

Arsenic intakes from spices and sheep tail (Donbeh) in a high oesophageal cancer area: Pilot study from Iran

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ABSTRACT

Arsenic is a carcinogenic and toxicant element widely found in the environment and might be part of causation web of Oesophageal Cancer (OC), which has one of the highest incidence rates in Golestan Province, Northeast Iran. In this pilot study, we collected 10 Sheep tail (donbeh) and 9 mixed spices samples, as widely consumed foods in the region, from main counties in the province and analyzed for arsenic concentrations using AOAC atomic absorption spectrophotometry method. Findings showed that arsenic levels in all samples were less than the safe level of 1 ppm. Total arsenic intake from sheep tail and mixed spices sources were estimated at 4.68 and 4.24 $\mu\text{g}/\text{day}$ in men and women, respectively. Therefore, the study suggests that arsenic intake from these commonly consumed foods do not seem as a major hazard for OC etiology.

Key words: Arsenic, Oesophageal cancer; Foodstuff; Iran

INTRODUCTION

Oesophageal Cancer (OC) is the 6th mortality cause from cancer in the world. Meanwhile, there are a couple of epidemiological zones where OC does have significantly high incidence, and therefore, much higher specific mortality rates. *Golestan* province, Northeast Iran, had been one of these zones with OC incidence reaching 109/10⁵ and 174/10⁵ among men and women, respectively, in 1970s [1-2]. Over 90% of OC cases in this region have been Oesophageal Squamous Cell Carcinoma (OSCC) [3]. Epidemiological studies have been done so far in *Golestan* province to test hypotheses correlating environmental factors to OC, but definite cause(s) need to be explored [1].

Higher OC incidence among women may be considered as a gender-based susceptibility to the disease and/or its risk factors, but on the other hand, might be related to higher specific exposures. With the latter assumption, analyzing

the dietary practices may shed some light.

Data collected in a recent food consumption survey in the region showed that the amounts of spices/condiments were high among inhabitants [4]. Moreover, qualitative data suggest high consumption of Sheep tail (locally known as "donbeh" which is bulky fat depot in traditional sheep) in the region [5]. Contamination of these foodstuffs with carcinogen or the accumulation of these materials in foodstuff therefore might shape a hypothesis relating to high incidence of OC in *Golestan* province. Arsenic has been known as a carcinogenic element. While the mechanism(s) are not totally clear at present [6], but using experimental data from cell cultures and results of epidemiologic studies, it has been found for the first time that arsenic activates the Hedgehog signaling by decreasing the stability of the repressor form of GLI3, which is one of

the transcription factors that regulate Hedgehog activity [7].

They also found high levels of arsenic exposure associated with high levels of Hedgehog activity. In this pilot study, we measured arsenic concentrations in two commonly consumed foods, i.e. sheep tail (*donbeh*) and spices, samples collected in *Golestan* province, Northeast Iran, to see if there is any sign of high intake risk of arsenic, and therefore, any need to conduct a larger survey.

MATERIALS AND METHODS

Location

Study was carried out in urban and rural areas of *Golestan* province, Northeast Iran. Figure 1 shows the study location.



Figure 1. *Golestan* province, Northeast Iran

Samples and sampling

For this pilot study, a total of 10 sheep tail (*donbeh*) and 9 mixed spices samples were taken from different main counties (one sheep

tail and one spices samples separately from urban and rural areas in each county) in *Golestan* province based on a convenient sampling method. Five-to-seven grams of each food items were collected in separate small sampling boxes all on the same day and delivered to the laboratory on the next day. Sheep tail and spices samples stored in fridge and room temperatures, respectively, till chemical analysis within 10 days following sampling.

Measurement techniques

Measurements were done in *Techno-Azma* accredited laboratory, Tehran, within one week after sample receipt. Arsenic was measured based on Hydride generation method using atomic absorption spectrophotometry (Varian Inc., USA), as described in AOAC 986-15 [8].

Estimation of arsenic intakes and risk

Amounts of Sheep tail and spices consumed by men and women were taken from a survey done recently to validate a Food Frequency Questionnaire (FFQ) for the OC cohort in the region [4]. Arsenic intakes from these food items were estimated by multiplying the amounts eaten by mean of arsenic concentrations in these foods. Comparison was made with the value of 1 mg/kg (1ppm) which is generally assumed as the safe level of arsenic in foods [9].

RESULTS

Concentrations of arsenic in food samples are shown in table 1. As can be shown in the table, the levels of arsenic in sheep tail samples are far less than the standard cut point of 1 ppm. All samples of mixed spices also had lower concentrations than the cut-off.

Table 1. Arsenic concentrations in sheep tail (*donbeh*) and mixed spices samples in *Golestan* province, Iran

County	Arsenic concentration (ppm)	
	Sheep tail (<i>donbeh</i>)	Mixed Spices
<i>Gorgan</i> (urban)	<0.07	0.21
<i>Agh-ghala</i> (rural)	<0.07	0.22
<i>Minoo-dasht</i> (urban)	<0.07	0.37
<i>Kalaleh</i> (urban)	<0.07	0.11
<i>Kalaleh</i> (rural)	<0.07	0.16
<i>Gonbad</i> (urban)	<0.07	0.37
<i>Gonbad</i> (rural)	<0.07	<0.07*
<i>Bandar-e-Turkman</i> (urban)	<0.07	0.45
<i>Azad-shahr</i> (urban)	<0.07	-
<i>Ali-abad</i> (urban)	<0.07	0.11
Mean	<0.07*	0.23

*Considered 0.07 for calculation purposes

Given the medium daily consumption of animal fat and mixed spices at 11 and 17 gr in men and 8 and 16 gr in women, respectively, in *Golestan* province [4], total arsenic intakes from these two sources, are estimated at 4.68 and 4.24 $\mu\text{g}/\text{day}$ in men and women, respectively.

DISCUSSION

This pilot study has shown negligible amounts of arsenic intakes from two suspicious and commonly consumed foods, i.e. Sheep tail and mixed spices, in *Golestan* province, Northeast Iran, where the incidence rate of OC is among the highest in the world.

Data employed for risk estimations in this study has been taken from a recent study in the region aiming at validation of a food frequency questionnaire (FFQ) used for the on-going OC cohort study in *Golestan* province [4]. The data in many instances however differ from what have been collected by qualitative techniques such as group discussions and interviews [5]. For example the latter data reveal that traditionally, lean parts of meats are served for men, who are regarded as bread-owners and "the most important" household member, and women receive more fatty parts. Sheep tail (*donbeh*) is also a favorite part of animal body which is used in preparation process of many traditional foods as well as eaten sometimes in its raw form. Therefore it is expected that women take more animal fats than men. This might also be true for mixed spices which are used extensively to prepare locally foods as well as pickled vegetables, consumed in higher amounts by women.

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Arsenic, as a carcinogen and toxicant, is widely found in the nature in different forms with different toxicity/carcinogenicity level. The most toxic forms of arsenic are its inorganic compounds. As arsenic is an element, it is not degraded in the environment. Instead, it may accumulate throughout the food chain. Soil, air, food and water are sources of arsenic. It has been estimated that the average daily dietary intake of arsenic by adults in the United States is 40 micrograms per day [6]. The amounts of arsenic provided by the studied food stuffs in *Golestan* were just one fortieth of total estimations in US, which can be regarded as quite safe.

Environmental factors, e.g. selenium status, silica concentration in soil and some foodstuffs, exposure to Polycyclic aromatic hydrocarbons, drinking hot tea, use of opioids, etc have been investigated in different studies to find out possible correlation with OC pathogenesis in *Golestan* province [1-2]. While no definite cause(s) has been introduced yet, the OC relationship with some factors, e.g. drinking hot tea [10] and opium and tobacco use [11] have been found strong. Meanwhile, it should be noted that other public health problems in the region, e.g. Coronary Vascular Diseases (CVDs), might have similar causal factors. This would necessitate broadening the epidemiological frameworks to investigate possible links between environmental factors and multiple disease development.

In conclusion, based on results of this pilot study, it does not seem that arsenic plays a major role in OC etiology in *Golestan* province, Northeast Iran.

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