# Flour handling behaviors: evaluation of selfreported U.S. consumer data and content analysis of popular recipes on YouTube and Cooking Blogs

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# Flour handling behaviors: evaluation of selfreported U.S. consumer data and content analysis of popular recipes on YouTube and Cooking Blogs

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Abstract. Approximately 48 million people get sick from foodborne illness in the U.S. Many people are unaware of the food safety risk of low moisture foods, like flour and quick bread mix. The research study assessed food safety behavior, knowledge, and risk of flour handling among consumers and evaluated food safety implications from popular recipe sources. Phase I: An online survey (Qualtrics) was developed for data collection, consisting of six areas: consumer and use of flour, safe flour handling knowledge, flour recall knowledge and behavior, message effectiveness, trusted source for flour handling, and demographic information. The participant selection criteria included: (1) primary food handler and grocery shopper, and (2) use of flour or quick bread mix at least once a month. Phase II: Recipes from an online source (blogs and YouTube videos) were selected and coded to assess the food safety implications according to FDA's flour handling recommendations. People that consume or play with raw dough or batter miss hygiene practices while handling flour. Popular recipes on YouTube and cooking blogs miss safety handling of flour. They do not follow the recommendations given by government agencies. Strategies of enhancing safe flour handling in popular recipes should be developed by the consolidation of health educators, researchers, and policymakers.

Keywords: Dough, food safety, risk perception, survey.

Resumen. Aproximadamente 48 millones de personas en EE.UU. se enferman a causa de enfermedades transmitidas por los alimentos. Muchas personas desconocen el riesgo microbiológico en los alimentos con bajo contenido de humedad, como la harina o la mezcla rápida de harina. El estudio evaluó las prácticas de inocuidad, conocimiento y riesgo en el manejo de la harina entre los consumidores y las implicaciones de inocuidad de las recetas populares. Fase I: se desarrolló una encuesta en línea (Qualtrics) que consta de seis áreas: uso de la harina, manejo inocuo de harina, retiro de harina y comportamiento, efectividad del mensaje, fuente confiable de receta y demografía. Los criterios de selección de los participantes incluyeron: (1) manipulador y comprador primario de alimentos, y (2) uso de harina o mezcla rápida de harina al menos una vez al mes. Fase II: La receta de las fuentes en línea (blogs y videos de YouTube) fue seleccionada y codificada para evaluar implicaciones de inocuidad de acuerdo a recomendaciones de manejo de harina de la FDA. Las personas que consumen o juegan con masa cruda carecen de prácticas de higiene al manipular la harina. Además, las recetas populares en YouTube y los blogs no siguen las recomendaciones de agencias gubernamentales para el manejo de la harina. Las estrategias para mejorar el manejo de la harina en las recetas populares deben ser desarrolladas por una consolidación de educadores de salud, investigadores y responsables políticos.

Palabras clave: Encuesta, inocuidad de alimentos, masa, percepción de riesgo.

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# **1. INTRODUCTION**

Foodborne illness is a major public health issue. In the United States approximately, 48 million people get sick from a foodborne illness, 128,000 are hospitalized and 3,000 die each year (CDC 2019). Food safety involves handling, preparing and storing food in order to reduce a person's risk of foodborne illness (AIFS 2016). Food safety, food security, and nutrition of people are related because unsafe food is responsible for disease and malnutrition (WHO 2017). Efforts have been made to educate consumers and food handlers; however, more actions need to be taken to address the outbreaks and recalls.

Foodborne outbreaks are commonly associated with meat, poultry, seafood and vegetables, which makes consumers surprised of outbreaks associated with low moisture foods. Microorganisms cannot grow in this product, but they are able to be in a latency state (FAO, WHO 2014). Some examples that can be classified as low moisture products (low water activity) include cereals, cocoa powder, dried fruits and vegetables, egg powder grits, dried meat, herbs, nuts, and flour. These examples are not exempt from having a microbiological hazard. As a result, low moisture food products can be a vehicle for bacteria (Sánchez-Maldonado *et al.* 2018).

There have been foodborne outbreaks linked to flour or products related to flour. Two outbreaks have been associated with *E. coli* O157:H7 in 2009 and 2016; four related to *E.coli* O121 (and two of these also with *E. coli* O26) in 2009, 2016, 2017 (Gieraltowski *et al.* 2007; Neil *et al.* 2012; BCCDC 2017; CFIA 2017; Crowe *et al.* 2017; FDA 2017a). In addition, *Salmonella* has been linked to flour and flour products. Four reported cases, two of them related to *Salmonella* Typhimurium (CDC 2007; Zhang *et al.* 2007; McCallum *et al.* 2013; Vencia *et al.* 2015). The specific products associated with the outbreaks were cookie dough, flour, quick bread mix, pizza dough, cake batter ice cream, frozen pot pies, lasagna. Moreover, recent recalls from flour and flour products linked to *Salmonella* and *E. coli* are of concern. The last six recalls were in January, March, May and June 2019, from Gold Medal, Pillsbury, Baker's Corner, King Arthur Flour unbleached all-purpose flour, Pillsbury bread flour, and Brand Castle and Sisters' gourmet baking mixes (FDA 2019).

Some government and consumer agencies provide recommendations to consumers for handling flour due to the common errors while using it. It should not be a behavior to eat raw cookie dough, cake mix, batter, or any other raw dough or batter product that has to be cooked or baked FDA 2017b; CDC 2018; Foodsafety.Gov 2019). In addition, it is important to follow the instruction on the package of flour to assure that time and heat provided to the batter or dough is proper. Moreover, a good practice after handling flour, dough or batter is to wash hands, work surfaces, and utensils. Maintaining raw foods separate from other foods prevents the risk of any contamination.

Improper handling can expose the consumer to a microbial risk, which is the reason why flour-handling behavior of consumers while cooking or baking with this product represents an important issue to understand. To know consumers' behavior while handling flour, represents an opportunity to visualize gaps in food safety knowledge, practices, and behavior on low moisture products that can represent a food safety risk for consumers. Popular recipes have a big impact on consumers' decisions and behavior. The online world has been connected with the kitchen world turning consumers' mobile devices into the kitchen (Cooper 2015). According to the Google Consumer Survey (2015), 33% of the consumers print recipes, 22% use cell phones directly for recipes and 20% use their tablets to get recipes (Cooper 2015).

Online recipes have become a trend among consumers. Blogs and YouTube videos have transformed the kitchen world, giving consumers an easy way to interact with the online world and their kitchens. A cooking blog can be defined as an online facility in which people can post, share, or comment on recipes, followed by steps and ingredients (Morrison & Young 2019). On the other hand, YouTube is popular among video social network websites. It has been used to conduct research to understand the behavior of consumers (Keelan *et al.* 2007). Both social media platforms can interact with a large audience. This generates a concern about the behavior shown or exposed to consumers (written or visualized). Previous studies found that even cooking shows on televisions had many food handling errors, which increased the risk of foodborne illness (Cohen 2016; Woods 2016; Maughan *et al.* 2017) In this study, we evaluated popular recipes on YouTube and cooking blogs and assessed the food safety messages of flour handling.

The objectives of the research were:

- Assess food safety knowledge, risk and behavior of flour handling among consumers.
- Understand food safety implications from popular recipe sources and their interaction with consumers.
- Evaluate food safety messages on flour packages to provide feedback related to their effectiveness.

# 2. MATERIALS AND METHODS

#### Location.

The population of the survey was recruited by Qualatrics U.S. that contacted each of the participants from all the states in the U.S. using their online database. The content analysis of the YouTube videos and cooking blogs were performed at the Food Safety Laboratory, Department of Food Science, Purdue University, 745 Agriculture Mall Drive, West Lafayette, IN 47907. The survey delivery, YouTube videos coding, and cooking blogs coding were conducted in the spring of 2019. This study was approved and exempted by Purdue's Institutional Review Board (IRB) on April 8th, 2019.

#### Phase I - Survey.

The survey was developed in cooperation with a university expert in the Food Safety area. Questions were related to general information, knowledge, risk perception and flour handling behavior. Examples of flour and quick bread mix were provided for applicable questions to clarify these terms for consumer. "Flour" included all-purpose flour, whole-wheat flour, bread flour, cake flour. "Quick bread mix" encompassed cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

The participants were recruited online from all over the U.S. by Qualtrics Company. The survey for the research project was divided into one main screener which set the criteria for recruitment; (a) primary food preparer; (b) primary grocery shopper (c) use of flour or quick bread mix at least once a month. These criteria allowed the participant to take the survey. If the criteria were not met, participants were redirected to the end of the survey, notifying participants that they do not qualify for this particular survey. The survey population recruitment was intended to mirror the U.S. population. To achieve this, quotas by Qualtrics Company were set. Additionally, it had six main topics: (1) Consumer and use of flour; (2) Safe flour handling knowledge and behavior; (3) Flour recall knowledge and behavior; (4) Message effectiveness; (5) Trusted source for flour handling; (6) Demographic information.

The survey consisted of 72 questions with an estimated time of 13 minutes to answer all of the questions. However, the total responses from each participant were different due to the selection of a specific answer that prompted follow up questions. Different types of questions were used to collect the data from participants: multiple-choice answer (including questions using a Likert scale -7 points), select all that apply, true and false questions. For a Likert scale, two different scale measurements were used. For perception items, a 1 to 7 scale was used, with 1 indicating "extremely effective", 4 indicating "neither agree nor disagree", and 7 indicating "extremely ineffective". For self-reported questions, a 1 to 7

scale was used, with 1 indicating "strongly disagree", 4 indicating "neutral", and 7 indicating "strongly agree".

(1) Consumer and use of flour, 28 questions. Questions related to the type of flour that consumers use were asked. Flour type question was a select all that apply question and the following questions were of a multiple-choice questions. General information of consumers flour was gathered. One question about frequency of consumption or playing with raw dough or batter divided consumers into two main groups: "Eaters" (for answers "every time", "sometimes", and "rarely") and "Non-eaters" (for answers "Never").

(2) Safe flour handling knowledge, 5 questions. Questions about food safety knowledge and food safety behavior about flour were asked. Select all that apply questions and multiple choice questions were used.

(3) Flour recall knowledge and behavior, 8 questions. Questions of knowledge and behavior about recalls related to flour (or related products, like cookie dough) were asked: three questions of true and false, 4 of select all that apply, 3 of multiple choice and two using a Likert scale (7 points scale).

(4) Message effectiveness, 19 questions. A field trip to a small local supermarket was developed for the food safety message selection. A total of 15 food safety messages on flour packages were recorded; the food safety messages that were repeated were only recorded once. The location of the recorded food safety messages was 7 (47%) on the top of the package; 6 (40%) on the side of the package; and 2 (13%) on the middle of the package. Three food safety messages of flour packages were set (Table 1), including two original food safety messages and one was generated based on the originals.

Message	Words (n)
M1 = "Do not eat or play with flour, raw dough or batter."	11
M2 = "Cook before sneaking a taste. Flour is raw. Please cook fully before enjoying. Flour is not ready-to-eat and must be thoroughly cooked before eating. To prevent illness from naturally occurring bacteria in wheat flour, do not eat or play with raw dough. Wash hands and surfaces after handling."	50
M3 = "Say no to raw dough: flour is a raw ingredient. Bake fully before enjoying."	14

Table 1. Food safety messages exposed to flour consumers.

In the survey, the three food safety messages of flour were shown for "Eaters" and "Noneaters" in a randomized way, to reduce the bias of perception questions of each message per participant. For "Eaters", four questions using a Likert scale (7 points scale) were presented. For "Non-Eaters", two questions using a Likert scale (7 points scale) were presented. Also, a multiple-choice question of the location of the food safety message on flour packages was presented.

(5) **Trusted source for flour handling, 3 questions.** The first question asked consumers' way to obtain recipes, in which consumers could select all the ways that apply to them. Followed by questions that prompted out only if the answer "cookbooks" was selected.

(6) **Demographic information, 9 questions.** All the questions in this section were multiple choice and were used to determine quotas by Qualtrics Company for participants recruitment to mirror the U.S. population.

A pilot test of the instrument (survey) was made for understandability and validity in 194 participants, which only 51 participants met all the criteria. Two quality-assurance questions were developed to identify participants who were skipping or not reading the questions when answering (Kahan *et al.* 2009; Sciandra *et al.* 2017). In the pilot study, only 49% (of the 51 participants that met all the criteria) answered both quality-assurance questions correctly. If the participant did not answer both correctly, they were redirected to the end of the survey and their data were not included in the analysis. Also, a quota for states was set for better matching of the population by states and the people who answered the survey.

#### Statistical analysis.

**Reliability of the survey.** Internal consistency reliability coefficients were calculated using Cronbach  $\alpha$  coefficient for Likert-type scales for message effectiveness (Kwiatkowska 2016). All the questions that were asked, related to consumers' perception of the message. These coefficients were calculated using the responses of the pilot test (51 participants that met the criteria). Two Cronbach  $\alpha$  were calculated for internal consistency; the first was calculated for perception and self-reported questions related to "Eaters" group using 13 items (Cronbach  $\alpha = 0.92$ ); the second was for perception and agreement for "Non-eaters" group using 6 items (Cronbach  $\alpha = 0.89$ ).

For true and false statements, the Difficulty Index (DI) was calculated. The total of correct answers was divided into the total of participants that answer the question. The DI proportion is 0-1, 1 indicating that the entire participants got the answer correct (Kwiatkowska M 2016). The statements were the following: 'People can get food poisoning from eating raw cookie dough.' (DI=0.71); 'Harmful bacteria can survive in raw flour.' (DI=0.69); and 'Bacteria can travel to different surfaces/utensils via flour.' (DI=0.78).

**Survey data analysis.** A descriptive analysis was conducted to identify important questions on the survey that characterized flour handlers. Chi-square and Spearman's correlation was used (SAS 9.4®).

An overall Chi-square was used to interpret any significant difference between the messages shown to the consumers and the frequency of the scores. The effectiveness was divided into three main groups, "Not effective" (extremely ineffective, moderately ineffective), "Neutral" (neutral), and "Effective" (slightly effective, moderately effective, extremely effective). In addition, two-divided Chi-square were calculated for "Eaters" and "Non-Eaters". Four partitions for each group were developed and the significant  $\alpha$  value used was  $\alpha/p$  (p = number of partitions).

For Spearman's correlation, three main factors were analyzed for better understanding of consumers: "Behavior", "Knowledge", and "Risk". Specific questions were selected for each factor to get a score (for "Behavior", and "Knowledge") and an average (for "Risk"). An over-all correlation was applied between the three factors, and the independent variable ("Eaters and Non-Eaters"). For the interpretation of the Spearman's correlation, the data shown in Table 2 was used.

<b>Correlation Coefficient</b>		Dancey & Reidy (Psychology)	
+1	-1	Perfect	
+0.9	-0.9	Strong	
+0.8	-0.8	Strong	
+0.7	-0.7	Strong	
+0.6	-0.6	Moderate	
+0.5	-0.5	Moderate	
+0.4	-0.4	Moderate	
+0.3	-0.3	Weak	
+0.2	-0.2	Weak	
+0.1	-0.1	Weak	
0	0	Zero	

Table 2. Interpretation of the Spearman's correlation coefficients.

\*This table was adapted from "User's guide to correlation coefficients" (Akoglu 2018).

#### Phase II- Popular recipes.

**Selection of cooking blogs recipes.** A search in Alexa Internet top 500 sites on the web was made (Morrison E 2019). To narrow the blogs, a filter by category was used, Home, followed by cooking (Sub-category 59). Also, a search for recipes on local supermarket (Indiana state) websites and appliance store websites was conducted. The criteria used for the recipe blogs (including supermarket and appliance store websites) was the following: (1) English language; (2) cookie and cookie dough recipes.

For cookie recipes, three keywords were used: "chocolate chip cookies", "sugar cookies", and "cookies". The first recipe that prompted out at the beginning and that followed the criteria was selected. For the cookie dough, the keyword "cookie dough" was used for

searching. A total of 17 blogs (including supermarket and appliance store websites) were selected to search the three different recipes for cookies, collecting a total of 51 recipes that were coded. Recipes from cookie dough were more difficult to find in blogs, which is the reason, only one recipe per blog was selected, resulting in 17 recipes. The blogs recipes were downloaded.

**Selection of video recipes.** The search for YouTube videos was conducted with the keywords "homemade cookies" and, "cookie dough recipe". Every time a search was made, the filter 'total views' was selected. The criteria for YouTube videos was the following: (1) English language; (2) wheat flour usage; (3) procedures shown. The first 50 videos that met all the criteria for both keywords, were used. The YouTube videos were downloaded.

**Coding of flour handling behavior.** A coding system was developed to assess the cookies and cookie dough handling, which was adapted from previous blog/book content analysis (Levine K, Chaifetz A, Chapman B 2017) and video content analysis (Borda D et al. 2014). The coding system of blogs and videos focused on four main topics. The topic areas included:

- **General information.** The general information was used to identify the video or blog, which included posting date, author, professional/consumer, number of subscribers.
- User's interaction. The users' interactions were recorded to demonstrate how popular the video or blog is, which included user-contributed comments, view count, number of likes, number of dislikes.
- **Procedures.** The procedures were to determine how the presenters handle flour and what happened when they started the process, which included facility setting, type of flour, storage of flour, flour transfer, mixing process, use of jewelry, clothes cover with flour, among other specific topics.
- FDA recommendations and behaviors. The last main topic was FDA recommendations and behaviors, which are described on the websites of FDA, CDC, and Foodsafety.gov (FDA 2017a; Akoglu H 2018; CDC 2018; Foodsafety.Gov 2019).

**Data analysis of popular recipes.** A descriptive analysis was conducted to obtain the frequencies of behaviors coded on cooking blogs and YouTube cooking videos.

# **3. RESULTS AND DISCUSSION**

#### Survey.

A total of 6,854 participants took the survey, in which 2,455 did not meet the screener and 2,764 did not meet both quality-assurance questions. For the remaining participants, the third-party company, Qualtrics (which recruited the participants), made a selection to record the answers of those participants that met the demographic characteristics set by the researcher (on the base of the U.S census).

The final participants used for the research were primary food handlers, grocery shoppers and they use flour or quick bread mix at least once a month. For this study, 37% were male, and 63% were female. The age of participants was grouped in six levels, between '45-54' were 19%, followed by group '24-34', '35-44' and '65 and above' with 18% each group. For ethnicity, 60% were white (non-Hispanic). This survey showed that 97% of the participants have a High School or higher degree. The participant's responses were from all over the states in the U.S. with the biggest groups in California (10%), and Texas (8%). The demographic results (Table 3) for gender (overpassed for women), age group, and ethnicity; and the sample per state, showed that the sample for this survey was close to the U.S population, which was an objective for the study (United States Census Bureau 2018).

For the characterization of consumers, general flour information was asked (Table 4). On the four types of flour that were presented, 928 participants responded to use all-purpose flour, 652 use quick bread mix, 288 use whole wheat flour and 217 use bread flour. All-purpose flour covers a big range of market segments because its wide use in bread, cookies, pastries, and cake (Absolute Reports 2019). The major companies (U.S) operating in the all-purpose flour market are Archer Daniels Midland Company, Cargill Inc., General Mills, Ardent Mills Corporate, Bob's red mills, King Arthur Flour Company, Inc.

For all types of flour, more than 90% of consumers (per each group) buy flour in a grocery store. The total number of U.S. supermarket stores by 2017 was about 38,307 stores (Statista 2019). The amount of flour that consumers usually buy for quick bread mix is 2 boxes (42%) and for bread flour, whole wheat flour, and all-purpose flour, between 1 pound and 2 pounds (including 1 pound) ( $\geq$  30%). The time that flour lasts for quick bread mix, bread flour and whole wheat flour is about two weeks to a month ( $\geq$  30%); and for all-purpose flour 1 to six months (48%). More than 50% of consumers (of each flour) store their flour in sealed containers at room temperature.

Demographic Characteristics	Number (%)
<b>Total consumers</b> $(n = 1,045)$	
Condor	
Male	385 (37)
Female	655 (63)
Prefer not to answer	5 (<1)
Age group	
18-24	115 (11)
24-34	190 (18)
35-44	189 (18)
45-54	194 (19)
55-64	168 (16)
65 and above	189 (18)
Ethnicity	
White (non-Hispanic)	630 (60)
Hispanic	189 (18)
African American	137 (13)
Asian	52 (5)
Other	28 (3)
Prefer not to answer	9 (1)
Education level	
Not High School graduate	29 (3)
High School or GED Degree	472 (45)
Bachelor's Degree	351 (34)
Graduate Degree	171 (16)
Prefer not to answer	22 (2)
Household's income	
Less than \$10,000	65 (6)
\$10,000-\$29,999	272 (26)
\$30,000-\$49,999	197 (19)
\$50,000-\$79,999	229 (22)
\$80.000 and above	270 (26)
Prefer not to answer	12 (1)

Table 3. Descriptive characteristics of participants of a study on flour handling behavior.

	Type of flour				
Conoral Information	Quick	Bread	Whole	All-	
General Information	bread mix	flour	wheat flour	purpose	
	(%)	(%)	(%)	flour (%)	
Total consumers (n=1,045)	652 (62)	217 (21)	288 (28)	928 (89)	
Primary way to obtain it					
Grocery Store	648 (99)	211 (97)	270 (94)	914 (98)	
From a friend or family member	2 (<1)	3 (1)	10 (3)	8 (1)	
I mill my own flour	0 (0)	2(1)	7 (2)	4 (<1)	
Other	2 (<1)	1 (<1)	1 (<1)	2 (<1)	
Amount of flour they buy					
1 box / Less than 1 lb.	180 (28)	9 (4)	19 (7)	41 (4)	
2 boxes / Between 1 lb. and 2	276 (42)	65 (30)	90 (31)	311 (34)	
lb. (including 1 lb.)	270 (42)	05 (50)	<i>J</i> 0 ( <i>3</i> 1)	511 (54)	
3 boxes / Between 2 lb. and 3	135 (21)	43 (20)	62 (22)	151 (16)	
lb. (including 2 lb.)		~ /			
4 boxes / Between 5 lb. and 4 lb. (including 3 lb.)	43 (7)	31 (14)	30 (10)	74 (8)	
5 hoxes / Between 4 lb and 5					
lb. (including 4 lb.)	5 (1)	34 (16)	39 (14)	167 (18)	
More than 5 boxes /Between 5 lb. and 10 lb. (including 5 lb.)	13 (2)	26 (12)	41 (14)	170 (18)	
Between 10 lb. and 25 lb. (including 10 lb.)	N/A	5 (2)	4 (1)	7 (1)	
25 l or more	N/A	4 (2)	3 (1)	7 (1)	
How long does it last					
I use it all at once	64 (10)	22 (10)	15 (5)	26 (3)	
One week or less	165 (25)	43 (20)	57 (20)	79 (9)	
Two weeks to a month	292 (45)	96 (44)	100 (35)	296 (32)	
1 to 6 month	113 (17)	44 (20)	99 (34)	443 (48)	
6 months to a year	14 (2)	9 (4)	11 (4)	69 (7)	
More than a year	4 (1)	3 (1)	6 (2)	15 (2)	

Table 4. General flour information from participants of a study on flour handling behavior.

	Type of flour			
General Information	Quick bread mix (%)	Bread flour (%)	Whole wheat flour (%)	All-purpose flour (%)
Totalconsumers(n=1,045)	652 (62)	217 (21)	288 (28)	928 (89)
Storage of flour				
Sealed container at the room temperature.	343 (53)	111 (51)	149 (52)	576 (62)
Sealed container in a refrigerator.	124 (19)	40 (18)	57 (20)	120 (13)
Sealed container in a freezer.	16 (2)	18 (8)	26 (9)	34 (4)
In the original package (unsealed) at the room temperature.	124 (19)	36 (17)	40 (14)	143 (15)
In the original package (unsealed) inside the refrigerator.	28 (4)	6 (3)	9 (3)	34 (4)
In the original package (unsealed) inside the freezer.	4 (1)	3 (1)	4 (1)	14 (2)
Other	13 (2)	3 (1)	3 (1)	7 (1)

Table 4. General flour information from participants of a study on flour handling behavior (cont.).

Since six recalls have happened in the first six months of 2019, the question "Have you heard of any recall related to flour or quick bread mix?" was important to measure. According to the data collected, 85% (890) of the flour consumers have not heard of any food recall related to flour or quick bread mix. It is known, that it is very important for the U.S. population to have a good idea and knowledge about recall information; however, they do not use adequate sources to inform themselves about recalled products (Liao *et al.* 2018). Also, low moisture products have not been well studied as food vehicles of bacteria. However, food recalls and foodborne illness outbreaks related to low moisture products have been rising in recent years.

The question, "How often do you eat or play with raw dough or batter?" was asked. For the 1,045 participants, 999 answered this question (46 do not use flour for baking goods). This question divided participants in two main groups, 66% (663) named as "Eaters" (they eat or play with raw dough or batter), and 34% (336) named as "Non-eaters". This behavior question showed the food safety risk of flour consumers for two reasons: (1) they do not

know about flour recalls; (2) Consumers' behavior does not promote safe flour handling practices, which increase their possibility of getting a foodborne disease due to flour.

Three food safety messages were evaluated, between both "Eaters" and "Non-eaters" groups (Figure 1). The majority of responses to the effectiveness of the messages were from the effective side. For message one, "Eaters" responded 56% effective and "Non-eaters" 76% effective. For message two, "Eaters" responded 77% effective and "Non-eaters" 88% effective. For message three, "Eaters" responded 70% effective and "Non-eaters" 80% effective. These results showed that, in all the messages, "Non-eaters" have a stronger perception of the effectiveness of the messages. Some flour companies' website gives food safety messages on how to handle flour, however, the effectiveness of those messages have never been evaluated in a research study (King Arthur Flour 2019; Pillsbury 2019).



■ Ineffective ■ Neutral ■ Effective

Figure 1. Effectiveness of flour safety messages. Results represent the % of 663 "Eaters" and 336 "Non-eaters" flour consumers. M1="Do not eat or play with flour, raw dough or batter."M2="Cook before sneaking a taste. Flour is raw. Please cook fully before enjoying. Flour is not ready-to-eat and must be thoroughly cooked before eating. To prevent illness from naturally occurring bacteria in wheat flour, do not eat or play with raw dough. Wash hands and surfaces after handling." M3="Say no to raw dough: flour is a raw ingredient. Bake fully before enjoying."

The proportion of the participants in each of three categorical scores of effectiveness is significantly different ( $X^2$  of 174.9273 and P < 0.0001) for each of the messages presented among "Eaters" and "Non-eaters". Moreover, messages qualified by "Eaters" and "Non-eaters" were evaluated separately. A general Chi-square for "Eaters" ( $X^2$  of 84.2661 and P < 0.0001) showed that the scores of effectiveness are different for each message presented,

as well as for "Non-eaters" (X<sup>2</sup> of 24.8538and P < 0.0001). After the previous analysis, the divided Chi-square for "Eaters" and "Non-Eaters" was conducted. Table 5 presents that partition one and two for "Eaters" are significantly different. This indicator suggests that message one and two showed different scores for effectiveness (Ineffective, neutral, effective) given by "Eaters", who perceived these messages as different. On the other hand, Table 6 presents that partition two for "Non-eaters" is significantly different. This indicator suggests that message one and two showed different scores for effectiveness (only for the effective side). Messages can be identified as low consensus messages and high consensus messages and consumers, can be identified to have low interpersonal influence or high interpersonal influence (Sciandra *et al.* 2017). The type of message given to the consumers can directly affect their behavior (Gerber 2009).

Partition	<b>X</b> <sup>2</sup>	p value		
1	13.1315	0.0003		
2	63.3414	< 0.0001		
3	5.0214	0.025		
4	2.7718	0.0972		
Total set	84.2661	< 0.0001		

Table 5. Summary of divided  $X^2$  for "Eaters" messages of a study on flour handling behavior.

\*For *a posteriori* results statistical significance was measure with  $\alpha/p = 0.0125$ .

Table 6. Summary of divided  $X^2$  for "Non-eaters" messages of a study on flour handling behavior.

Partition	$\mathbf{X}^2$	p value
1	3.0643	0.0800
2	16.0238	< 0.0001
3	4.6393	0.0312
4	1.1264	0.2885
Total set	24.8538	< 0.0001

\*For *a posteriori* results statistical significance was measure with  $\alpha/p = 0.0125$ .

In this survey, flour consumers were asked about the best place for visualizing the food safety message on flour packages (Table 7). The main place that consumers suggested for this food safety message was in the middle of the package (50%), followed by the top of the package (34%). However, the food safety messages on flour packages that were recorded on the field trip showed to be more frequently on top of the package. Food safety messages are labels, which represent a channel for communication with consumers. To design an attractive label placed in the correct spot for visualization can make it easier to read and to understand (Hall 2013).

Place	Number (%)		
Total consumers (n=1,045)	-	-	
	Survey	Local supermarket	
On middle of the package	524 (50)	2 (13)	
On top of the package	355 (34)	7 (47)	
On the side of the package	149 (14)	6 (40)	
None of above	17 (2)	N/A	

Table 7. Consumers' preference on the place of the food safety message of flour packages.

The survey took a general vision from the population about the factors that can influence flour consumers while handling flour (Table 8). A moderate correlation of -0.59822 (P < 0.0001) between the independent variable "Eaters and Non-eaters" represent that as consumers eat or play with raw dough or batter, they scored fewer points on the behavior questions. The lowest score also suggests that they are more likely to have a foodborne illness due to poor behavior while handling flour.

On the other hand, another moderate correlation was between the independent variable and the risk perception 0.50191 (P < 0.0001). As consumers do not eat or play with raw dough or batter, they are more likely to score fewer points on risk perception. Finally, a weak correlation -0.37889 (P < 0.0001) was found between the behavior and the risk perception. The risk perception rises as people behaves improperly while handling flour. Other studies have been done trying to understand consumers' handling practices (while handling a specific food); one study related with poultry and the risk related to campylobacteriosis demonstrates a correlation between safer behavior associated with less risk perception for foods prepared at home (Bearth *et al.* 2014).

	Behavior	Knowledge	Risk	"Eaters and Non-eaters"
Behavior	-			
Knowledge	0.070034	-		
Risk	-0.3789*	0.083885	-	
"Eaters and Non- eaters"	-0.59822*	-0.0614	0.50191*	-
* $P \le 0.05$				

Table 8. Behavior, knowledge, risk, "Eaters, and Non-eaters": Spearman's correlation of a study on flour handling behavior.

One question was generated to focus on how consumers obtain recipes to prepare cookies, cake/muffin or bread. According to Table 9, consumers who took the survey answered that their primary way to obtain recipes were cookbooks (64%), followed by flour/quick bread mix package (47%) and YouTube videos (44%). Nowadays, recipes that consumers use are often digital, even cookbooks, which can be downloaded on the web from different websites (flour companies or blogs). Regardless of the format of cookbooks, they have still been popular among consumers and sales are increasing 1 (Almanza *et al.* 2017). Also, the most popular brands in the U.S. of quick bread mix or flour package a description of a recipe on the backside of the package. Moreover, there is a trend 'Millennials eat up YouTube food videos' (Cooper 2015). YouTube has become an important source for people to get ideas, inspiration, and tips on cooking techniques. In 2013, YouTube views of food and recipe content grew 59%, which suggests greater use of this video streaming media (Delgado *et al.* 2014).

Way to obtain recipes	Number (%)
Cookbooks	670 (64)
Flour/quick bread mix package	491 (47)
YouTube videos	462 (44)
Flour company website	359 (34)
TV shows	321 (31)
Blogs	197 (19)
Kitchen tool company website	100 (10)
None of the above	71 (6)

Table 9. Consumers' principle way to obtain recipes of a study on flour handling behavior.

#### Popular recipes.

A total of 50 YouTube videos of cookie recipes and 50 of cookie dough recipes were evaluated. Also, 51 cookie recipes on 17 cooking blogs and 17 cookie dough recipes on 17 cooking blogs were evaluated. In Figure 2, the interaction between view count and the number of likes was presented for YouTube videos. It shows a moderate correlation of consumers' views and their agreement with the information provided on the video. The number of likes can represent how popular a video can be among consumers. The search interest for "best recipes" on YouTube is around 48% in a year (Cooper 2015).



Figure 2. Consumers' interaction on YouTube videos – popular recipes.

Table 10 shows the food safety behavior on YouTube videos and cooking blogs. For the behavior "eat raw cookie dough", in which cookie dough is define as ready-to-eat, cookie dough recipes showed on YouTube videos that 74% of the youtubers consume it in front of the camera. On the other hand, 88% on cooking blogs mentioned to eat cookie dough on the main text of the blog. For behavior "Wash surfaces/cleaning areas", less than 20% for both recipes and online facilities make this action. "Wash hand after contacted flour" and "separate flour from ready-to-eat product", was coded only for YouTube because it can only be observed. In addition, none of the videos regarding to "wash hand after contacted flour" makes this action. For "separate flour from ready-to-eat product", in YouTube videos, it was performed 18% on cookies recipe videos and only 2% on cookie dough videos. They do not follow the food safety recommendation of flour handling given by the FDA, CDC, and foodsafety.gov. Research studies have shown that television celebrity chefs do not have proper food handling behaviors while preparing food on popular shows (Woods 2016; Maughan *et al.* 2017).

YouTube • Cookie d • Cookies Cooking Blogs • Cookie d • Cookie d	ough n= 50 n= 50 ough n= 51 n= 17	Eat raw cookie dough n (%)	Wash surfaces/cleaning areas n (%)	Wash hands after contacted flour n (%)	Separate flour from ready-to- eat product n (%)
Cookia dough	YouTube	37 (74)	1 (2)	0	1 (2)
COOKIE dougii	Blogs	15 (88)	2 (12)	N/A	N/A
Cookies	YouTube	1 (2)	2 (4)	0	9 (18)
Cookies	Blogs	0 (0)	3 (6)	N/A	N/A

Table 10. Food safety behavior on YouTube videos and cooking blogs.

A total of 13 cookie dough recipes between YouTube videos and cooking blogs expressed their concern of the possibility of a pathogenic bacteria on flour. YouTubers and bloggers gave a recommendation of heat treatment to the flour before their usage for cookie dough recipes. Table 11 shows those heat treatments (10 different processes), which are divided in two groups. Four heat treatments described the use of a microwave. The final internal temperatures that were provided are 71 °C, 74 °C, and 82 °C. Six heat treatments described the use of an oven; however, these heat treatments did not provide a final internal temperature. They recommended to bake the flour for 5-18 minutes at temperature between 149 °C to 177 °C. Research studies have been made on heat treatment of flour and the subsequent effects on the characteristics of flour (Chenling et al. 2017; Keppler et al. 2018); also a validation of a baking process for killing Salmonella was conducted (Lakshmikantha et al. 2017). A research on thermal inactivation of Salmonella enterica and non pathogenic bacterial surrogates in wheat flour by baking in a household oven showed that home ovens can reduce the pathogenic bacteria and surrogate until 1.14 log CFU/min at 204 °C (Jung et al. 2019). However, the use of a microwave for heat treatment to flour have not been evaluated.

Table 11. Flour heat treatments mentioned on popular recipes on YouTube and Cooking Blogs.

Internal temperature	Non internal temperature
"Microwave for 2 minutes, until it reaches	"Evenly spread flour out on a baking tray
74 °C (165 °F)."	and bake for 5 minutes."
"Microwave the flour in a small	"Bake at 177 °C (350 °F) for 5 minutes."
microwave-safe bowl for 1 minute or until	
(82 °C) 180 °F."	
"Microwave at 30 sec intervals until 71 °C	"Bake at 177 °C (350 °F) for 15 to18
(160 °F)."	minutes."
"Bake at 191 °C (375 °F), until it reaches a	"Bake 149 °C (300 °F) for 5 to 10 minutes."
temperature of 71 °C (160 °F)."	
"Microwave with intervals of 30 seconds	"Spread flour onto a baking sheet and bake
until 71 °C (160 °F)."	in a 177 °C (350 °F) for 10 minutes."

# 4. CONCLUSIONS

- People who consume or play with raw dough or batter have an improper behavior while handling flour, which exposes them to a higher risk of getting a food borne illness; knowledge was not significant for behavior nor risk perception of the consumers, which can increase the potential risk.
- Popular recipes on YouTube and cooking blogs have a lack of flour safety handling behavior and do not follow the recommendations given by government agencies (FDA, CDC); hence, people who tend to use YouTube videos and cooking blogs as tools to get recipes are exposed to a higher food safety risk.
- Message effectiveness perception by consumers of food safety messages of flour packages suggests that long messages (≥50 words) are more effective and can influence consumers' food safety risk perception of flour.

# 5. RECOMMENDATIONS

- Future research has to focus on food safety message on flour package in order to determine what factors make the message effective.
- Video tape the preparation of cookies or cookie dough inside a home kitchen in order to observe consumer behavior while handling flour.
- Evaluate the heat treatments of flour that were given by consumers, to expose the food safety risk that remains on that procedure.

#### 6. **REFERENCES**

- Absolute Reports. 2019. Global all-purpose flour market insights forecast to 2025. [updated 2019; accessed 05/06/2019]. https://www.marketreportsworld.com/global-all-purpose-flour-market-insights-forecast-to-2025-13456527.
- Akoglu H. 2018. User's guide to correlation coefficients. Turkish Journal of Emergency Medicine. 18(3):91–93. eng. doi:10.1016/j.tjem.2018.08.001.
- Almanza BA, Byrd KS, Behnke Carl, Ma J, Ge L. 2017. Cookbooks in U.S. history: how do they reflect food safety from 1896 to 2014? Appetite. 116:599–609. eng. doi:10.1016/j.appet.2017.05.053.
- AIFS, Australian Institute of Food Safety. 2016. What is food Safety? Australia: AIFS. [updated 2019; accessed 01/21/2019]. https://www.foodsafety.com.au/resources/articles/what-is food-safety.
- BCCDC, BC Centre for Disease Control. 2017. BCCDC advises British Columbians about a new outbreak of *E. coli* O121 associated with flour. British Columbia. [updated 2019; accessed 02/22/2019].http://www.bccdc.ca/about/news-stories/newsreleases/2017/bccdc-advises-british-columbians-about-a-new-outbreak-of-e-coli-0121-associated-with-flour.
- Bearth A, Cousin ME, Siegrist M. 2014. Poultry consumers' behaviour, risk perception and knowledge related to campylobacteriosis and domestic food safety. Food Control. 44:166–176. doi:10.1016/j.foodcont.2014.03.055.
- Borda D, Thomas M, Solveig L, Kathrin R, Kieran J, van der Roest J, Nicolau I. 2014. Food safety practices in European TV cooking shows. British Food Journal. 116(10):1652–1666. doi:10.1108/BFJ-12-2013-0367.
- CDC, Center for Disease Control Prevention. 2019. Foodborne outbreaks. United States. [updated 2019; accessed 01/23/2019]. https:// www.cdc.gov/foodsafety/outbreaks/ multistate-outbreaks/outbreaks-list.html.
- CDC, Centers for Disease Control and Prevention. 2007. Multistate outbreak of *Salmonella* infections associated with frozen pot pies. United States. [updated 2019; accessed 02/22/2019]. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5747a3.htm.
- CDC, Centers for Disease Control and Prevention. 2018. Say no to raw dough! United States. [updated 2019; accessed 02/26/2019]. https://www.cdc.gov/features/no-raw-dough/index.html
- CFIA, Canidian Food Inspection Agency. 2017. Food safety investigation of *E. coli* O121in flour products. Canada. [accessed 02/22/2019]. http://www.inspection.gc.ca/food/

information-for-consumers/food-safety-investigations/flour-products-e-coli-o121-/eng/1521138330972/15211388477096.

- Chenling Q, Hongliang W, Shengqiang L, Fangting W, Chang L. 2017. Effects of microwave heating of wheat on its functional properties and accelerated storage. Journal of Food Science and Technology. 54(11):3699–3706. eng. doi:10.1007/s13197-017-2834-y.
- Cohen NL ORB. 2016. Compliance With Recommended Food Safety Practices in Television Cooking Shows. Journal of Nutrition Education Behavior. 48(10):730-734.e1. eng. doi:10.1016/j.jneb.2016.08.002.
- Cooper J. 2015. Cooking trends among millennials: Welcome to the digital kitchen. United States. [accessed 05/06/2019]. https://www.thinkwithgoogle.com/consumer-insights/cooking-trends-among-millennials/.
- Crowe S, Bottichio L, Shade LN, Whitney BM, Corral N, Melius B, Arends KD, Donovan D, Stone J, Allen K, Rosner J, Beal J, Whitlock L, Blackstock A, Wetherington J, Newberry LA, Schroeder MN, Wagner D, Trees E, Viazis S, Wise ME, Neil KP. 2017. Shiga toxin-producing *E. coli* infections associated with flour. The New England Journal of Medicine. 377(21):2036–2043. eng. doi:10.1056/NEJMoa1615910.
- Delgado J, Johnsmeyer B, Balanvskiy S. 2014. Millenials eat up YouTube food videos. [accessed 05/06/2019]. https://www.thinkwithgoogle.com/consumerinsights/millennials-eat-up-youtube-food-videos/.
- FAO, Food and Agriculture Organization, WHO, World Health Organization. 2014.
  Ranking of low moisture foods in support of microbiological risk management.
  United States: FAO, WHO. [accessed 02/22/2019].
  http://ucfoodsafety.ucdavis.edu/files/209893.pdf.
- Foodsafety.Gov. 2019. Flour, raw, dough, and raw batter. United States: Foodsafety.Gov. [updated 2019; accessed 02/26/2019]. https://www.foodsafety.gov/keep/types/flour /index.html.
- Gerber AS RT. 2009. Descriptive Social Norms and Motivation to Vote: Everybody's Voting and so Should You. The Journal of Politics. 71(1):178–191. doi:10.1017/S0022381608090117.
- Gieraltowski L, Schwesohn C, Meyer S, Eikmeier D, Medus C, Sorenson A, Forstener M, Madad A, Blankenship J, Feng P, Williams I. 2007. Role of microbiological guidelines in the production and commercial use of milled cereal grains: a practical approach for the 21st century. Journal of Food Protection. 70(4):1041–1053. doi:10.4315/0362-028X-70.4.1041.
- Hall C OF. 2013. A review to inform understanding of the use of food safety messages on food labels. International Journal of Consumer Studies. 37(4):422–432. doi:10.1111/ijcs.12010.
- Jung J, Casulli K, Schaffiner D. 2019. T10-10: thermal inactivation of *Salmonella enterica* and non-pathogenic bacterial surrogates in wheat flour by baking in a household

oven [abstract]. In: International Association for Food Protection. July 24. Kentucky. https://iafp.confex.com/iafp/2019/meetingapp.cgi/Paper/21486

- Kahan DM, Braman D, Slovic P, Gastil John, Cohen G. 2009. Cultural cognition of the risks and benefits of nanotechnology. Nature Nanotechnology. 4(2):87–90. eng. doi:10.1038/nnano.2008.341.
- Keelan J, Pavri-Garcia V, Tomlinson G, Wilson K. 2007. YouTube as a source of information on immunization: a content analysis. JAMA. 298(10.1001/jama.298.21.2482):2482–2484.
- Keppler S, Bakalis S, Leadley C, Sahi S, Fryer P. 2018. Evaluation of dry heat treatment of soft wheat flour for the production of high ratio cakes. Food Research International. 107:360–370. eng. doi:10.1016/j.foodres.2018.02.041.
- King Arthur Flour. 2019. Safe handling of flour. United States; [updated 2019; accessed 06/26/2019]. https://www.kingarthurflour.com/info/safe-handling.html.
- Kwiatkowska M. 2016. Measuring the difficulty of test items in computing science education. In: Dhanjal S, Ahmed F, editors. Proceedings of the 21st Western Canadian Conference on Computing Education - WCCCE '16. the 21st Western Canadian Conference; 5/5/2016 - 6/5/2016; Kamloops, BC, Canada. New York, New York, USA: ACM Press. p. 1–6.
- Lakshmikantha C, Minto M, Acuff J, Phebus R, Thippareddi H, Olewnik M, Milliken G. 2017. Validation of the baking process as a kill-step for controlling *Salmonella* in muffins. International Journal of Food Microbiology. 250:1–6. eng. doi:10.1016/j.ijfoodmicro.2017.03.007.
- Levine K, Chaifetz A, Chapman B. 2017. Evaluating food safety risk messages in popular cookbooks. British Food Journal. 119(5):1116–1129. doi:10.1108/BFJ-02-2017-0066.
- Liao C, Zhou X, Zhao D. 2018. An augmented risk information seeking model: perceived food safety risk related to food recalls. International Journal of Environmental Research and Public Health. 15(9). eng. doi:10.3390/ijerph15091800.
- Maughan C, Chambers E, Godwin S. 2017. Food safety behaviors observed in celebrity chefs across a variety of programs. Journal of Public Health (Oxf). 39(1):105–112. eng. doi:10.1093/pubmed/fdw026.
- McCallum L, Paine S, Sexton K, Dufour M, Dyet K, Wilson M, Campbell D, Bandaranayake D, Hope V. 2013. An outbreak of *Salmonella* Typhimurium phage type 42 associated with the consumption of raw flour. Foodborne Pathogene Disease. 10(2):159–164. eng. doi:10.1089/fpd.2012.1282.
- Morrison E, Young I. 2019. The missing ingredient: food safety messages on popular recipe blogs. Food Protection Trends. 39:28–39.
- Neil KP, Biggerstaff G, MacDonald JK, Trees E, Medus C, Musser KA, Stroika SG, Zink D, Sotir MJ. 2012. A novel vehicle for transmission of *Escherichia coli* O157:H7 to humans: multistate outbreak of *E. coli* O157:H7 infections associated with consumption of ready-to-bake commercial prepackaged cookie dough--United

States, 2009. Clinical Infectious Diseases. 54(4):511–518. eng. doi:10.1093/cid/cir831.

- Pillsbury. 2019. Flour Safety: what you need to know. United States. [accessed 06/26/2019]. https://www.pillsburybaking.com/flour-safety.
- Sánchez-Maldonado AF, Lee A, Farber JM. 2018. Methods for the control of foodborne pathogens in low-moisture foods. Annual Review of Food Science and Technology. 9:177–208. eng. doi:10.1146/annurev-food-030117-012304.
- Sciandra MR, Lamberton C, Reczek RW. 2017. The wisdom of some: do we always need high consensus to shape consumer behavior? Journal of Public Policy & Marketing. 36(1):15–35. doi:10.1509/jppm.14.123.
- Statista. 2019. Number of supermarkets and grocery stores in the U.S. 2011-2018, by format. United States.[updated 2019; accessed 05/07/2019]. https://www.statista.com/statistics/240892/number-of-us-supermarket-stores-byformat/.
- U.S. FDA, U.S. Food and Drug Administration. 2017a. Investigated multistate outbreak of shiga toxin-producing *E. coli* infections linke to flour. United States. [updated 1019; accessed 02/22/2019]. https://www.fda.gov/food/recallsoutbreaksemergencies/ outbreaks/ucm504192.htm.
- U.S. FDA, U.S. Food and Drug Administration. 2017b. Raw dough's a raw deal and could make you sick. [updated 2019; accessed 02/26/2019]. https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm508450.htm.
- U.S. FDA, U.S. Food and Drug Administration. 2019. All recalls. United States. [accessed 01/24/2019]. https://www.fda.gov/AJAX/All/.
- United States Census Bureau. 2018. Quick facts United States. United States. [updated 2019; accessed 07/03/2019]. https://www.census.gov/quickfacts/fact/table/US/IPE120217
- Vencia W, Gariano GR, Bianchi DM, Zuccon F, Sommariva M, Nguon B, Malabaila A, Gallina S, Decastelli L. 2015. A Salmonella enterica subsp. enterica serovar Enteritidis foodborne outbreak after consumption of homemade lasagne. Italian Journal of Food Safety. 4(4):5127. eng. doi:10.4081/ijfs.2015.5127.
- Woods R BC. 2016. Television celebrity chefs as role models for consumers' safe food handling in the home. Food Protection Trends. 36:443–457.
- WHO, World Health Organization. 2017. Food safety. [updated 2019; accessed 01/27/2019]. https://www.who.int/news-room/fact-sheets/detail/food-safety
- Zhang G, Ma L, Patel N, Swaminathan B, Wedel S, Doyle MP. 2007. Isolation of Salmonella Typhimurium from outbreak-associated cake mix. Journal of Food Protection. 70:997–1001.

# 7. APPENDICES

<b>Appendix 1.</b> Messages on flour package	ges.
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Message
"Do not eat raw mix, dough, or batter." **
"Do not eat raw batter." ***
"Do not consume raw flour, dough or batter." *
"Do not eat raw batter, dough or mix." *
"Don't eat raw batter or dough." *
"Do not eat raw biscuit dough. No coma la masa para biscuits cruda." *
"Do not eat or play with raw flour, dough or batter. Wash hand, utensils & surfaces after
handling." *
"Cook before sneaking a taste. Flour is raw. Please cook fully before enjoying. Flour is
not ready-to-eat and must be thoroughly cooked before eating. To prevent illness from
naturally occurring bacteria in wheat flour, do not eat or play with raw dough. Wash
hands and surfaces after handling." **
"Say no to raw dough: flour is a raw ingredient. Bake fully before enjoying." **
"Do not eat raw flour, dough, or batter. Flour is raw, please cook fully before enjoying."
*
"Do not eat raw dough." **
"Do not eat raw muffin batter." *
"Do not consume raw flour, dough or batter." ***

"Don't eat raw batter." \*\*

"Do not eat raw cake batter." \*\*

\*On the top of the package

\*\*On the middle of the package

Score	M1	M2
flour handling behavior.		
Appendix 2. Partition 1 "Eaters"	observed and expected scores for	or messages of a study on

Score	M1	M2
Ineffective	210	85
	*192.71	*102.29
Neutral	82	70
	*99.29	*52.71

\*Expected frequency

Score	M1	M2
Ineffective + Neutral	292	155
	*223.5	*223.5
Effective	371	508
	*439.5	*439.5

**Appendix 3.** Partition 2 "Eaters" observed and expected scores for messages of a study on flour handling behavior.

\*Expected frequency

**Appendix 4.** Partition 3 "Eaters" observed and expected scores for messages of a study on flour handling behavior.

Score	M1 + M2	M3
Ineffective	295	113
	*282.32	*125.68
Neutral	152	86
	*164.68	*73.32

\*Expected frequency

**Appendix 5.** Partition 4 "Eaters" observed and expected scores for messages of a study on flour handling behavior.

Score	M1 + M2	M3
Ineffective + Neutral	447	199
	*430.67	*215.33
Effective	879	464
	*895.33	*447.67

\*Expected frequency

**Appendix 6.** Partition 1 "Non-eaters" observed and expected scores for messages of a study on flour handling behavior.

Score	M1	M2
Ineffective	60	24
Neutral	*55.77 21	*28.23 17
	*25.23	*12.77

\*Expected frequency

Score	M1	M2
Ineffective + Neutral	81	41
	*61	*61
Effective	255	295
	*275	*275

**Appendix 7.** Partition 2 "Non-eaters" observed and expected scores for messages of a study on flour handling behavior.

\*Expected frequency

**Appendix 8.** Partition 3 "Non-eaters" observed and expected scores for messages of a study on flour handling behavior.

Score	M1 + M2	M3
Ineffective	122	41
	*115.40	*47.6
Neutral	38	25
	*44.60	*18.40

\*Expected frequency

**Appendix 9.** Partition 4 "Non-eaters" observed and expected scores for messages of a study on flour handling behavior.

Score	M1 + M2		M3	
Ineffective + Neutral	160	66		
		*153.40	*72.60	
Effective	550	270		
		*556.58	*263.40	

\*Expected frequency

Appendix 10. Questions for behavior score of a study on flour handling behavior.

Behavior	Score
How often do you eat or play with raw dough or batter?	1
Do you wash your hands with water and soap after handling flour/quick bread mix?	1
Do you clean the counter after using flour/quick bread mix?	1
What would you do if you hear about a flour/quick bread mix recall?	1
What would you do if the flour/quick bread mix you bought was recalled?	1
Total Score	5

Annendiv 11	Questions for	knowledge score	of a study of	n flour handling	hehavior
Appendix 11.	Questions for	Kilowieuge scole	Of a study 0.	n nour nanunng	Uchavior.

Knowledge	Score
Check which of the following food products do you believe have a	1
microbiological safety risk.	1
People can get food poisoning from eating raw cookie dough.	1
Harmful bacteria can survive in raw flour.	1
Bacteria can travel to different surfaces/utensils via flour.	1
Have you heard of any food recall related to flour or quick bread mix?	1
Total Score	5

# Appendix 12. Questions for risk average of a study on flour handling behavior.

Risk	Maximum average
What is the risk for you to get poisoning due to eating or playing with raw dough or batter?	7
Recalled product is likely to be sold in the grocery stores I often go to.	7
The flour or quick bread mix I use is likely to be recalled.	7
If I compare myself with an average person of my sex and age, then my risk of suffering from foodborne illness is low.	7
I am confident with my safe food handling of dry foods, like flour.*	7
Maximum average	7

\* If you are more confident you will perceive yourself lower risk for foodborne illness. The score was used in the opposite way for this statement.

**Appendix 13.** Recommendation of flour handling behavior of a study on flour handling behavior.

#### **FDA Recommendation**

Do not eat any raw cookie dough, cake mix, batter, or any other raw dough or batter product that is supposed to be cooked or baked.

Follow package directions for cooking products containing flour at proper temperatures and for specified times.

Wassh hands, work surfaces, and utensils thoroughly after contact with flour and raw dough products.

Keep raw foods separate from other foods while preparing them to prevent any contamination that may be present from spreading. Be aware that flour may spread easily due to its powdery nature.

Follow label directions to chill products containing raw douh promptly after purchase.

\*This information is from FDA (U.S. Food and Drug Administration 2017b).

## Appendix 14. Flour survey.

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#### SURVEY flour and quick bread mix

#### **SCREENER**

 $\Box$  Yes

 $\square$  No

• Are you the primary grocery shopper in the household?

No

No

Are you the primary food preparer in the household?

 $\square$  Yes

• Do you use either flour or quick bread mix at least once a month? Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour. Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

 $\Box$  Yes  $\Box$ 

*Note: For questions a), b) and c), the answer has to be yes to allow them to continue with the survey.* 

# Screeners & Quotas

*Q1. What is your gender?* 

- Male
- $\circ$  Female

• Prefer not to answer

Q2. What is your age?

o 18-24

- o 25-34
- o 35-44
- o 45-54
- o 55-64
- $\circ$  65 and above

Q3. Would you give us a guess of your total household's income (previous year) before taxes?

- o Less than \$10,000
- o *\$10,000 \$29,999*
- o *\$30,000 \$49,999*
- o *\$50,000 \$79,999*
- *\$80,000 and above*
- $\circ$  Prefer not to answer
- *Q4. What is your ethnicity?* 
  - White (non-Hispanic)
  - 0 Hispanic
  - o African American
  - o Asian
  - Other specify \_\_\_\_\_
  - Prefer not to answer
- Q5. What is your education level?
  - Not High School graduate
  - High School or GED Degree
  - Bachelor's Degree
  - Graduate Degree
  - Prefer not to answer

Q136. In which state do you currently reside?

(All the states are presented)

# Part I. Consumers and use of flour

Instructions: "Section I. In this section we want to understand how do you use your flour or quick bread mix."

*Q6. What type of flour or mix do you buy? (Select all that apply to you)* 

- □ All-purpose flour
- □ Whole wheat flour
- $\Box$  Bread flour
- □ *Quick Bread mix (like cookie mix, cake mix, biscuit mix, pancake mix, muffin mix, brownie mix)*
- $\Box$  Other, specify\_\_\_\_\_

Note: These questions (2-25) will be displayed depending on the answer in Q1.

Q = "quick bread mix"

#### We want to know more about how you purchase and use the quick bread mix.

*Q7.* When buying *quick bread mix*, where is your primary way to obtain it?

Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

- Grocery store
- *From a friend or family member*
- I mill my own flour
- Other, specify\_
- *Q8. How much of quick bread mix do you usually buy at once?*

Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

- 0 One
- o Two
- 0 Three
- o Four
- 0 Five
- Five or more

*Q9. How long does the quick bread mix last after each purchase?* 

- I use it all at once after I purchased it.
- One week or less
- Two weeks to a month
- $\circ$  1 to 6 months
- $\circ$  6 months to a year
- *More than a year*
- Q10. After the package of your quick bread mix is opened, how do you store it?

Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

- Sealed container at the room temperature.
- Sealed container in a refrigerator.
- Sealed container in a freezer.
- In the original package (unsealed) at the room temperature.
- In the original package (unsealed) inside the refrigerator.
- In the original package (unsealed) inside the freezer.
- Other, please specify\_

Q11. Do you wash the container where the **quick bread mix** was stored every time you purchase new quick bread mix? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q10) Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

- Yes
- o No
- Not sure

Q12. When storing **quick bread mix** in a container, what are the labels you use for the container? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q10) Quick bread mix: like cake mix cookie mix biscuit mix pancake mix muffin mix brownie

*Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.* 

- *I do not put any label on the container*
- *Type of flour*
- $\circ$  Brand
- Lot number
- Use by date
- Other, specify \_\_\_\_\_

Q = "bread flour"

#### We want to know more about how you purchase and use the bread flour.

Q13. When buying bread flour, where is your primary way to obtain it?

- Grocery store
- From a friend or family member
- I mill my own flour
- Other, specify\_\_

Q14. How much of bread flour do you usually buy at once?

1 pound = 16 ounces

2 pounds = 32 ounces

- 3 pounds = 48 ounces
- 4 pounds = 64 ounces
- 5 pounds = 80 ounces
- 10 pounds = 160 ounces
- 25 pounds = 400 ounces
  - Less than 1 pound
  - *Between 1 pound and 2 pounds (including 1 pound)Four*
  - Between 2 pounds and 3 pounds (including 2 pounds) Five or more
  - Between 3 pounds and 4 pounds (including 3 pounds)
  - *Between 4 pounds and 5 pounds (including 4 pounds)*
  - *Between 5 pounds and 10 pounds (including 5 pounds)*
  - Between 10 pounds and 25 pounds (including 10 pounds)
  - 25 pounds or more

Q15. How long does the bread flour last after each purchase?

- □ *I use it all at once after I purchased it.*
- $\Box$  One week or less
- $\Box$  Two weeks to a month
- $\Box$  1 to 6 months
- $\Box$  6 months to a year
- $\Box$  More than a year

Q16. After the package of your **bread flour** is opened, how do you store it?

- Sealed container at the room temperature.
- Sealed container in a refrigerator.
- Sealed container in a freezer.
- In the original package (unsealed) at the room temperature.
- In the original package (unsealed) inside the refrigerator.
- In the original package (unsealed) inside the freezer.
- Other, please specify \_

Q17. Do you wash the container where the **bread flour** was stored every time you purchase new flour? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q16)

- Yes
- o No
- Not sure

Q18. When storing **bread flour** in a container, what are the labels you use for the container? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q16)

- *I do not put any label on the container*
- Type of flour
- $\circ$  Brand
- Lot number
- Use by date
- Other, specify \_\_\_\_\_\_

# Q = "whole wheat flour"

# We want to know more about how you purchase and use the whole wheat flour.

Q19. When buying bread flour, where is your primary way to obtain it?

- Grocery store
- From a friend or family member
- *I mill my own flour*
- Other, specify\_\_\_

# Q20. How much of whole wheat flour do you usually buy at once?

- 1 pound = 16 ounces
- 2 pounds = 32 ounces
- 3 pounds = 48 ounces
- 4 pounds = 64 ounces
- 5 pounds = 80 ounces
- 10 pounds = 160 ounces
- 25 pounds = 400 ounces
  - Less than 1 pound
  - o Between 1 pound and 2 pounds (including 1 pound)Four
  - Between 2 pounds and 3 pounds (including 2 pounds)Five or more

- *Between 3 pounds and 4 pounds (including 3 pounds)*
- Between 4 pounds and 5 pounds (including 4 pounds)
- Between 5 pounds and 10 pounds (including 5 pounds)
- Between 10 pounds and 25 pounds (including 10 pounds)
- 25 pounds or more

Q21. How long does the whole wheat flour last after each purchase?

- I use it all at once after I purchased it.
- One week or less
- *Two weeks to a month*
- 0 1 to 6 months
- $\circ$  6 months to a year
- *More than a year*

## Q22. After the package of your whole wheat flour is opened, how do you store it?

- Sealed container at the room temperature.
- Sealed container in a refrigerator.
- Sealed container in a freezer.
- In the original package (unsealed) at the room temperature.
- In the original package (unsealed) inside the refrigerator.
- In the original package (unsealed) inside the freezer.
- Other, please specify \_

Q23. Do you wash the container where the **whole wheat flour** was stored every time you purchase new flour? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q22)

- Yes
- o No
- Not sure

Q24. When storing **whole wheat flour** in a container, what are the labels you use for the container? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q22)

- *I do not put any label on the container*
- Type of flour
- o Brand
- Lot number
- Use by date
- Other, specify \_\_\_\_\_\_

# Q = "all-purpose flour"

# We want to know more about how you purchase and use the all-purpose flour.

#### Q25. When buying all-purpose flour, where is your primary way to obtain it?

- Grocery store
- From a friend or family member
- I mill my own flour

• Other, specify\_\_\_\_\_

Q26. How much of all-purpose flour do you usually buy at once?

- 1 pound = 16 ounces
- 2 pounds = 32 ounces
- 3 pounds = 48 ounces
- 4 pounds = 64 ounces
- 5 pounds = 80 ounces
- 10 pounds = 160 ounces
- 25 pounds = 400 ounces
  - $\circ$  Less than 1 pound
  - *Between 1 pound and 2 pounds (including 1 pound)Four*
  - Between 2 pounds and 3 pounds (including 2 pounds) Five or more
  - Between 3 pounds and 4 pounds (including 3 pounds)
  - Between 4 pounds and 5 pounds (including 4 pounds)
  - Between 5 pounds and 10 pounds (including 5 pounds)
  - Between 10 pounds and 25 pounds (including 10 pounds)
  - 25 pounds or more

Q27. How long does the all-purpose flour last after each purchase?

- □ *I use it all at once after I purchased it.*
- $\Box$  One week or less
- $\Box$  Two weeks to a month
- $\Box$  1 to 6 months
- $\Box$  6 months to a year
- □ *More than a year*

Q28. After the package of your **all-purpose flour** is opened, how do you store it?

- Sealed container at the room temperature.
- Sealed container in a refrigerator.
- Sealed container in a freezer.
- In the original package (unsealed) at the room temperature.
- In the original package (unsealed) inside the refrigerator.
- In the original package (unsealed) inside the freezer.
- Other, please specify \_\_\_\_

Q29. Do you wash the container where the **all-purpose flour** was stored every time you purchase new flour? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q28)

- Yes
- o No
- Not sure

Q30. When storing **all-purpose flour** in a container, what are the labels you use for the container? (Only if "sealed container at the room temperature", or "sealed container in a refrigerator", or "sealed container in a freezer" is selected in Q28)

- I do not put any label on the container
- Type of flour

- $\circ$  Brand
- o Lot number
- Use by date
- Other, specify \_\_\_\_\_\_

#### **Baking** goods

*Q31.* What kind of baking goods do you make? (select all that apply)

- $\Box$  Cookies
- □ *Cake/muffin*
- $\Box$  Bread
- □ *Other, specify* \_\_\_\_\_
- $\Box$  I do not bake

#### Dough or batter

If Q31 = "cookies" or "cake/muffin" or "bread" or "other". Q32. How often do you eat or play with raw dough or batter?

- *Every time*
- Sometimes
- Rarely
- $\circ$  Never

*Q33. Please rate the following question.* 

What is the risk for you to get poisoning due to eating or playing with raw dough or batter?

Extremely Low	Very Low	Low	Natural	High	Very High	Extremely High
0	0	0	0	0	0	0

#### Part II. Safe flour handling knowledge and behavior

Instructions: "Section II. In this, some questions about food safety will be ask."

Q34. Check which of the following food products do you believe have a microbiological food safety risk. (Select all that apply to you)

 $\Box$  Raw cake mix

- □ *Raw bread dough*
- □ *Raw cookie dough*
- □ *Raw noodles*
- $\Box$  *Raw muffin mix*
- □ *Raw nuts*
- □ *Raw ground beef*
- □ *Raw chicken*

□ Uncooked fruit

□ *Raw vegetables* 

 $\Box$  Raw eggs

 $\Box$  All of the above

 $\Box$  None of the above

Q35. Do you wash your hands with water and soap **before** handling flour/quick bread mix? Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour. Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

 $\Box$  Yes

 $\Box$  No

 $\Box$  Not sure

Q36. Do you wash your hands with water and soap **after** handling flour/quick bread mix? Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour.

*Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.* 

 $\Box$  Yes

 $\Box$  No

 $\Box$  Not sure

*Q37.* Do you clean the counter **after** using flour/quick bread mix?

Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour.

*Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.* 

- $\Box$  Yes
- $\Box$  No

 $\Box$  Not sure

Q38. How do you clean your counter? (Only if "yes" is selected in Q37)

- Wiping the surface with a dry cloth.
- Wiping the surface with a dry paper towel.
- Wiping the surface with a damp cloth.
- Wiping the surface with a damp paper towel.
- Scrubbing the surface with soap and water.
- Wipe the surface with a sanitizer product (like Lysol, Clorox, Fantastik, Formula 409, Mr. Clean).
- Other, please specify\_\_\_\_\_

#### Part III. Flour recall knowledge and behavior

Instructions: "Section III. In this section we want to know how much knowledge do you have on recalls of flour or quick bread mix".

Q39. Please, select if the statement is 'True', 'False' or 'I don't know'.

	True	False	I don't know
People can get food poisoning from eating raw cookie dough.	0	0	0
Harmful Bacteria can survive in raw flour.	0	0	0
If you are paying attention, please select 'I don't know.'	0	0	Ο
Bacteria can travel to different surfaces/utensils via flour.	0	0	0

Q40. What information do you pay attention on a flour or quick bread mix package? Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour. Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

- $\Box$  Brand
- □ Non-GMO label
- □ Organic label
- $\Box$  Lot number
- $\Box$  Use by date
- □ Storage instruction
- $\Box$  Cooking instruction
- $\Box$  Recipe
- □ *Caution notice about food safety*
- □ Ingredient list
- $\Box$  Other, specify \_\_\_\_

Q.41 Please select in which point of the scale you consider yourself.

	Stron disag some	gly di ree; 1 what a	isagreo neither Igree;	e; diso · agre agree;	agree; e nor strong	some disa gly ag	ewhat gree; ree.
Recalled product is likely to be sold in the grocery stores I often go to.	0	0	0	0	0	0	0
be recalled.	0	0	0	0	0	0	0

Q42. Have you heard of any food recall related to flour or quick bread mix?

Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour. Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.

- 0 Yes
- o No
- Not sure

Q43. How did you hear about the recall? (Select all that apply to you) (Only if "yes" is selected in Q42)

- Official FDA website
- Official CDC website
- TV news.
- Newspaper
- Facebook
- Family or fiends
- Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians)
   Other, specify

*Q44.* What would you do if you hear about a flour/quick bread mix recall? (Select all that apply to you)

- *Check the brand and Lot number of my flour.*
- I do not care and I will continue using mine.
- *I will not buy flour for a while.*
- *I will advise my friends and families to stay away from all flour.*
- *I will throw away the flour at home no matter if it is related or not to the recall.*
- I don't know what to do.
- Other, specify\_

*Q45.* What would you do if the flour/quick bread mix you bought was recalled? (Select all that apply to you)

Flour: including all purpose flour, whole wheat flour, bread flour, cake flour.

*Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.* 

- *Put it in the garbage.*
- *Give it back to the facility that sold it to me.*
- *Leave it in my kitchen and continue using it.*
- *Clean and sanitize all kitchen surfaces that were contacted with the flour.*
- I don't know what to do.
- Other, specify\_\_

Q46. If the flour/quick bread mix you bought was in a recall related to bacteria contamination, what will you do after the flour/quick bread mix recall is over?

Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour.

*Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.* 

- *I will buy the same product from this brand immediately after the recall is done.*
- *I will buy the same product from a different brand for a few months before I go back to the recalled brand.*

- *I will never buy the same product from this brand any more, but I will buy different products from this brand.*
- *I will never buy any related products from this brand any more.*
- *None of above.*

Q47. If the flour/quick bread mix you bought was **NOT** in a recall related to bacteria contamination, what will you do after the flour/quick bread mix recall is over?

Flour: including all-purpose flour, whole wheat flour, bread flour, cake flour.

*Quick bread mix: like cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix.* 

- *I will continue to buy the product from my usual brand.*
- *I will not buy the product from any brand for a few months before I go back to buying the product.*
- *I will never buy product again.*
- None of above.

## Part IV. Message effectiveness

Instructions: "Section IV. We want to know your opinion about three food safety warnings messages".

Note: This section is divided in two main blocks, the people who eat or play (every time, sometime rarely) with dough or batter and the people who do not eat or play (never) with dough or batter. The answers that are linked are the ones of Q27 and Q28. For this section the 3 different messages and its questions should be presented randomized.

# Eater (1)

Q48. Read the following message. How effective is this message to prevent consumers from eating or playing with flour, dough or batter.

#### "Do not eat or play with flour, raw dough or batter."

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremel
Ineffective	Ineffective	Ineffective		Effective	Effective	Effective

0 0 0 0 0 0

Q49. Please rate the following statement.

This message made me more cautious about flour food safety.

Strongly disagree	Disagree	Somewhat disagree	Neither agree S nor disagree	Somewhat agree	Agree	Strongly agree
0	0	0	0	0	0	0

Q50. Please rate the following statement. Due to this statement, I will not eat raw dough or batter.

Strongly disagree	Disagree	Somewhat disagree	Neither a nor disag	gree S ree	Somewhat agree	Agree	Strongly agree
0	0	0	0	0	0	0	

Q51. Please rate the following statement. **Does this message can remind me not to eat or play with flour, dough or batter?** 

Strongly	Disagree	Somewhat	Neither agree S	omewhai	Strongly	
disagree		disagree	nor disagree	agree	agree	
0	0	0	0	0	0	0

#### Eater (2)

Q52. Read the following message. How effective is this message to prevent consumers from eating or playing with flour, dough or batter.

"Cook before sneaking a taste. Flour is raw. Please cook fully before enjoying. Flour is not ready-to-eat and must be thoroughly cooked before eating. To prevent illness from naturally occurring bacteria in wheat flour, do not eat or play with raw dough. Wash hands and surfaces after handling."

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
Ineffective	Ineffective	Ineffective		Effective	Effective	Effective

0 0 0 0 0 0 0

*Q53. Please rate the following statement. This message made me more cautious about flour food safety.* 

Strongly	Disagree	Somewhat	Strongly			
disagree		disagree	nor disagree	agree		agree
0	0	0	0	0	0	0

Q54. Please rate the following statement. Due to this statement, I will not eat raw dough or batter.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewha agree	t Agree	Strongly agree	
0	0	0	0	0	0	0	
Q55. Does this m	Please essage can t	rate remind me	e the <b>not to eat or pla</b>	iy with fl	following our, doug	h or batte	statement. <b>r?</b>
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewha agree	t Agree	Strongly agree	
0	0	0	0	0	0	0	
Eate	r (3)						

Q60. Read the following message. How effective is this message to prevent consumers from eating or playing with flour, dough or batter.

"Say no to raw dough: flour is a raw ingredient. Bake fully before enjoying."

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
Ineffective	Ineffective	Ineffective		Effective	Effective	Effective

0 0 0 0 0 0 0

#### *Q61. Please rate the following statement.*

# This message made me more cautious about flour food safety.

Strongly	Disagree	Somewhat	Neither agree S	omewhat Agree		Strongly
disagree		disagree	nor disagree	agree		agree
0	0	0	0	0	0	0

## *Q62. Please rate the following statement. Due to this statement, I will not eat raw dough or batter.*

Strongly	Disagree	Somewhat	Neither agree	Somewhat Agree		Strongly
disagree		disagree	nor disagree	agree		agree
0	0	0	0	0	0	0

Q63.	Please	rate	the	following	statement.
Does this	s message can remi	nd me not to	eat or play wi	th flour, dough or t	oatter?

Strongly	Disagree	Somewhat	Neither agree S	omewhat Agree	e Strongly
disagree		disagree	nor disagree	agree	agree

Ο

Ο

Ο

0

Non-eater (1)

Ο

Ο

Ο

Q64. Read the following message. How effective is this message to prevent consumers from eating or playing with flour, dough or batter. "Do not eat or play with flour, raw dough or batter."

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
Ineffective	Ineffective	Ineffective		Effective	Effective	Effective
0	0	0	0	0	0	0

*Q65. Please rate the following statement.* 

This message made consumers cautious about flour food safety.

Strongly	Disagree	Somewhat	Neither agree	e Somewhat Agree		Strongly
disagree		disagree	nor disagree	agree		agree
0	0	0	0	0	0	0

No-eater (2)

*Q66. Read the following message. How effective is this message to prevent consumers from eating or playing with flour, dough or batter.* 

"Cook before sneaking a taste. Flour is raw. Please cook fully before enjoying. Flour is not ready-to-eat and must be thoroughly cooked before eating. To prevent illness from naturally occurring bacteria in wheat flour, do not eat or play with raw dough. Wash hands and surfaces after handling."

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
Ineffective	Ineffective	Ineffective		Effective	Effective	Effective
0	0	0	0	0	0	0

*Q67. Please rate the following statement.* 

#### This message made consumers cautious about flour food safety.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
0	0	0	0	0	0	0

Non-Eater (3)

Q68. Read the following message. How effective is this message to prevent consumers from eating or playing with flour, dough or batter.

"Say no to raw dough: flour is a raw ingredient. Bake fully before enjoying."

Extremely	Moderately	Slightly	Neutral	Slightly	Moderately	Extremely
Ineffective	Ineffective	Ineffective		Effective	Effective	Effective
0	0	0	0	0	0	0

*Q69. Please rate the following statement. This message made consumers cautious about flour food safety.* 

Strongly	Disagree	Somewhat	Neither agree S	omewhat Agree		Strongly	
disagree		disagree	nor disagree	agree		agree	
0	0	0	0	0	0	0	

Q70. Where do you want this warning message to be on the package?

1. On top of the package.



2. On the middle of the package





3. On the side of the package

*4. None of the above* 

#### Part V. Trusted source for flour handling

Instructions: "Section V. This section is about popular recipes."

*Q71.* Which of the following media do you use for getting a cookie, bread or cake recipe? (Select all that apply to you)

 $\Box$  Cook books

 $\Box$  YouTube videos

 $\Box$  Blogs

 $\Box$  TV shows

□ *Flour/quick bread mix package* 

□ Flour company website (like, King Arthur, Gold medal, Betty Crocker, Pillsbury)

□ *Kitchen tool company website (like, William Sonoma and Kitchen Aid)* 

 $\Box$  None of above

Q72. Which cookbook's instruction do you trust more? (Only if "cook books" is selected in Q71)

• A newly published cooking books.

- A vintage or heritage cooking books.
- 0 Both
- $\circ$  Neither
- Not sure

*Q73.* Who is responsible for telling me that raw flour may contain bacteria that can make people sick?

- Government
- 0 Scientist
- *Flour company*
- *Health professional*
- School teacher
- Cookbook author
- YouTuber who created the recipe video
- Blogger who created the recipe blog
- Myself
- No one
- Other, Specify \_\_\_\_\_\_

# Part VI. Demographic information

Instructions: "Section VI. This is the last set of question; we want to know more about you."

Q74. Please select in which point of the scale you consider yourself.

Strongly disagree	Disagree	Somewhat disagree	Neither agree Somewha nor disagree agree		t Agree	Strongly agree
0	0	0	0	0	0	0

- a) If I compare myself with an average person of my sex and age, then my risk of suffering from foodborne illness is low.
- b) I am knowledgeable about food safety.
- *c) I am confident with my safe food handling of dry foods, like flour.*
- *d) If you are paying attention to this question, please select the second circle from the left.*

Q75. Do you have children or grandchildren from 5 years or younger?

- 0 Yes
- $\circ$  No

*Q76. Check all the statements that apply to you. (Only if "Yes" is selected in Q67)* 

- *I hold my children/grandchildren while cooking/baking.*
- *I let my children/grandchildren play with flour or dough.*
- *I let my children/grandchildren on the kitchen floor to play.*
- *I sit my children/grandchildren on the counter.*
- o I let my children/grandchildren taste the batter or dough.
- Other, specify \_\_\_\_\_\_