



## Adherence of Food Blog Salsa Recipes to Home Canning Guidelines

### ABSTRACT

Increased consumer interest in home food preservation, the popularity of home canning of salsa and the emergence of food blogs as an easily accessible source for recipes have created concerns about the safety of food preserved according to home canning recipes on food blogs. This research examines the adherence of canned salsa recipes on food blogs to recommended home canning guidelines. A tool based on the USDA Complete Guide to Home Canning for Acidified Foods was used by four raters to examine 56 blog posts on home canning of salsa from 43 food blogs. Adherence to guidance in the categories of acidification, thermal processing, contaminants and vacuum sealing were the variables measured. The majority of these guidelines were not included in food blog recipes (average 70% across all categories), representing a significant lack of adherence. Of particular concern, the majority of foods prepared according to the recipes evaluated were insufficiently acidified (91%), and very few recipes (14%) provided information regarding necessary adjustments for altitude. Food blog writers

have the opportunity to provide recommended home canning guidelines or links to USDA resources that would enable their followers to reduce risk. Outreach efforts targeting digital influencers, including a recipe style guide for home canning, may expand reach and application of research-based home canning methods.

### INTRODUCTION

Salsa's popularity as a condiment in the United States continues to climb, as does interest in home canning (1, 15, 24, 25). The popularity of salsa has expanded to home food preservers, who want to extend the shelf life of perishable home-grown tomatoes and other vegetables (10, 18, 24). Not only are more people canning at home; data suggest that the variety of foods being canned is increasing (11). The process of safe home canning requires adherence to research-based practices for minimization of food safety risks (32). Since its first publication on home canning in 1909, the United States Department of Agriculture (USDA), along with the Cooperative Extension System, has provided the public with credible, science-based recommendations

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for home food preservation. The National Center for Home Food Preservation (NCHFP), established with funding from the Cooperative State Research, Education and Extension Service (CSREES-USDA) in 2000 to continue to update food preservation recommendations, has recognized the popularity of home canned salsa and the concern for safe acidity levels in mixtures of low-acid foods such as salsa. In 2013, the NCHFP developed a “Choice Salsa” recipe that was tested with a wide variety of tomatoes, peppers and onions to ensure the necessary acidification for boiling water bath (BWB) canning and still allow for some consumer choice in ingredients (as to variety, not volume) (2, 24).

Historically, home-canned vegetables have been the most common cause of botulism outbreaks in the United States (7). Two recent botulism outbreaks in 2015 and 2018 involving improperly home canned foods demonstrate that this risk continues (3, 7, 22). Foodborne botulism is a potentially fatal paralytic illness caused by ingestion of neurotoxin produced by the spore-forming bacterium *Clostridium botulinum* (7). Foodborne botulism outbreaks caused by home canned vegetables have highlighted critical areas of concern in home canning and in food preparation knowledge and practices, as well as the need for targeted educational outreach activities to home canners to prevent botulism (3, 7, 9, 11, 22). Between 2009 and 2015, 12% of recorded outbreaks of foodborne diseases in the United States were attributed to foods prepared in the home (8), but surveys have demonstrated that consumers do not perceive their homes as a place they are likely to acquire a foodborne disease (26), highlighting the need for a food safety focus in home canning education, instruction and recipes.

In recent decades, the rise of digital technology has contributed significantly to changes in consumer information-seeking behavior. Weblogs, or 'blogs', initially defined as pages displaying a list of the writings of an individual or group in reverse chronological order, have evolved into more subject-specific websites curated by individuals or small groups, retaining some biographical content. These have become one of the most abundant types of social media platforms, particularly with regard to food-related topics. Among other unique features of blogs is their mixture of biographical and informational content, which results in development of a virtual relationship between the writer and the reader (12). This aspect allows blog content to transcend the disconnection of the digital platform and serve as a surrogate for face-to-face communication, resulting in a perception of greater trustworthiness and expertise, particularly by readers who view blogs frequently (12). Surveys have demonstrated that food blogs are a popular go-to site for home canners (4, 5). The two-way nature of communication through social platforms has been suggested as one explanation of consumers' increasing preference to seek information outside of traditional “authoritative” sources, such as government agencies and universities (30).

The cultural omnipresence of food television in the early 21st century sparked interest in the behavior modeling of TV chefs. Multiple investigators have found high prevalence of improper behaviors, including lack of handwashing and failure to monitor the internal temperature of meat products, demonstrated on cooking shows (6, 19). A recent evaluation of popular cookbooks reported similar results, with only 8.2% of nearly 1,500 recipes reviewed providing an endpoint temperature for animal products (17). Both the general food safety and nutritional quality of food blog recipes have raised concerns in recent reviews and raised a call for intervention by experts (dietitians and food safety authorities) to target educational materials for food blog writers (23, 29). Additionally, a study demonstrated that recipes modified to include food safety information for consumers had the potential to improve behaviors so as to reduce foodborne illness (20).

Although food blogs are increasingly popular sources for cooking tips and recipes, there has been little investigation of food safety messaging from them. A recent evaluation of popular food blogs found that food handling practices were rarely recommended, and when recommendations were provided, they did not correspond to current government recommendations (23). Food blogs can potentially be an important influence on home canning habits of readers (viewers).

The purpose of this research was to examine adherence of canned salsa recipes on food blogs to USDA and NCHFP recommended home canning guidelines. These recommendations exist to ensure proper acidification, prevention of cross-contamination and adequate thermal processing and vacuum sealing to reduce risk. Knowing that the public is accessing information via new technologies such as food blogs, this research is needed to assess the adherence of these popular resources to USDA and NCHFP research-based guidance and to identify methods to improve dissemination of information to individuals using them.

## MATERIALS AND METHODS

The University of Maine Institutional Review Board noted that this study did not meet the federal regulations definition of human subjects research and therefore did not require submission to the institutional review board.

### Blogs and recipe selection

Salsa recipes were compiled using search engine results for the query “canned salsa.” Individual food blogs were screened for recent activity (minimum of one post within the past 24 months) and active social media presence, defined as the existence of a Facebook page with a minimum of 500 followers. Recipes for salsas that were not canned were rejected, as were those that did not use tomatoes as a base ingredient (e.g., fruit salsas, zucchini salsa, etc.),  $n = 8$ . Recipes were required to state specifically that they were intended to be used for home canning in a BWB. Finally, all

**TABLE 1. Source of home-canned salsa recipes evaluated against USDA and NCHFP guidelines**

Blog	Number of recipes evaluated	Facebook followers*
Superhealthykids.com	1	3256656
Simplyrecipes.com	1	1055600
Familyfreshmeals.com	1	558252
Yourhomebasedmom.com	1	456666
Attainable-sustainable.net	1	448083
Reluctantentertainer.com	2	387116
Foodinjars.com	1	169984
Commonsensehome.com	1	160866
Fabulouslyfrugal.com	1	158298
Melskitchencafe.com	1	154001
Anamericanhomestead.com	1	132620
Getrichslowly.org	1	104013
Kitchenstewardship.com	1	91591
Jamiecooksitup.net	1	82098
Oldworldgardenfarms.com	2	74460
Modernalternativemama.com	1	67711
Daringgourmet.com	1	43423
Canningandcookingathome.com	1	36227
Lifeingraceblog.com	1	35529
Reformationacres.com	1	27415
Growagoodlife.com	1	27039
Whoneedsacape.com	1	23253
Noshingwiththenolands.com	1	22631
Preparednessmama.com	1	16597
Wellpreserved.ca	2	11543
Lanascooking.com	1	11497
Montanahomesteader.com	1	9924
Anoregoncottage.com	1	8979
Northernhomestead.com	1	6347
Homemadefoodjunkie.com	1	6103
Nittygrittylife.com	1	5521
Growitcookitcanit.com	1	4636
Luluthethebaker.com	1	3931
Localkitchenblog.com	5	3632
Curiouscuisiniere.com	1	3228
Yankeehomestead.com	1	2708
Icancookthat.org	1	2379
Sbcanning.com	6	1579
Cookswithcocktails.com	1	1550
Theconsciousdietitian.com	1	1093

*Continued on next page.*

**TABLE 1. Source of home-canned salsa recipes evaluated against USDA and NCHFP guidelines (cont.)**

Blog	Number of recipes evaluated	Facebook followers*
Puttingupwitherin.com	2	813
Thebaldgourmet.com	1	727
Relishingit.com	1	719

\*Number of followers as of November, 2018.

**TABLE 2. Acid to pepper and onion ratio for validated canned salsa recipes**

Recipe	Source	Ratio
Choice Salsa*	NCHFP	2.33 T/cup PO
Tomato Salsa (using paste tomatoes)	USDA	1.9 T/cup PO
Tomato Salsa (using slicing tomatoes)	USDA	4 T/cup PO
Tomato/Green Chile Salsa	USDA	2.63 T/cup PO
Tomato/Tomato Paste Salsa	USDA	3.25 T/cup PO

PO = peppers and onions

\*Choice Salsa recipe was used as a benchmark for proper acidification in further analyses.

of the recipes selected for further review were cross-checked to ensure that they were not identified by the author as being attributed to (based on or reproductions of) one of the other recipes included in the data set. The final data set consisted of 56 recipes, sourced from 43 blogs, as displayed in *Table 1*.

#### Acidification assessment

Initially, salsa recipes were screened for risk of insufficient acidification, using two measures: use of standard ingredient volumes for vegetables (pounds or cups), and use of standard acidulant type and concentration (specification that lemon/lime juice should be bottled and indication of vinegar acidity percentage). Each recipe was also subjected to a calculation to determine whether a sufficient volume of acid was included for the volume of tomatoes in the recipe (0.5 T bottled lemon juice or 1 T vinegar at 5% acidity per cup tomatoes, according to USDA acidification guidelines) (32) and further evaluated as to whether the recipe met acidification requirements for volume of peppers and onions as specified in a validated canned salsa recipe (24). Acid ratios for a variety of validated recipes are displayed in *Table 2*. For further analysis of food blog recipes, the NCHFP “Choice Salsa” recipe was selected on the basis of its being a generous standard (2). To simplify this analysis, all recipes, regardless of whether they called for lemon juice

or vinegar, were standardized to the target value for lemon juice (2.33 T per cup of peppers and onions) beyond meeting the USDA acidification guidelines for canning tomatoes. Recipes that lacked standard volumes were modified so as to include standard volumes, using USDA standard values for applicable commodities (31).

#### Screening tool

Other risk factors relating to acidification, contamination, thermal processing and vacuum sealing were assessed using a screening tool developed by the authors from the USDA Complete Guide to Home Canning, Bulletin No. 539, Guide 1. Principles of Home Canning and Guide 3. Selecting, Preparing, and Canning Tomato and Tomato Products (32). This tool consisted of 36 checkpoints to be rated as “Correct, Incomplete/Incorrect, or Not Included.” This tool, with categorization of each checkpoint, is presented in *Table 3*. Checkpoints assessed home food canning guidelines pertaining to quality produce, general cleanliness, jars and lids, boiling water bath canners, processing time, altitude adjustments, factors impacting thermal processing, cooling jars, testing jar seals, reprocessing and storing. In addition, one item assessed whether hyperlinks to USDA, NCHFP, Extension or Ball® websites were provided.

**TABLE 3. Screening tool: USDA home-canning guidelines by category for weblog recipe review**

Guideline	Category*
Clean kitchen area and clean hands	C
Mason-style jar and 2-piece lid style	T, V
Jar prep: Wash jars, lids and bands	C, V
Use jars free of nicks, cracks	C, V
Use lids free of dents, scratches, rust, with uniform sealing compound	C, V
Keep jars warm prior to filling	T, V
Use good quality produce (disease and frost-free), suitable for canning	A, C
Wash produce	C
Remove tomato skins	C
Includes clear directions on size of chop	T
Safe substitutions (alter dried spice/herb amounts/type, sub bottled lemon juice for vinegar, but NOT vinegar for bottled lemon juice)	A
Recipe states: Do not increase volume of low acid foods (peppers/onions) or add other ingredients (beans/corn)	A
Recipe provides clear cooking directions (boil and length of time)	T
Specifies: Do not add thickeners	T
Specifies: Do not drain tomatoes	A, T
Recipe tested for pH	A
Pack jars with hot product	T, V
Remove air bubbles	V
Headspace amount specified	T, V
Wipe rim	C, V
Adjust screw band lid to fingertip tight	V
Pre-heat the water in the BWB	T, V
Process in a Boiling Water Bath	T, V
Water level in BWB at least 1" over jars	T, V
Specifies rack in BWB	T, V
Length of time to process in BWB	T, V
Specifies when to start processing time	T, V
Altitude adjustment guidelines included for processing > 1000 ft.	T, V
Turn off heat, remove lid and wait 5 minutes to remove jars after processing time	T, V
Cooling process on towel or rack with 1" space between for seal formation (12–24 hours at room temp)	T, V
Do not retighten screw bands after processing	V
How to check for vacuum seal	V
How to reprocess unsealed jars; or refrigerate (and consumption recommendation) or freeze	C, T
Storage guidelines (screw bands removed, rinse jars, label, date, cool, dark, dry place and use within 1 year)	C
Once opened, refrigerate and use within 2 weeks	C
Provide links or refer to USDA, NCHFP, Extension or Ball® for home canning guidelines	Uncategorized

\*Category Code: A = Acidification, C = Contaminant, T = Thermal Processing, V = Vacuum Seal.

### Screening process

Four raters, consisting of the authors and two additional Cooperative Extension Food Safety Professionals, performed the assessment. The instrument was pilot-tested by the raters, all of whom rated the same randomly chosen food blog recipe, and tested for inter-rater reliability using the Fleiss kappa statistic. Agreement was calculated for written content (Fleiss kappa of 0.82 = almost perfect agreement) and visual content (Fleiss kappa of 0.74 = substantial agreement). The raters were then randomly assigned to screen 14 recipes from the data set selected.

Each recipe was rated separately for written content and visual content (photographs and video). “Correct” was used when the weblog correctly wrote or visually depicted the home food preservation guidelines as outlined in the USDA Complete Guide to Home Canning Bulletin No. 539. “Incorrect” was used when the weblogs incorrectly or incompletely depicted (written or visually) the home food preservation guideline as outlined in the USDA Complete Guide to Home Canning Bulletin No. 539. “Not included” was used when the guideline was not addressed in the blog post.

### Data analysis

De-identified rating data was compiled to yield total scores by recipe for each of the four categories of risk and

classification ratings. Because individual categories consisted of unequal numbers of checkpoints, totals were transformed to percentages before analysis. Data were analyzed using MANOVA in SPSS software version 25 (IBM, Armonk, NY). Pearson Product-Moment Correlations were also calculated.

### RESULTS

Data gathered regarding visual attributes of food blogs (photos and videos) were not analyzed because of their sparsity, redundancy and variability. The majority of recipes contained few images and very few made use of video content for educational instruction.

Analysis of recipe content demonstrates that, overwhelmingly, guidance related to safe home canning practices is missing from food blog recipes, regardless of category. Variability was high among recipes, as shown in *Fig. 1*. Of the four categories of analysis checkpoints, information related to proper acidification was most likely to be “not included” (average of 12% correct, 12% incorrect, 76% not included). Guidance relating to thermal processing was the most likely to be present and correct in the recipes surveyed (average of 29% correct, 17% incorrect, 54% not included). Notably, the percentage of information presented correctly was statistically unrelated to the percentage of information presented incompletely or incorrectly. Total “correct” scores were

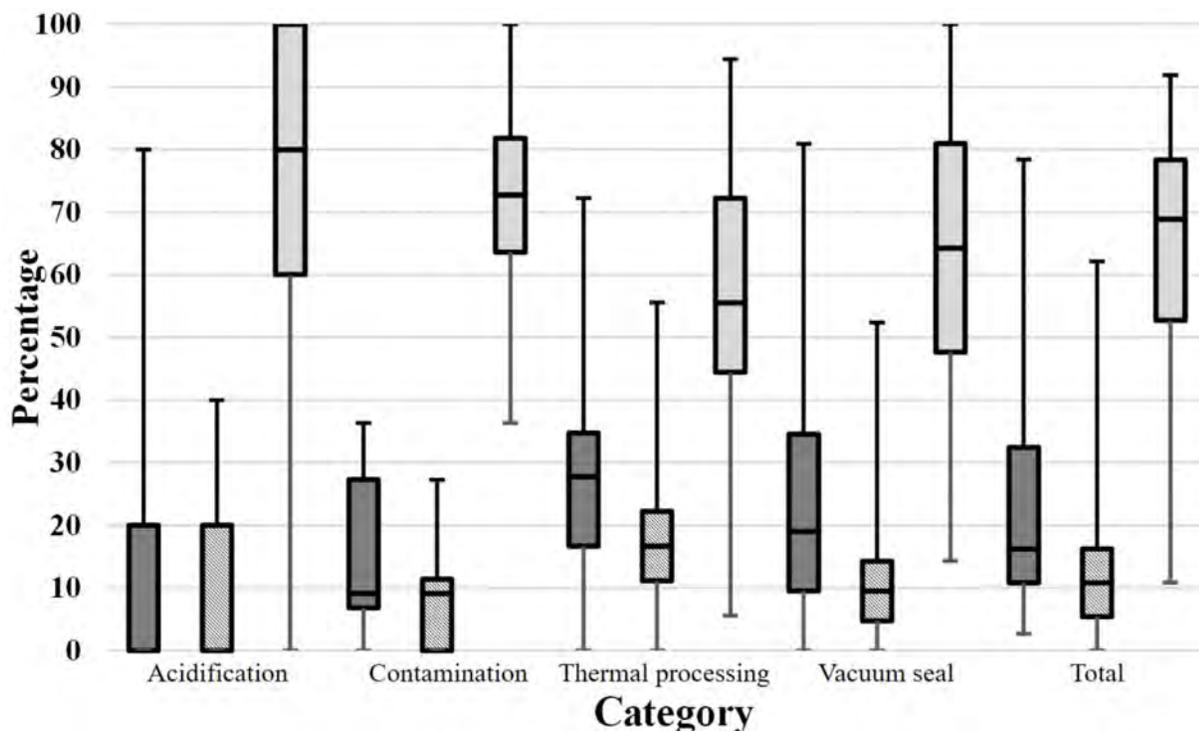


FIGURE 1. Weblog canned salsa recipe adherence to established USDA guidelines; percentage of information presented correctly (dark gray), incorrectly (striped), or incomplete/not included (light gray) n = 56 blogs, error bars denote standard deviation.

**TABLE 4. Pearson's product moment correlations between correctly presented information and other select factors in weblog salsa recipes**

		Total guidelines incompletely or incorrectly presented	Total guidelines not included	Facebook followers	Acid ratio
Total guidelines correctly presented	Pearson's Correlation	-0.08	-0.61	-0.082	0.038
	Significance	0.56	0.00	0.55	0.78

strongly negatively correlated with “not included” scores (Table 4). This trend was observed both within and across all categories, meaning that where correct information was not given, it was much more likely to be omitted than incorrect. Anecdotally, much of the information scored as “incorrect” either was incomplete or represented outdated guidance from validated sources.

Of the blogs evaluated for this study, the number of Facebook followers ranged from 719 to 3,256,656, with an average of 145,953 (Table 1). No statistically significant relationships between this metric and any other factor were discerned. Adjustments for home canning at high altitude were provided by only eight (14%) blogs. Although more than half of recipes (34, or nearly 61%) correctly specified the length of time to process jars in a boiling water bath, only ten (29%) of these indicated that processing time should start after a rolling boil is achieved, representing a critical risk of under-processing. Additionally, only four (7%) of the 56 recipes reviewed provided correct information on all three of the following measures: total processing time, when to start processing time and altitude adjustment.

Eighteen food blogs (32%) either mentioned or provided a hyperlink to outside guidance. When provided, these sources were most often USDA webpages, but they also included Cooperative Extension, Ball® and NCHFP references. Food blogs that provided hyperlinks to such a reference were significantly more likely to have higher total “correct” scores.

Of the 56 home canned salsa recipes screened, 24 (43%) failed to use standard volumes. Only eight (14%) specified the correct type and strength of acid(s) to ensure safety (Table 5) and only five recipes (9%) actually contained sufficient quantities of acid for the volume of vegetables used (Fig. 2, Table 5). Noncompliant recipes lacked up to 16 T of necessary bottled lemon juice to achieve the safety benchmark. According to the Choice Salsa standard, recipes should contain a minimum of 2.33 T bottled lemon juice (or 4.66 T vinegar at 5% acidity) per combined cup of peppers and onions (represented as a target acidification ratio of 2.33:1) (2). The mean acidification ratio across all recipes in this study was 0.94 T per cup of peppers and onions, less

than half the level recommended to ensure safety during extended anaerobic storage. Analysis of acidification volume to tomato volume revealed that 12 (21%) of the 56 recipes failed to meet even the minimum USDA acidification guidelines for tomato volume alone. No relationship was observed between acidification ratio and overall adherence to USDA guidelines (Table 4), meaning that even in cases where guidance for home canners was largely complete and accurate, recipes would not ensure that the resulting salsa was properly acidified.

## DISCUSSION

Traditionally, salsas are mixtures of low-acid foods, such as onions and peppers, with acid foods, such as tomatoes. Depending on ingredient ratios, the natural acidity of salsa mixtures may not be high enough to be safely processed in a BWB, which is still the most common method for canning in American homes (1). According to research conducted by the NCHFP and USDA Guidelines, the use of validated salsa recipes and acidification with commercially bottled lemon juice or with vinegars with 5% acidity is required to ensure safety for home canned salsas (2, 24, 32). Utilizing nonstandard units (e.g., 1 green pepper), draining tomatoes and/or employing unspecified acidulant type can alter the acid balance, yielding an unsafe product for processing in a BWB and thus increasing the risk of foodborne illness, particularly in instances of insufficient heat processing.

Processing times, including instructions regarding when timing should begin, were correctly presented in only 10 (18%) of the recipes analyzed. The combination of heat treatment and low pH is necessary for control of *Clostridium botulinum* in canned foods. Spore germination and toxin production during storage are primarily inhibited by control of pH to a level below 4.5 (14). None of the recipes evaluated specified that pH had been tested, which makes adherence to acidification guidelines even more vital. When the findings for thermal processing and acidification are taken together, they indicate a real risk for the production of unsafe food and foodborne illness.

**TABLE 5. Correct presentation of critical food safety-related information in weblog salsa recipes**

Attribute	Measure	Number of recipes	Percentage of sample
Altitude	Correct altitude adjustment guidelines included for processing at >1000 ft. above sea level	8	14.3
Thermal processing	Specifies length of time to process in boiling water bath	34	60.7
	Indicates when to start processing time	10	17.9
Acidification	Recipe written using standard volumes	32	57.1
	Percent acidity of vinegar and/or bottled lemon juice specified	8	14.3
	Recipe contains sufficient acid for volume of tomatoes (USDA guidelines)	44	78.6
	Recipe contains sufficient acid for all ingredients (tomato + onions, peppers, etc.; based on NCHFP Choice Salsa)	5	8.9
External guidance	Reference or link provided to USDA, NCHFP, Extension or Ball resources	18	32.1

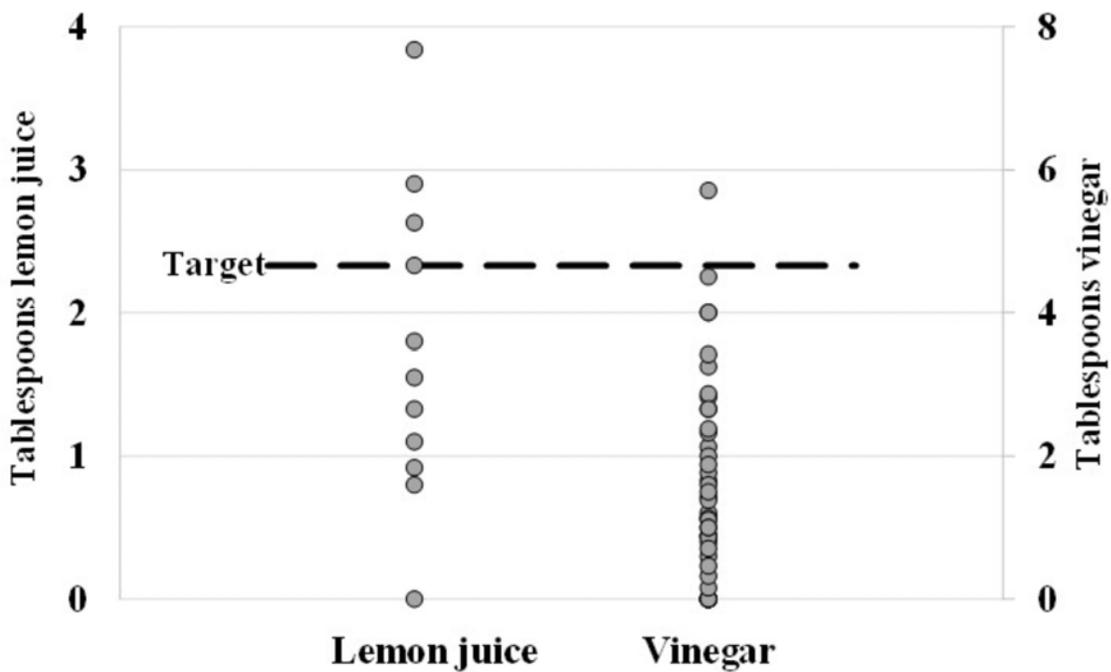


FIGURE 2. Compliance with Choice Salsa recommended acid:pepper/onion ratio in weblog canned salsa recipes  
 Values plotted as zero (n = 11 of 56 total) represent recipes recommending insufficient acidification for tomato volume alone.

A further complicating factor in the safe home canning of foods is altitude. Approximately 40% of the 50 largest U.S. cities by population are located at more than 1,000 ft. above sea level, where time/temperature combinations must be adjusted (33). Proper guidance for these adjustments was largely missing. Multiple surveys of American households have demonstrated the persistence of unsafe canning practices (9, 11). In order for experts to more effectively educate the public, changes in dissemination strategy may need to be made. Moreover, social science suggests that consumer motivations for home food preservation may be diverse, ranging from preservation as a form of political or environmental activism (5) to necessity as a result of food insecurity (13). Ideally, guidance would be tailored to, and distributed appropriately for diverse and divergent groups of consumer constituents.

The growing preference for digital communication media necessitates that food safety educators make a concerted effort to reach the public through these channels (23). Efforts should also be made by food safety educators to educate digital influencers on their responsibility to disseminate information that is accurate and to utilize existing accurate resources. This is particularly true when targeting a youthful audience, a population segment demonstrating increasing interest in home food preservation (10) and for whom social media-based interventions have been shown to increase food safety knowledge (16, 21). Risks to investing in a digital communication approach, including the difficulty of reaching certain audiences and the accelerated rate at which digital content becomes outmoded, have been identified in the literature and continue to be barriers to the enactment of this strategy (27, 28). Notably, one European survey of food experts (regulatory and academic) and stakeholders (media and food professionals) identified a disparity in the perceived benefit of community dissemination, or democratization, of information sharing through social channels. While stakeholders favored the casual sharing of validated information among community members, experts saw more promise in digital communication as a tool for information broadcasting during crisis situations (27). The evolution of the digital platform from content-centered (“Web 1.0”) to user-generated (“Web 2.0”), has been well documented and partially explains the growth in readership of blogs, as well as the changing expectations of the public with regard to

digital content. The association between external links and correct guidance identified in this analysis demonstrates the potential for improving food safety messaging through blogs by targeting education to their writers.

This analysis demonstrates that food safety messaging in food blogs is currently highly variable and insufficient. Regardless of this deficiency, food blogs continue to be a popular information source for home food preparation and home canning.

## IMPLICATIONS FOR RESEARCH AND PRACTICE

Overall, food blogs are not communicating recommended home canning practices related to thermal processing, acidification, attaining vacuum seals, adjusting for altitude and preventing contaminants. Given this lack of communication of research-based information, food blog authors are potentially increasing the risks already associated with home canning. Including correct food canning guidance in food blogs, or providing links to research-based websites including USDA, NCHFP and Extension, may help to reduce the risk of foodborne illness associated with these foods.

Education and reinforcement of research-based food preservation resources are essential to promoting safe home canning techniques. A recipe style guide that incorporates food safety instructions as well as USDA and NCHFP guidelines to minimize risk in the areas of vacuum sealing, cross contamination, thermal processing and acidification could assist in risk reduction. The results of this research identify a current critical area of concern in consumer home canning practices and a heightened need for Extension-based efforts to educate the public, with emphasis on the digital influencers, on the importance of using research-based resources to reduce the risk of foodborne illness.

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