Introduction

As smoking restrictions and high cigarette taxes have reduced demand for cigarettes in the United States, cigarette manufacturers have responded with diversified product offerings, including snus: a Swedish-style smokeless tobacco product. Altria and Reynolds American began test-marketing snus during 2006 and 2007, respectively, and quickly developed national markets for snus products using the names of major cigarette brands, ( Marlboro and Camel, respectively).  

Characteristics of “American Snus” and Swedish Snus Products for Sale in Massachusetts, USA

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Abstract

Introduction: Snus may present lower health risks than cigarettes, but its harm reduction potential may be undermined if used dually with cigarettes. The likelihood of exclusive snus use compared with dual use may depend in part on the capacity of snus to deliver nicotine in doses that are satisfactory to smokers. We examined characteristics of “American snus” products, including nicotine levels, and compared to snus products that are more typical of Sweden.

Methods: Tobacco industry reports for snus products submitted to the Massachusetts Department of Public Health for the year 2014 were used to assess moisture (%), pH, total nicotine, and unionized (free) nicotine (both mg/g and percent of total). A total of 14 (“American”) snus products made by American manufacturers Philip Morris USA (n = 6), R.J. Reynolds Tobacco Company (n = 6), and US Smokeless Tobacco Company (n = 2), were compared with Swedish-style (“Swedish”) snus products (n = 10) made by Swedish Match North America.

Results: Compared with Swedish snus, American snus brands contained significantly lower concentrations of unionized nicotine (median: 0.52 mg/g vs. 6.52 mg/g; p < .001) and proportion of unionized nicotine (median: 3.17% vs. 81.8%; p < .001). American snus brands also had significantly lower pH (median: 6.54 vs. 8.68; p < .001) and moisture (median: 30.3% vs. 53.4%; p < .001).

Conclusions: Swedish-made snus has higher unionized nicotine, measured by concentration and proportion of total nicotine, compared with snus products made by American manufacturers. These findings suggest that American snus products have lower addiction potential than Swedish snus, and may be more likely to be used dually with cigarettes than as a sole source of nicotine.

Implications: American snus products contain significantly lower unionized nicotine, lower pH, and lower moisture, compared with Swedish snus products. Snus addiction potential and patterns of usage, including co-use with cigarettes, may differ between American and Swedish snus products due to differences in snus product characteristics.
snus market, and by 2014, snus products represented 1.7% of the total volume of American smokeless tobacco market.\textsuperscript{3,4}

Snus differs from traditional American-style smokeless tobacco—moist snuff—in several ways. Snus products are typically sold in pouch form, rather than packaged as loose tobacco, and each pouch is intended for placement by the consumer under the top rather than the bottom lip.\textsuperscript{5} Compared to moist snuff, snus use has a reduced urge to spit. Further, snus is made of a low nitrate tobacco, and snus processing involves pasteurization instead of fermentation. As a result, snus contains significantly lower levels of carcinogenic tobacco-specific nitrosamines, compared with moist snuff.\textsuperscript{6,7} The lowered potential for toxicant exposure has led to the promotion of snus as a reduced harm product.\textsuperscript{8} In Sweden, the prevalence of snus use among males exceeds that of smoking, and some Swedish men report using snus to quit smoking.\textsuperscript{9} However, promoting snus as a smoking cessation product has not been universally endorsed by the International Tobacco Control Community, because of concerns that snus may give rise to dual use with cigarettes, delaying smoking cessation and thus perpetuating the harms of smoking.\textsuperscript{10} Similarly, concerns have been raised regarding the potential for snus to promote initiation of tobacco use among youth who might not otherwise use tobacco.\textsuperscript{11,12}

Certain factors, including lower price, targeted marketing and ease of use may contribute to the appeal of snus in the American market.\textsuperscript{13,14} However, a key driver of snus product appeal may be product physical characteristics, particularly nicotine levels and bioavailability, which influence its potential to support nicotine dependence (ie, addiction potential). Tobacco manufacturers can directly influence nicotine bioavailability by increasing pH, which allows a greater proportion of nicotine to exist in unionized form.\textsuperscript{15,16} Unionized nicotine is transported more rapidly across mucous membranes giving rise to a more rapid increase in blood nicotine levels, which in turn reinforces tobacco use behavior.\textsuperscript{16,17} Oral tobacco products with higher unionized nicotine have been associated with higher cessation outcomes among smokers interested in quitting,\textsuperscript{18} suggesting better capacity to support nicotine dependence and alleviate withdrawal. This implies that snus products with low levels of unionized nicotine will be less likely to support complete switching from cigarettes and may be more likely to promote dual use, undermining the potential for harm reduction.\textsuperscript{19-21} A version of Marlboro Snus test marketed in 2007 had lower reported pH, nicotine and moisture compared with snus products made in Sweden.\textsuperscript{22} Since their early test markets, both Marlboro and Camel Snus have undergone changes in pouch size and flavoring, and nicotine bioavailability has increased.\textsuperscript{22} Data from recent iterations of American-made snus products are needed to gauge their potential for nicotine delivery compared with Swedish snus. This information may provide insight into the addiction potential of American-style snus and the implications for patterns of use.

Massachusetts regulations require smokeless tobacco manufacturers to report data on nicotine and other product characteristics annually to the Massachusetts Department of Public Health (MDPH) for products sold in Massachusetts.\textsuperscript{24} These reports were examined to compare the product characteristics, including pH, moisture, and unionized nicotine (level and percent of total), of snus products made by American and Swedish tobacco manufacturers.

**Methods**

In 2014, tobacco industry reports for snus products were submitted to the MDPH from American manufacturers Phillip Morris USA (Altria), RJ Reynolds Tobacco Company (Reynolds American), and US Smokeless Tobacco Company (Altria). In addition, snus products manufactured by Swedish manufacturer Swedish Match North America, were also submitted. No other companies reported snus data to MDPH. The snus products made by American manufacturers (and here forward referred to as American snus) were: Camel Snus (n = 6 products), Marlboro Snus (n = 6), and Skoal Snus (n = 2). Data for a total of 10 snus products were reported by Swedish Match North America (and here forward referred to as Swedish snus): Ettan Snus (n = 2) and General Snus (n = 8).

The MDPH reports included data on percent moisture, pH, total nicotine (mg/g), and unionized nicotine (mg/g and %). The reports also included data on percent nicotine as a proportion of dry tobacco mass. However, this characterization was not included because it is less relevant to user experience compared to other characteristics.

Descriptive statistics (median, interquartile range) were calculated for all characteristics for each snus brand family. Based on manufacturer, all products were classified as American snus or Swedish snus, and Mann-Whitney U tests were used to compare reported values for all product characteristics between American and Swedish made products.

**Results**

**Percent Moisture**

Swedish snus products were found to contain significantly higher moisture content compared with American snus products (p < .001). Median moisture of the American snus brands Camel, Marlboro, and Skoal were 33.6% (IQR = 33.4–33.6), 14.2% (IQR = 10.4–29.1), and 30.3% (IQR = 29.6–31.0), respectively. Median moisture of Swedish snus brands Ettan and General were 54.5% (IQR = 49.8–59.2) and 53.4% (IQR = 52.0–53.9), respectively (Figure 1A).

**pH**

Similarly, median pH was significantly higher among Swedish snus brands compared to American snus (p < .001). Median pH among all Swedish brands was 8.7, compared to 6.5 for American snus. While all Swedish products and all Camel Snus products had a pH exceeding 7 (alkaline range), all Marlboro Snus and Skoal Snus had pH below 7 (acidic range). Camel, Marlboro, and Skoal products had median pH of 7.5 (IQR = 7.5–7.6), 6.4 (IQR = 6.3–6.5), and 6.5 (IQR = 6.4–6.6), respectively. Among Swedish brands, Ettan and General had median pH of 8.7 (IQR = 8.7–8.8) and 8.7 (IQR = 8.6–8.8), respectively (Figure 1B).

**Total Nicotine (mg/g)**

Total nicotine levels were significantly higher among American snus brands, compared to Swedish snus brands (p < .001). Median total nicotine levels for American snus and Swedish snus brands were 12.15 mg/g and 7.82 mg/g, respectively. Among American brands, Skoal had the highest median total nicotine level (17.54 mg/g; IQR = 17.40–17.67), followed by Marlboro (14.11 mg/g; IQR = 12.25–14.86) and Camel (8.89 mg/g; IQR = 8.79–9.30). Median total nicotine levels for Swedish brands General and Ettan were 7.87 mg/g (IQR = 7.67–8.28) and 7.76 mg/g (IQR = 7.67–7.85), respectively (Figure 1C).

**Unionized Nicotine (mg/g and Percent of Total Nicotine)**

Swedish snus products contained significantly greater levels of unionized nicotine, compared with American snus products (p < .001).
Median unionized nicotine for Swedish brands General and Ettan, were 6.52 mg/g (IQR = 6.06–6.63) and 6.47 mg/g (IQR = 6.34–6.59), respectively. In contrast, none of the American snus brands exceeded 3 mg/g. Camel, Marlboro, and Skoal products had median unionized nicotine levels of 2.23 mg/g (IQR = 2.12–2.53), 0.29 mg/g (IQR = 0.27–0.4), and 0.52 mg/g (0.46–0.58), respectively (Figure 1D).

Similarly, the proportion of total nicotine that is unionized was significantly higher for Swedish snus products, compared to American snus products (p < .001). While both Swedish snus brands had median % unionized nicotine above 80%, all American snus brands were below 31% (Figure 1E).

**Discussion**

Compared to Swedish-style snus products, American-style snus products had significantly lower moisture, pH, and unionized nicotine. Moreover, the characteristics of Swedish-style snus closely resemble the CORESTA snus reference product (CRP1). CRP1 is described as a “Swedish-style Snus smokeless tobacco product,” and has a moisture content of 52% and a pH of 8.5.\textsuperscript{24} The median moisture and pH for Swedish snus brands in this study were 53% and 8.7, respectively. By contrast, American snus products had lower median moisture (30.3%) and pH (6.5), further underscoring the product variations between American and Swedish-style snus.

It is feasible that higher levels of unionized nicotine in Swedish-style snus products contribute to greater nicotine reward and more appealing sensory effects (and thus addiction potential), compared to American snus. Previous research has demonstrated strong correlations between levels of pH (and thus higher levels of unionized nicotine) and nicotine absorption and exposure.\textsuperscript{26,27} Although nicotine levels in tobacco leaf can vary due to soil quality, leaf position, and other agricultural and processing factors, pH is easily manipulated and controlled by tobacco manufacturers via the addition of basic (ie, pH > 7) agents (eg, sodium carbonate).\textsuperscript{17} Levels of unionized nicotine may in turn impact product acceptability and usage patterns.

There are at least two important implications of designing snus products with low nicotine delivery potential (by keeping pH low). First, while Swedish snus products have higher nicotine delivery potential and their use has been associated with smoking cessation among Swedish males, lower nicotine in American snus may encourage dual use with cigarettes. That is, if American snus products provide inadequate nicotine dosing, smokers may not be able to fully replace cigarettes with snus and may continue smoking, while using

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**Figure 1.** Median moisture (%) (A), pH (B), total nicotine (mg/g) (C), unionized nicotine (mg/g) (D), and percent unionized nicotine (%) (E) with error bars (IQR) for Swedish (n = 10) and American (n = 14) snus products sold in Massachusetts, 2014.
snus when there is no opportunity to smoke. Some marketing messages for Marlboro Snus and Camel Snus suggest the products are being promoted for dual use with cigarettes. For example, Marlboro Snus ads have featured the tagline “Fits Alongside Your Smokes.” Similarly, Camel Snus ads have highlighted using snus on airplanes and in other environments where smoking is not permitted. However, Camel Snus has also launched a campaign encouraging smokers to “switch” to using Camel Snus.

Secondly, low levels of unionized nicotine may facilitate initiation among naïve nicotine users. Tobacco industry documents reveal that smokeless tobacco product design has been used to facilitate initiation and progression towards nicotine dependence. US Smokeless Tobacco Company utilized a “graduation” strategy whereby new users initiate with low-nicotine products and “graduate” to higher nicotine products. Lower nicotine products are thought to create a less aversive initial sensory experience for novice nicotine users. Thus, the introduction of snus products with lower nicotine delivery potential could conceivably assist in recruiting new tobacco users.

The lower moisture content reported for American snus is consistent with suggestions that snus in the United States is targeted at smokers who would not quit smoking, but would use snus in places where they cannot smoke. In particular, the findings of a market survey reported in a previously secret industry document suggest smokers prefer lower moisture smokeless products, which is similar to the mouth feel from smoking.

Independent testing is needed to confirm the product characteristics reported by tobacco manufacturers. Further, inter-laboratory variations and the use of different analytic procedures may have introduced bias into the comparisons between American and Swedish made products. This analysis includes only data reported to MDPH and included products sold in Massachusetts. Previous product testing identified varying levels of nicotine in earlier versions of Marlboro and Camel Snus purchased from different geographic locations across the United States. Therefore, the characteristics reported to MDPH may not be representative of products sold elsewhere. Further, these analyses did not take into consideration quantity of tobacco inside each snus pouch, which will influence total nicotine delivery. Such information is not reported to MDPH. Similarly, these data do not take into account how the described products are used by consumers, which could influence nicotine uptake. For instance, placing multiple snus pouches in the mouth at once would increase nicotine delivery for a product containing a lower unionized nicotine level (eg, American snus products). Also, if snus is placed under the bottom lip (rather than top), which is associated with more salivation, nicotine extraction is potentially increased. However, considering the observed difference in nicotine delivery capacity between Swedish snus and American snus was between 2- and 6-fold per mg of each product, quantity of tobacco in a pouch and expected use behaviors are not likely to compensate for the large differences in unionized nicotine.

American manufacturers have marketed snus products by highlighting the product’s Swedish heritage and drawing parallels between American-made and Swedish-made snus products. Data reported to the MDPH reveal significant differences in product characteristics between American and Swedish snus. These data are consistent with data on characteristics of earlier iterations of American snus, which showed lower levels of moisture, pH, and unionized nicotine. The addiction potential of American snus is likely to be lower than Swedish-style snus as a result of these product characteristics. Research is needed to establish whether higher nicotine snus products might reduce harm by deterring initiation among novice users, while encouraging complete switching from cigarettes among established smokers. Such data would inform future FDA product standards to reduce demand for tobacco products and the associated health burden of tobacco product use.

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**Declaration of Interests**

None declared.

**References**

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