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High levels of tobacco-specific *N*-nitrosamines and nicotine in Chaini Khaini, a product marketed as snus

Irina Stepanov, PhD,

Masonic Cancer Center and Division of Environmental Health Sciences, University of Minnesota, Minneapolis, MN 55455, USA

Prakash C. Gupta, PhD,

Healis - Sekhsaria Institute for Public Health, Belapur Navi Mumbai 400 614, India

Gauri Dhumal, MSc,

Healis - Sekhsaria Institute for Public Health, Belapur Navi Mumbai 400 614, India

Katrina Yershova, BS,

Masonic Cancer Center, University of Minnesota, Minneapolis, Minnesota, 55455, USA

William Toscano, PhD,

Division of Environmental Health Sciences, University of Minnesota, Minneapolis, Minnesota, 55455, USA

Dorothy Hatsukami, PhD, and

Masonic Cancer Center, University of Minnesota, Minneapolis, Minnesota 55455, USA

Mark Parascandola, PhD

Tobacco Control Research Branch, National Cancer Institute, Bethesda, MD 20892

Abstract

Introduction—Recently, a tobacco product, Chaini Khaini, identified as *snus* appeared in India. The product marketing emphasizes its discreet nature and explicitly claims safety by referring to the existing evidence on Swedish snus. We here analyzed tobacco-specific nitrosamines and nicotine in 12 samples of Chaini Khaini purchased in 2013 at open markets in India.

Methods—Samples were purchased twice: in March 2013 from Mumbai and in November 2013 from Mumbai and Ahmedabad. Chemical constituents were measured by our routine validated methods.

Corresponding author: Irina Stepanov, Ph.D. Masonic Cancer Center, University of Minnesota, Cancer and Cardiovascular Research Building, 2231 6th Street SE - Room 2-140, Minneapolis, MN 55455, USA, phone: 1-612-624-4998 ; fax: 1-612-624-3869; stepa011@umn.edu.

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Results—Levels of carcinogenic nitrosamines NNN, NNK, and NNAL averaged 22.9 (\pm 4.9) μ g/g, 2.6 (\pm 1.0) μ g/g, and 3.1 (\pm 1.5) μ g/g tobacco (wet weight), respectively. The levels of NAB, which is normally present in trace levels in tobacco products, ranged from 3.9 to 12.9 μ g/g tobacco. Total nicotine levels in all samples averaged 10.0 mg/g tobacco and unprotonated nicotine accounted for an average 95.4% of the total nicotine content.

Conclusions—Chaini Khaini, which is labeled as *snus* and is marketed as a safe alternative to other tobacco products contains very high levels of carcinogenic nitrosamines and biologically available nicotine. Interventions are urgently needed to educate current and potential consumers of this product.

Keywords

Smokeless tobacco; snus; tobacco-specific nitrosamines; nicotine; toxicology

INTRODUCTION

The use of smokeless tobacco has been evaluated as a causal factor for oral, pancreatic, and esophageal cancer.¹ However, existing epidemiologic studies indicate that exclusive use of Swedish moist snuff, which is called snus, is associated with the relatively low overall cancer risks.² An increased risk of pancreatic cancer has been reported in snus users when compared to never-users of any tobacco; however, the evidence suggests that it is not associated with significant risk of oral cancer.

Swedish snus is a moist finely ground product made with pasteurized air- or sun-cured tobacco. It is available in either loose form or pre-portioned in small teabag-like sachets and is typically used by placing it between the upper lip and gum for approximately 30 minutes. The relatively low risk of cancer associated with the use of Swedish snus is attributed, at least in part, to the fact that it contains low levels of tobacco-specific *N*-nitrosamines (TSNA) – a major group of potent carcinogens in smokeless tobacco.³ Indeed, in laboratory animal studies, the two carcinogenic TSNA, *N*'-nitrosornicotine (NNN) and 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), cause cancers that are most strongly associated with smokeless tobacco use,⁴ and there is strong and consistent evidence of an increased risk of oral cancer with the use of smokeless tobacco that is highly contaminated with TSNA.⁵ The specifics of Swedish snus manufacturing prevent the formation of high levels of TSNA in this product.⁶ Thus, based on the “Swedish experience”, encouraging smokers to switch to the Swedish-type low-nitrosamine snus is seen by some as a potential harm reduction strategy.⁷

While Sweden is the home of snus, products with this name started appearing in other parts of the world. For instance, several new tobacco products called snus entered the U.S. market in 2006. More recently, a tobacco product Chaini Khaini that is also marketed as snus appeared in India. The product package and website seem to employ marketing features similar to those used for the U.S. snus: the statements emphasize its discreet nature, and a 3-step instruction on how to use this product is provided. In addition, Chaini Khaini is explicitly equated with Swedish snus and is claimed to offer “safety from smoking and chewing tobacco” (<http://chainikhaini.com/index.htm>, Figure 1). However, traditional Khaini

– the product that is the most popular in India – was reported to contain high levels of TSNA. On the other hand, a recent publication described Chaini Khaini “snus” as not being the traditional khaini, and it was suggested that cultural attributes are being exploited in the promotion of this product.

To explore whether Chaini Khaini is similar to Swedish snus and is simply called “khaini” to appeal to Indian consumers, or it is actually more similar to khaini and is marketed as snus, we analyzed TSNA, nicotine and unprotonated nicotine in samples of this product purchased in 2013 in India.

METHODS

Tobacco samples

Sample collection was carried out twice: in March 2013 in Mumbai and in November 2013 in Mumbai and Ahmedabad. At all locations, Chaini Khaini was exposed to high ambient temperatures and humidity, similar to the routine handling of other smokeless tobacco products. We sought to obtain representative averages for constituent levels by purchasing samples from three different markets in each location. After the purchase, samples were labeled and handled according to our standardized sampling and labeling procedures. In the laboratory, samples were sealed in plastic sleeves and stored at 4 °C until analysis.

Tobacco analysis

Samples were prepared according to our routine validated methods. Analysis of five TSNA – NNN, NNK, 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL), *N*'-nitrosoanatabine (NAT), and *N*'-nitrosoanabasine (NAB) – were performed by liquid chromatography-tandem mass-spectrometry as described. Nicotine was analyzed by gas chromatography-mass spectrometry-selected ion monitoring. The amount of unprotonated nicotine was calculated using the Henderson-Hasselbalch equation. Moisture content and pH were measured as previously described.

RESULTS

A total of 12 samples, all produced by the same manufacturer, have been purchased and analyzed. The first set of 6 samples was purchased in March 2013 in three markets in Mumbai, two samples per vendor. To confirm the results of chemical analyses obtained for this first set, additional samples were obtained in November 2013 from three markets in Mumbai and three markets in Ahmedabad, one sample per location.

Constituent levels in all samples are summarized in Table 1. The results are expressed per gram tobacco (wet weight). Nicotine levels in all samples ranged from 7.9 to 13.4 mg/g tobacco, and pH ranged from 9.01 to 9.92. On average, unprotonated nicotine accounted for 95% of total nicotine content. The sum of all five measured TSNA ranged from 23.1 to 61.2 µg/g tobacco. Levels of carcinogenic NNN, NNK, and NNAL averaged 22.9 (±4.9) µg/g, 2.6 (±1.0) µg/g, and 3.1 (±1.5) µg/g tobacco, respectively. The levels of NAB, which is normally present in trace levels in tobacco products, ranged from 3.9 to 12.9 µg/g tobacco.

DISCUSSION

As manufactured in Sweden, snus contains relatively low levels of TSNA and is associated with relatively low risk of cancer compared to other forms of smokeless tobacco. Thus, there is an opinion shared by many public health researchers that Swedish-type snus has a potential to reduce tobacco-induced morbidity and mortality in people who switch to this product instead of using other, more harmful, forms of tobacco. We here demonstrate that Chaini Khaini, a product marketed as snus in India with explicit reference to “Swedish experience”, contains remarkably high levels of TSNA and biologically available nicotine. This is an example of how the notion of snus “harm reduction” can be misused in the marketing of a highly carcinogenic and addictive product.

The reported levels of TSNA and nicotine in traditional Khaini and in Swedish snus are listed in Table 1 for comparison with the data obtained in the current study. We found that the levels of TSNA in Chaini Khaini are similar to those found in traditional Khaini. These levels are among the highest reported to be present in tobacco products, second only to those found in Sudanese toombak in the recently analyzed sample of products from the global market. It is also notable that the levels of NNAL, which is a metabolite of NNK and demonstrates carcinogenicity that is comparable to NNK in laboratory animals, is unusually high in this product; the levels are similar to those of NNK (Table 1). Typically, NNAL levels in tobacco comprise about 10% of the NNK content. However, relative amounts of NNK and NNAL found in Chaini Khaini in this study are also similar to those previously reported for traditional khaini. In addition, the levels of NAB, a weak esophageal carcinogen which is normally present in trace levels in tobacco products, averaged 8.4 µg/g tobacco. Whereas, given its weak carcinogenicity and typically low levels NAB is usually not referred to as an essential carcinogenic TSNA, such high levels of NAB in Chaini Khaini may contribute to the carcinogenicity of this product. Similarly high levels of NAB are also found in traditional khaini.

Similar to traditional Kahini, pH of Chaini Khaini is highly alkaline, leading to more than 90% of total nicotine being present in the biologically available unprotonated form (Table 1). Furthermore, total nicotine levels in Chaini Khaini are higher than those reported for traditional khaini. Thus, the levels of unprotonated nicotine, which defines the addictive potential of smokeless tobacco, are 2–3 times higher in Chaini Khaini than in traditional khaini, and are among the highest reported for smokeless tobacco products.

Together, our analyses demonstrate that, in its carcinogenic and addictive potential, Chaini Khaini is very close to traditional khaini. Thus, labeling this product as *snus* and claiming its safety as compared to other forms of tobacco use is unsubstantiated. Such labeling represents an example of dangerous misuse of the available evidence on Swedish snus in the marketing of a highly carcinogenic and addictive tobacco product. The misleading marketing of Chainin Khaini is aggravated by the fact that, according to Global Adult Tobacco Survey, khaini is the most popular smokeless tobacco product in India. It is the most commonly used smokeless product by both exclusive smokeless users and dual users (with bidi smoking). There is no published data available on the prevalence of use or the consumer perception of Chaini Khaini. However, marketing of this product seems to be a

“perfect storm” that combines an appeal of a popular tobacco product type, emphasis on the use of native tobacco and indigenous flavors, trendiness of packaging, discreet nature of the pouched form, and a promise of safety. Given that the tobacco use-associated oral cancer rates in India are among the highest in the world, this issue requires immediate attention.

In summary, we here report that the product that is identified by its manufacturer as snus and is marketed as a safe alternative to other tobacco products contains very high levels of carcinogenic nitrosamines and biologically available nicotine. Interventions are urgently needed to educate current and potential consumers of this product. Furthermore, regulatory measures are warranted to prevent mislabeling of similarly harmful products as snus and claims, implied or explicit, of risk reduction.

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What this paper adds

- Epidemiologic studies indicate that exclusive use of Swedish snus, which contains low levels of carcinogenic tobacco-specific nitrosamines (TSNA), is associated with relatively low risk of cancer compared to other forms of smokeless tobacco. Encouraging smokers to switch to the Swedish-type snus is seen by some as a potential harm reduction strategy.
- This study shows that a product marketed in India as snus and explicitly claimed to be a safe alternative to other tobacco products contains remarkably high levels of TSNA and biologically available nicotine.
- Interventions are urgently needed to educate current and potential consumers of this product, and to prevent mislabeling of similarly harmful products as snus with claims of risk reduction.

MAHAK Chaini Khaini
Chen Se Maza Lo

Safety From the harm of Smoking and Chewing Tobacco.

More and more people across the world are switching from smoking & tobacco chewing to Chaini Khaini Filter Pouches, not only for the safety but for the unique Chaini Khaini experience.

The concept of filter tobacco pouches is not a new one. It has been popular in the west and other religions as snus. It is a medically proven fact that snus (Chaini Khaini) is much less harmful than smoking. Sweden, where people prefer snus over smoking has the lowest incidence of tobacco related lung cancer.

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Figure 1. Image of the website that claims safety of Chaini Khaini use and implies similarity of this product with Swedish snus (retrieved from—<http://chainikhaini.com/index.htm>—on 7 August 2014).

Table 1
Summary of chemical analyses performed on Chaini Khaini and comparison with published data on traditional Khaini and Swedish snus.

Vendor	Sample #	Moisture content, %	pH	Total nicotine, mg/g wet weight	Unprotonated nicotine		ug/g wet weight					
					%	mg/g wet weight	NNN	NNK	NNAL	NAT	NAB	Total TSNA
Analyzed in this study												
<i>Mumbai, India (March 2013)</i>												
M1	1	26.1	9.01	8.2	90.6	7.5	19.5	2.3	2.3	5.7	7.5	37.2
	2	26.1	9.20	7.9	93.7	7.4	17.4	2.4	2.3	5.3	7.3	34.8
M2	3	25.0	9.60	13.4	97.4	13.1	29.4	2.0	4.9	11.6	12.9	60.8
	4	21.5	9.39	12.9	95.9	12.4	27.4	5.0	5.7	10.2	12.9	61.2
M3	5	22.9	9.50	10.0	96.8	9.7	26.7	3.5	5.5	6.1	11.0	52.9
	6	25.1	9.92	9.1	98.7	9.0	25.1	1.9	4.9	6.3	11.0	49.3
<i>Mumbai, India (November 2013)</i>												
M4	7	25.6	9.41	11.0	96.1	10.6	26.2	3.2	2.4	8.5	7.9	48.2
M5	8	26.9	9.35	9.6	95.5	9.2	24.5	2.1	1.9	6.4	7.0	41.9
M6	9	27.9	9.64	12.0	97.7	11.7	24.9	3.3	2.0	9.1	7.3	46.5
<i>Ahmedabad, India (November 2013)</i>												
A1	10	25.2	9.24	8.3	94.3	7.8	16.0	1.2	1.7	3.1	4.2	26.3
A2	11	26.1	9.13	8.7	92.8	8.1	13.2	1.5	1.8	2.8	3.9	23.1
A3	12	26.4	9.36	8.3	95.6	7.9	25.0	2.7	2.3	6.1	7.8	43.9
Average for Chaini Khaini		25.4	9.4	10.0	95.4	9.5	22.9	2.6	3.1	6.8	8.4	37.6
SD		1.7	0.2	1.8	2.2	1.9	4.9	1.0	1.5	2.5	2.9	18.7
Previously published data												
<i>Traditional Khaini</i>												
Super Raja Khaini		n/r*	9.65	4.79	97.7	4.7	16.8	0.502	1.44	2.22	2.58	23.5
Spiti Raja Chap Khaini		n/r	9.79	2.53	98.3	2.5	17.5	0.288	1.35	0.303	2.19	21.6
<i>Swedish snus</i>												
General Original Snus		n/r	7.01	8.34	8.98	0.75	0.345	0.096	0.013	0.248	0.021	0.723
General White Portion Snus		n/r	6.86	8.09	6.48	0.52	0.296	0.097	0.013	0.225	0.018	0.648

* N/r, not reported in the original publication (reference).