LWT - Food Science and Technology 53 (2013) 139–145

Contents lists available at SciVerse ScienceDirect

LWT - Food Science and Technology

journal homepage: www.elsevier.com/locate/lwt

Descriptive analysis and consumer acceptance of black walnut cultivars in a sugar cookie base

Ashley E. Miller, Delores H. Chambers*

Sensory Analysis Center, Kansas State University, Justin Hall, Manhattan, KS 66506, USA

ARTICLE INFO

Article history:
Received 23 August 2012
Received in revised form
19 February 2013
Accepted 22 February 2013

Keywords:
Black walnut
Sensory
Descriptive
Consumer acceptance

ABSTRACT

Researchers incorporated seven black walnut cultivars (Brown Nugget, Davidson, Emma K, Football, Sparks 127, Sparrow, and Tomboy) into sugar cookies, a commonly eaten nut product, to characterize their flavor attributes by trained assessors and acceptance by consumers. Nine of the 25 attributes differed significantly ($P \leq 0.05$) across cultivars: black walnut ID, overall nutty, nutty-buttery, brown, toasted, acrid, rancid, overall sweet, and sweet. Lower mean scores in black walnut ID, overall nutty, and sweet and higher mean scores in rancid and acrid characterized the Emma K cultivar. The remaining six samples were more similar to one another in flavor characteristics. Four clusters of consumers who differed in their acceptance of the cookie samples were found. Cluster 1 preferred Football, clusters 2 and 3 each showed no overall preference, and cluster 4 preferred Emma K suggesting a set of niche consumers for black walnuts used in cookies.

1. Introduction

Black walnut (*Juglans nigra* L.) is a hardwood tree species valued for its fine wood and distinctively-flavored nuts. Known as eastern black walnut or American walnut, the species is native to North America extending from Ontario, Canada to northern Florida in the United States (US) then west toward Nebraska, Kansas, and Texas (Michler, Woeste, & Pijut, 2007; Reid, 1990; Williams, 1990). To date, over 750 black walnut cultivars have been described. Cultivars for propagation are selected on the basis of nut quality characteristics, most notably percent edible kernel (Michler et al., 2004; Reid, 1990). In addition to producing edible nuts and timber for furniture and cabinet-making, the black walnut shell has many uses as well; therefore increasing the value of the crop. The shell is found in oil well drilling processes, paints, as filler in dynamite, and as an abrasive agent in soaps, cosmetics, and dental cleansers (Thomas & Schumann, 1993).

In commercial shelling operations, only 6–10% of usable nutmeat is recovered compared with over 40% recovered nutmeat in English (Persian) walnuts (*Juglans regia* L.). Of the edible nutmeat extracted from the shells, 60% of the kernels are packaged for retail sale, 30% are used in ice cream manufacturing, and 10% are used in commercial baking and candy-making ventures (Reid, 1990). The black walnut is much stronger and richer in flavor than that of the English walnut (Thomas & Schumann, 1993).

Little formal research on characterizing the sensory attributes of black walnuts has been completed. Warmund, Elmore, Drake, and Yates (2009) investigated the sensory attributes between black and English walnuts using descriptive sensory analysis. Black walnuts were distinguished from English cultivars by their fruity, musty, and sweeter characteristics. Overall aroma, fruity, woody, musty, and sweet notes varied among the black walnut cultivars studied. A second descriptive analysis study compared flavor attributes of light-, medium-, and dark-colored kernels of the black walnut cultivars Emma K, Kwik Krop, and Sparks 127 plus one wild species (Warmund, Elmore, Adhikari, & McGraw, 2009). Kernel color affected six of the attributes: burnt, musty/dusty, oily, woody, astringent, and sour. Additionally, the Emma K and Sparks 127 cultivars varied more in color and flavor than the Kwik Krop and wild sample.

Because of their strong flavor, black walnuts are consumed more frequently as an ingredient in ice cream and baked goods and confectionary items; however, only one research paper was found investigating the sensory characteristics of a black walnut food product. Matta, Chambers, and Naughton (2005) compared black walnut syrup, maple syrup, and maple-flavored table syrup using both descriptive and consumer sensory analysis. Research indicated that the pure maple and walnut syrups contained more complex attributes and had somewhat similar sensory profiles, while deeming the table syrup a simple product. However, results of the consumer analysis indicated the table syrup was liked best among

* Corresponding author. Tel.: +1 785 532 0162; fax: +1 785 532 0176.
E-mail address: delores@ksu.edu (D.H. Chambers).

0023-6438/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.lwt.2013.02.023

the samples perhaps because it was more familiar to the products most consumers purchase.

Black walnut cultivars differ from one another based on tree and nut quality characteristics that may affect their performance and acceptance in food products. Thus, understanding how black walnut sensory attributes may change when incorporated into a specific food item becomes vital to producers. Therefore, the objectives of this paper were to 1) determine differences in flavor attributes among black walnut cultivars in a cookie base using descriptive sensory analysis, 2) determine consumer acceptance and flavor intensity of black walnut cookies, and 3) correlate the descriptive data with the consumer acceptance data on the black walnut cookies to better understand consumer acceptance of black walnut cultivars.

2. Materials and methods

2.1. Black walnut samples and preparation

Researchers procured seven black walnut cultivars (Brown Nugget, Davidson, Emma K, Football, Sparks 127, Sparrow, and Tomboy) from a nut orchard in Joplin, MO during October 2011. The cultivars had been harvested during the previous month and remained in their shells prior to the researchers obtaining them. The nuts were transported to the Sensory Analysis Center (Manhattan, KS), were dried for 5 days, shelled, chopped and sieved to control piece size, and stored frozen (−26 °C ± 1 °C) until used for testing (~3 months).

2.2. Cookie preparation and baking method

A basic sugar cookie recipe from the American Association of Cereal Chemists (AACC) was selected as a food carrier for the black walnuts (AACC International Method 10-53.01). Researchers modified the size of the cookies from the AACC method by rolling the cookies to a thickness of 9.5 mm instead of 7.0 mm as identified in the method and cut the cookies to a 63.5 mm diameter instead of 60 mm. The modifications imposed were because of the availability of local production supplies.

Black walnuts were removed from the freezer the day before preparing the cookies and allowed to thaw at room temperature (23 ± 1 °C). Ingredients were weighed out using a digital scale (model SI-4001, Denver Instrument, Bohemia, NY) then mixed according to the AACC procedures in a 575 W KitchenAid stand mixer with 5.7 L bowl and paddle attachment (KitchenAid Professional 600, model KP26M1XWH, Whirlpool Corporation, Benton Harbor, MI). Researchers added 90 g of black walnut to the recipe and incorporated the nuts into the dough with the flour. Each of the cultivars was added individually to cookie batches to achieve separate sets of cookies with each of the seven black walnut cultivars. The dough was rolled out on a lightly-floured countertop with a wooden rolling pin and rubber dough guides placed on the ends of the rolling pin. A single mass of the dough was rolled out rather than dividing it into eight portions as stated in the original AACC procedures in order to streamline the process. A metal cookie cutter measuring 63.5 mm in diameter was used to cut out the cookies from the dough. In order to ensure a controlled bite amount for the panelists when evaluating the samples, researchers scored the cookies into one-eighths (for descriptive testing) or one half (for consumer testing) using the edge of a metal spatula. Each batch of cookie dough yielded approximately 11 cookies.

Researchers baked the cookies in an electric oven (model RB160PXYB, Whirlpool Corporation, Benton Harbor, MI) for 11 min on a lightly greased metal baking sheet, rotating the baking sheet halfway through the baking time to ensure even baking of the cookies. Cookies were allowed to cool on the baking sheet for 5 min before being moved to a metal baking rack to cool completely. Once cooled, the cookies were placed in gallon-sized, re-sealable plastic bags (Ziploc® brand freezer bags with the Smart Zip® seal, S.C. Johnson & Son Inc., Racine, WI) and labeled with the date, cultivar name, and batch number. Black walnut cookies were stored under frozen conditions (−26 ± 1 °C) for one week prior to evaluation.

2.3. Descriptive analysis

Seven (six female, one male) highly trained descriptive analysis panelists from the Sensory Analysis Center (Manhattan, KS) evaluated the flavor attributes of the black walnut cookies. The panelists had 120 h of general descriptive analysis training, over 2000 h of evaluation experience with a wide array of food products, and had previously evaluated raw black walnut samples (Miller & Chambers, in press). Three panelists also had prior experience evaluating nut-related samples (Miller, Jenkins, Chambers, Chambers, & Lee, 2013).

2.3.1. Orientation and lexicon development

Two, 90 min orientation sessions were held to familiarize the panelists with the samples and to refine the lexicon and ballot that would be used for evaluation. During these sessions, the panelists tasted the samples and used a lexicon from prior black walnut testing to determine appropriate attributes for the black walnut cookies. The panelists engaged in open discussion to add or delete terms from the lexicon and also tasted the references to determine their appropriateness. The final lexicon contained 25 flavor attributes including the basic tastes bitter, salty, sour, sweet, as well as the feeling factor astringent. Table 1 provides attribute definitions and references unique to this study. Adhikari et al. (2011), Elía (2011), Koppel, Timburg, Salumets and Paalme (2011), Talavera-Bianchi, Chambers, Chambers, Adhikari, and Carey (2011), and Vásquez-Araújo, Chambers, Adhikari, and Carbonell-Barrachina (2011) used similar lexicon development techniques as those presented in this study.

During orientation, panelists determined the order of the attributes listed on the ballot. Panelists listed the more prominent attributes toward the ballot's beginning and grouped similar terms together, (i.e., overall sweet, brown sweet, and sweet). Sample amount for evaluation purposes and standard evaluation protocols were also established. Panelists practiced balloting a couple of the samples to ensure consistent evaluation procedures were used. All samples were served at room temperature (23 ± 1 °C).

2.3.2. Test design and sample evaluation

Researchers used a series of modified complete Latin Squares to create the test design for evaluating the black walnut cookies. The Latin Square design was adjusted for first-order bias and treatment order by randomizing the design to ensure each sample was seen in each serving position (1, 2, 3,…, 7) exactly once when viewed by columns or rows. Construction of the Latin Square design was computed in SAS® statistical software (version 9.2, SAS Institute Inc., Cary, NC).

The cookies were removed from the freezer 3 h prior to testing and cut into wedges on the pre-scored lines using a serrated knife following the score lines indented in the cookies before baking. Two cookies were served to each panelist (total of 16 wedges) in 236.6 mL Styrofoam bowls with plastic lids (Dart Container Corporation, Mason, MI) labeled with three-digit blinding codes. Panelists sat at a round table under ambient lighting and temperature conditions. Panelists scored the samples using a 0–15