and Same district some bee fodders were found to contain some levels of alkaloids (nicotine, cocaine, caffeine) however tobacco was not among the bee fodder identified in the area

Therefore this study concludes that the traces of nicotine in the honey samples from Urambo and Same does not originate from tobacco crop, as tobacco were not among the bee fodders plant identified. The traces might have been originated from the bees fodder plant identified in the study areas as among them there were bee fodders that found to contains alkaloids elements(nicotine cocaine, caffeine), for example *Tamarindus indica*, *Acacia mellifera*, *Syzygiumguineense*. It was further found that honey has a characteristic of absorbing smell or flavor of things stored close to it thus another source of contamination might be due to storage of honey with things that containing alkaloids. This study recommend that Apart from the key factors that determines the quality of honey, we recommend that there is a need for Tanzania Bureau of Standards (TBS) and Tanzania Food and Drugs Agency (TFDA) to establish the allowable levels of nicotine in honey.

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**REFERENCES**

1. AEMSA. (2014). *Creating responsible and sustainable practices and process for the safe manufacturing of “e-liquids” used in electronic cigarettes*. American E-Liquid Manufacturing Standard Association (AEMSA), Version 1.8 1.14. 10pp.
2. Asiyah, H. S. (n.d.). *Effects of nicotine and Gelam honey on testis parameters and sperm qualities of juvenile rats*. *Scientific Research and Essays*, 6(26), 5471-5474.
3. B.A., G., E.B., C., B.N., S., & Nnko A, S. a. (2004). *Quality Evaluation of Honey Harvested From Selected Areas in Tanzania With Special Emphasize on Hydroxymethyl Furfural (HMF) Levels*, 200. *Plant foods for Human Nutrition.*, 59:, 129- 132.
4. Balama, C. M. ((2018)). *Nicotine Contents in Honey From Tobacco and Nontobacco Growing Areas in Kigoma Region, Tanzania*. *Proceedings of the 1st TAFORI Scientific Conference on Forestr Research for Sustainable Industrial Economy in Tanzania*.
5. Carlos, A. V. (2011). *Quantification of nicotine in commercial brand cigarettes*. *Biochemistry and Molecular Biology Education*. , 38: 330–334 .
6. Centre., I. T. (2015). *Tanzania Honey Sector Synthesis Report and Development Road Map*. Geneva, Switzerland.
7. Guyo, S. a. (2015,). *Review on Beekeeping Activities, Opportunities, Challenges and Marketing in Ethiopia*, *Journal of Harmonized Research in Applied Sciences.*, 3(4), 201-214.
8. IUPAC, *Compendium of Chemical Terminology, 2nd ed. (the "Gold Book") (1997)*. Online corrected version: (2006–) "alkaloids". doi:10.1351/goldbook.A00220. (n.d.).
9. K.H. Bhuiyan, M. H. (2002). *Identification of Bee Plants and Analysis of Honey Collected from Different Plant Sources*. . *Pakistan Journal of Biological Sciences*, 5, 1199-1201.
10. Kadir, E. Y. (2013). *Inhibitory Effects of Tualang Honey on experimental Brest Cancer in Rats; A preliminary Study*, *Asian Pacific Journal of Cancer Prevention.*, 14(4), 2249-2254.
11. Kihwele, D. ((1991)). *Report on Research and Development advisory committee*.
12. Limited, M. (2007). *Honey and beeswax value chain analysis in Tanzania, Dar Es Salaam.: A Study Commissioned By Traid-craft and SME Competitiveness Facility.*
13. Mbeiyererwa, G. A. (2014). *Honey Value Chain Mapping in Njombe and Siha Districts, Dar es Salaam: A report submitted to The United Nations Development Programme.*,
14. Mwakatobe, A. a. (2006, 8 24). *The status of Tanzanian honey Trade, Domestic and International Markets*, Arusha, Tanzania Wildlife Research Institute. Retrieved 8 24, 2015, from [www.tanzaniagateway.org](http://www.tanzaniagateway.org)
15. Pinda, P. 2. (2014, November). *Prime Minister, United Republic of Tanzania: an Opening Speech, The 1st Apimondia Symposium On African Bees And Beekeeping, Arusha International Conference Centre, Tanzania*

16. Tanzania, B. (2013). *Better Income through Beekeeping, Project on Development and Improvement of Processing.*
17. Tanzania, U. R. (2002). *The Beekeeping Act. Tanzania.*
18. Yanda, P. (n.d.). *Impact of small scale tobacco growing on the spatial and temporal distribution of Miombo woodlands in Western Tanzania. Journal of Ecology and the Natural Environment, 2(1), 10.*

