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Research Article

Management Practices of Peanuts Applied by Producers of Manhica and Magude Districts and Consumers of Five Markets of Maputo Municipalities and the Contribution of these Practices for the Exposure to Aflatoxins

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Abstract

The excessive humidity and high temperature favor peanuts to be contaminated with fungi producers of aflatoxins, which has adverse effects to the health of consumers. The aflatoxins can develop in any step of chain peanuts production when the management fails. The present study aimed to assess the practices of maneuverer of peanuts from the producing place of consumption and its influence to contamination by aflatoxins. It was a descriptive study held in Magude and Manhiça and five markets of Maputo, Mozambique. A questionnaire with semi-structured questions were used to collect data about the practices of producing, storage and consumption. In the two Districts the peanut is cultivated traditionally with weak technical assistance and in consortium with maize. The harvesting is manual and the dry is made naturally in the sun, in the field and at home. The storage is in raffia bags, traditional pest and insect control are implemented. The consumers know the integrity of the peanut and the signals of deterioration. The storage is made under room temperature or in the refrigerator, on both cases the storage period could be more than a month. Some consumers affirm to consume peanuts presenting wires with the appearance of spider webs which is evidence of

fungi development and they are provably exposing themselves to aflatoxins. The practices and procedures of both producers and consumers favor the growing of fungi; the consumption of contaminated peanuts with fungi could be considered a strong exposure to aflatoxins consequently risks to health. With the find it can suspect the existence of consumer developing diseases in asymptomatic stage.

Keywords: Aflatoxins; Consumers; Fungi; Health; Peanuts; Producers

1. Introduction

The peanut is a palatable oleaginous with highly nutritional content, the macronutrient content is estimated at 25% of protein, 48% of fat and 21% of carbohydrates, it also holds micronutrients in varying proportions. The peanut is broadly consumed worldwide and the processing of peanut results in several other products which are used for confection of a number of other food products [1]. The main producers of peanuts in Africa include Nigeria (6.9%) and Senegal (1.6%) of global peanut production [2]. In Mozambique the cultivation of peanuts is made by small and medium scale farmers. Along the country peanuts is cultivated in 416.5 ha resulting in 140 thousand tons; the Northern region is the major producer, accounting with 46% of the total area for peanut cultivation. Maputo Province, where the study took place peanut is cultivated in 9% of the total area, contributing with about 8.790 tons [3]. Generally the peanut is cultivated in drought regime due to their easy adaptation to the adverse climatic conditions [4]; In Africa the peanut is cultivated predominately in tropical and sub-tropical climate zones, characterized by high humidity and high temperature, together with the absence of rain and frequent drought. All those conditions, together favors the development of fungi aflatoxins producers [5-7].

Many factors contribute to the development of fungi aflatoxins producers (*Aspergillus flavus* and *Aspergillus parasiticus*) in peanuts, namely deficient dry, harvesting before the achievement of maturity, drought, and storage for long periods which favors the growth of insects [8]. Deficient ventilation, place of storage without procedures for pest and insects control and deficient control of temperature and humidity [8, 9]. The diet of Africans at South Sahara includes Mozambicans is based on beans, cassava, maize, peanuts and sorghum, all those staple food are susceptive to aflatoxins contamination [10]. Various are the implication of consumption of food staples contaminated with aflatoxins, the concerns include edema in malnourished individuals, aggravation of signals and symptoms of kwashiorkor [10], liver cancer [11], urinary deficiency [12] and death [13]. In Mozambique in the years 1985 have been reported aflatoxins linked to liver cancer and virus of B hepatitis [14]. The present study approaches the maneuver practices of peanuts applied by the producers of Manhica and Magude Districts and consumers of five markets of Maputo Municipalities and the contribution of these practices for the exposure to aflatoxins.

2. Materials and Methods

2.1 Study place

The study took place in Manhica and Magude Districts of Maputo Province, Southern part of Mozambique. Manhica District is located in the Northern region of Maputo Province at 80 km from Maputo City, it crossed by national street number 1 (EN 1). At Northern Manhica is bordered with Macia District (Gaza Province), at the Southern border with Marracuene District, at the Western border with Moamba District and at Eastern by the Indic Ocean [15]. Manhica District holds 2373 km^2 of surface, the population of the District is estimated at 208466 inhabitants [16]. The climate is humid at littoral and tropical dry at the inland. The soil

fertility is considered as medium with high zone of aeolian sandy sediments (West and along the coast) and a zone of coastal dunes; an alluvial plain with less than 100 meters, at length of the Incomati River which presents argillaceous soils of stratified texture or peaty [15]. The arable soil of the district is estimated at 236 thousand hectares, of which about 20% is used for agricultural activities. The farming is practiced mainly by familiar sector in agricultural plots of less than 1 ha [15].

The Magude District is also located in Northern part of Maputo Province, it is bordered in Northern with two Districts of Gaza Province, namely Chokwe and Bilene Macie, at the Southern border with Moamba District, at Eastern with Manhica District and at West with the Republic of South Africa [15]. Magude District owns a surface of 7010 km^2; administratively it divided into five stations, namely Magude-sede, Mapulanguene, Mahele, Motaze and Panjene which are also divided into 18 locations. According to the National Census of 2017 the population is about 63691 inhabitants [16]. The climate is subtropical dry with areas, mainly plains of red argillaceous soil and good fertility interleaved with franco-argillaceous-sandy brown soils of good fertility to intermediated [15]. About half of the area of the District is potentially arable and only 7% of which is exploited and the agricultural is the base of the family economy. The majority of the soils are cultivated in the consortium regime of staples, the most cultivated staples are cassava, beans, maize, sweet potatoes and peanuts [15].

2.2 Methodology

To assess the maneuver practices of peanuts by the producers, data was collected based on the questionnaire with semi-structured questions about the procedures of production, harvesting, drying and storage procedures. The questionnaire was self-administrated study using Portuguese as official language and when it was needed the local language. A total of 114 were submitted to a questionnaire (68 for Manhica District and 46 for Magude District) during July and October 2017. All producers' participated in the study was members of farmers associations and showed their interest to be part of the study based on informed consent made verbally. The data about the maneuver of peanut by the consumers was collected from individuals who gather to five selected markets (Central, Fajardo, Malanga, Xipamanine and Zimpeto) of Maputo City with big convergence of quite a lot of social extracts. The sampling was probabilistic by conglomerates in multiple stages [17]. Then was used the random sampling to determine the sampling size. The total sample size was 270 corresponding to 54 consumers per market; the consumers were found during their normal shops. The consumers were also submitted to questionnaire with semi-structured questions about peanut consumption, the form of consumption and utilization, the way of storage, integrity and deterioration.

2.3 Data analysis

The database was made using the Microsoft Excel program 2007, which was also used to calculate the means, frequencies and percentages. The results were illustrated in Tables.

2.4 Ethical considerations

The proposal of the present study was submitted to the Ethical Committee of Faculty of Medicine, Eduardo Mondlane University and the Ethical Committee of Central Hospital of Maputo for appreciation, which was approved for the implementation.

3. Results and Discussion

3.1 Sociodemographic characteristics of the producers

A total of 114 producers of peanut participated in the present study, 46 (40.3%) were from Magude District

and 68 (59.7%) from Manhica District. In the two Districts 97 (85%) were females and 17 (15%) were males; according to the results the females are more involved in the peanut production. The findings were in concordance with previous studies where 60% to 80% of women in Africa at South Sahara where point to be more involved in agricultural activities [18, 19]. In the Northern region of Mozambique for example the women hold about 70% of farm and this region is considered the major peanut producer [3]. The schooling of producers from Magude District was distributed as follows: 26 (56.5%) primary school, 5 (10.8%) secondary school and 15 (32.6%) without any schooling. In Manhica District 30 (44.1%) Primary school, 6 (8.8%) secondary school and 32 (47.0%) without schooling. It was evident that the level of schooling of the peanut producers was low, which could be influenced negatively in the implementation of best maneuver practices through the peanut producing chain. Studies point out the schooling as a determinant factor in agricultural production [20]. It has been reported that the small scale producers, which are the case of the present study are less schooled (informed) about contamination of staple food by aflatoxins [6, 21].

3.2 Description of the peanuts production

The producers of peanuts in the two Districts are mainly of family sector, more than 90%, the production is for domestic consumption (66%) and the remaining for income. Table 1 describes the production in the two Districts, the majority of producers cultivate peanuts for many years between 20 to 37 years (32.4%). Comparing the period of time of producing among the two Districts, Manhica 24 (35.5%) produces peanuts for longer, more than 20 years. The peanut is produced mainly in small plots and again Manhica District with higher number (37) with small plots (Table 1). Approximately 80% of producers of the two Districts producing peanuts in dry soils without any technical assistance. The way in which the peanut is produced favour the growing of aflatoxins. If the technical assistance was more robust and embracing together with secular knowledge about the maneuverer hold by the producers, all these together could avoid the contamination of peanut by the aflatoxins. According to Misihairabgwi et al., [22] the implementation of technological process in small scales could decrease the contamination of staple food by the aflatoxins. The production in the dry regime is a favorable factor for the growth of fungi producers of aflatoxins, associated with the climate (subtropical and tropical) of the District which is also favorable. The finding is in concordance with [6, 7] who point the dryness and the type of climate (tropical or subtropical) as factors which create an optimal environment for growth of fungi in the peanut. The soil is considered the first reservation for the fungi producers of aflatoxins [23] thus the fungi infect the peanuts and easily profile in the environment of heat and drought [24].

3.3 Practices of peanut maneuverer by the producers

The producers of peanut in the two Districts recognize the maturity of peanut by the following characteristics: maturity of maize, yellowness of the leaves, dryness of the leaves and testing the fruit. Among the ways of recognition, the yellowness of the leaves was more stated (50%) by the producers and the less mentioned was testing (19%) Table 2. The recognition of peanut maturity based on the maturation of maize revels that the peanut is cultivated with consortium with maize. Showing that the two staples mature at the same time, this factor advance the occurrence of cross contamination by the fungi of aflatoxins producers; take into consideration that both staples are susceptive to the growth of fungi. Both peanut and maize as well its derivatives are in the list of staples vulnerable to contamination by fungi [25, 26]; derivatives of cereals include sorghum and wheat [27, 28], cassava and derivatives [29]. With exception of wheat all the staples

mentioned above are cultivated in Mozambique and mostly in consortium with peanut.

The harvesting of peanut in the two Districts is made manually, 91 (78.8%) of the harvesting is made without rain and 23 (20.2%) with rain; being Manhica District with higher harvesting made with rain 16 (34.8%). The manual harvesting can be considered a protective factor against the contamination of peanuts by the fungi of aflatoxins producers because this procedure does not make pressure to the peanuts. The pressure of the fruit (peanut) during the harvesting could cause injury and serve as an open door for the entrance of fungi aflatoxins producers. It is recommended to avoid mechanical injury of peanuts during the harvesting because it increases the suitability to contamination [30]. However, the fact that 20. 2% of the harvest at the rainy time keep some merit of manual harvesting as the rain interfere with the drying of peanut and promote the growth of fungi aflatoxins producers. Diener and Davis [31] have been reported that the rapid drying of peanut blocks the growth of fungi.

Two forms of drying were mentioned, directly in the soil 65 (57.0%) and drying in floor of cement 29 (25.4%); Where in Manhica District, 35% of producers dry peanut directly in the soil (35%) and (22%) in the floor of cement. The drying of peanuts directly in the soil made by more than 50% of the producers of this study is not advised; mainly when one of the objective is to avoid the contamination by fungi. That is why Zuza et al., [32] recommends the adoption of good drying practices to prevent the contamination by fungi. According to the authors, the drying of peanuts in cadre shows to be effective compared to the drying in canvas extended directly to the soil [32].

Table 3 shows the practices of storage implemented by the producers of peanut; the most frequent are packing in the barn 61 (54.0%), stored in bag 78 (68.4%). The peanut is stored without the control of temperature 91 (84.2%) and the period of time of storage could reach more than a year 58 (51.0%) Table 3. The implementation of traditional practices for the storage without control of temperature and considering that there are cases where the peanut is stored for more than a year; all these practices advance the appearance of insects and rodents; take into account that long period of storage increase the probability of peanut be attacked by insects and rodents as the control of pest are made by secular procedures.

According to the results 81 (71.0%) the producers affirm to control the insects e rodents and 33 (29.0%) do not apply any practices. Manhica District has a huge number (46) of producers who implement practices control. The practices for the control of insects and rodents implemented are as follows: Chemical products 34 (41.9%), biological products 19 (23.4%) and combination of chemical and biological products 28 (34.5%) where Manhica District appears with more (22) producers using chemical products. The 29.0% of producers who do not apply any procedure of control put at risk of attack on their product by these pests as it was found that the peanut is stored for a long period of time. The attack of peanut by insect and rodent propitiate the damage and consequently the growth of fungi aflatoxin producers as well as bring in other microorganisms into the peanuts.

3.4 Forms of peanut consumption

A total of 270 consumers participated in the study, all consumers stated to buy peanut for own consumption. According to them the peanut is consumed fresh/raw and dried; the fresh could be roasted or cooked with the peel. The distribution of the forms of consumption is as follows: fresh peanuts are consumed raw 6.3%, cooked with peel 15.6%, roasted with peel 1.5% and raw and

cooked with peel 41.5%, raw and roasted with peel 2.6% among other combinations 32.5%. The dry peanut is consumed mainly in the form of curry, 215 (79.6%), roasted 50 (18.5%) curry and sweets 5 (1.9%). It is supposed that in some form of consumption the peanut can be contaminated by fungi and expose the consumers to aflatoxins and consequently to the risks to health. This statement is supported by Kooprasertying et al., [33] where assessed the exposure of aflatoxins in Thai peanut consumer and 80% samples of raw peanut and 100% samples of roasted peanut were assessed. In the study the expose to aflatoxins by the consumption of contaminated peanut was estimated at 0.49 and 0.40 for raw and roasted peanut respectively. The potential risk for cancer was estimated in 0.01 to 0.12 cancers/year/100 000 individuals [33].

The consumption in the form of curry is the more frequent, being consumed in an average of two (43.0%) to three (32.6%) times per week. For the curry preparation 83.0% of consumer buy the peanut in grain and other buy milled peanut (15.9%), the remaining consumers do not answer. Though, only 28.1% of consumer's quantities to be used once and the other 70.7% buy large amount to be used several times. 70% of consumers' mille peanut in large quantities for the preparation of more than one meal, this habit can contribute to the exposition to aflatoxins taking into account that the milling increase the surface of contact for the fungi and the large quantities bought obligate the storage and also increases the proliferation of fungi in the milled peanut.

3.5 Consumer peanut maneuverer practices

The Table 4 describes the several peanut maneuverer practices implemented by the consumers in the five markets of Maputo City. Approximately 60% of consumers' mill peanut, mostly the milled peanut is stored at room temperature (55.1%), for an average period of time between two weeks (41.8%) to one month (41.8%). Other consumer's storage the milled peanut in freezer for a period of time of more than a month (52%) as described in Table 4. These findings reinforce the probability of growth of fungi aflatoxins producers and the chance of consumers be exposed to aflatoxins and put at risk their health.

The consumers were asked about the quality of milled peanut (Table 5), where some peanut was considered not be of good quality, as presented signals of deterioration such as cobwebs and fungi. The consumption of peanut with signals of deteriorations for 34.6% of consumers (Table 5) constitutes a concern for the health taking into account the consequence of consumption contaminated peanut.

District		**Magude N = 46**	**Manhica N = 68**	**Total N = 114**
Period of cultivation (years)	1	2 (4.3%)	0	2 (1.75%)
	2 to 4	12 (26%)	14 (20.5%)	26 (22.8%)
	5 to 10	12 (26%)	16 (23.5%)	28 (24.6%)
	11 to 20	7 (15.4%)	14 (20.5%)	21 (18.4%)
	<20	13 (28.3%)	24 (35.5%)	37 (32.4%)
Size of plot (Ha)	>1	3	4	7 (6.1%)
	1 a 5	26	37	63 (55.2%)
	6 a 10	15	21	36 (31.6%)

	<10	2	6	8 (7.1%)
Type of soil	Dry	32 (69.5%)	59 (86.7%)	91 (79.8%)
	Dry and irrigation	14 (30.4%)	9 (13.2%)	23 (20.2%)
Technical assistance	Yes	8 (17.3%)	24 (35.3%)	32 (28.1%)
	No	38 (82.6%)	44 (64.7%)	82 (71.9%)
Type (size(of peanut)	Small	33 (71.7%)	54 (79.5%)	87 (76.3%)
	Small and Big	13 (28.25)	14 (20.5%)	27 (23.7%)

Table 1: Description of peanut production in Magude and Manhica Discrits.

District	**Forms of recognition**			
	Maize maturity	**Yellowness of leaves**	**Testing the fruit**	**Dryness of the plant**
Magude	16 (23.5%)	32 (47%)	9 (13.3%)	11 (16.2%)
Manhiça	9 (19.5%)	18 (39.1%)	10 (21.7%)	9 (19.5%)
Total	25 (21.9%)	50 (43.8%)	19 (16.6%)	20 (17.5%)

Table 2: Recognition of peanut maturity.

	Practice	**Magude**	**Manhiça**	**Total**
Storage	Storehouse	27	34	61(54%)
	Bags	15	23	38(33.3%)
	Others	4	11	15(13.1%)
Form of storage	Bags	30	48	78 (68.4%)
	Silos	11	20	31(27.1%)
	Others	5	0	5 (4.3%)
Temperature control in the storage	Yes	10	8	18 (15.8%)
	No	36	60	91 (84.2%)
Period of time of storage	> year	29	36	58(51%)
	A year	21	32	53 (46.4%)
	6 Months	0	3	3(2.6%)

Table 3: Practices of storage of peanut by the producers.

Practice of maneuverer	**Event**	**%**
Milled peanut	Yes	57.8
	No	34.1
	Not responded	8.1
	-	100

Place of storage of milled peanut	Room temperature	55.1
	Glacier	14.1
	Freezer	30.7
	-	100
Period of storage the milled peanut	One week	5.8
	Two weeks	41.8
	One month	41.8
	> One month	10.4
	-	100
Period of storage the milled peanut in freezer	One week	10.4
	Two weeks	29.1
	One month	52
	> One month	8.3
	-	100

Table 4: Consumer peanut maneuverer practices.

Parameter	**Event**	**%**
Observation of signals of deterioration	Yes	18.1
	No	51.1
	Not responded	30.7
	-	100
Type of deterioration signal observed	yarn/cobwebs	53.1
	Mold	46.9
	-	100
Use of peanut with signals of deterioration	Yes	34.6
	No	65.3
	-	100

Table 5: Attention to milled peanut quality.

4. Conclusions

The management practices of both producer and consumer are somehow due to mostly advance the growth of fungi aflatoxin produce. The fact that peanut presenting visible signals of deterioration with evidence of fungi growth and being consumed it can suppose that some participants of the study may be developing the illness in asymptomatic stage.

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