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Semi-Quantitative Evaluation of Protein Residues in Foods Using the FLASH™ Rapid Cleaning Validation Method

Complete names of authors and affiliations:

David A. Olds[1]*, Daniel Y. C. Fung[2], and Carol W. Shanklin[1]

[1] Department of Hotel, Restaurant, Institution Management and Dietetics
103 Justin Hall
Kansas State University
Manhattan, Kansas 66506-1404
*Author for Correspondence: TEL: 785-532-5513; FAX: 785-532-5522; E-MAIL: daveolds@ksu.edu

[2] Department of Animal Sciences and Industry
216E Call Hall
Kansas State University
Manhattan, Kansas 66506

Contribution No. 05-311-J, Kansas Agricultural Experimental Station, Manhattan, KS

Abstract:

Cross-contamination of food contact surfaces in retail foodservice establishments may result in outbreaks of foodborne illness. Traditional microbiological sampling collection methods using swab tests or agar surface tests to monitor cross-contamination can be time and cost prohibitive to restaurant operators. The purpose of this study was to develop an identification protocol for residual proteins on foodservice contact surfaces using rapid chemical detection methods. The FLASH™ Rapid Cleaning Validation device was used to detect residual traces (exposed for 0, 2, 4, 6, and 8-hours) of six different food samples (ground beef, ground turkey, ground pork, catfish, shredded cheddar cheese, and shredded vegetables) on plastic cutting boards. Catalase testing was performed concurrently with FLASH™ validation to add further estimation of potential biological activities. Results showed that meat, cheese, and vegetable samples were positive for the FLASH™ test and can provide semi-quantification using a RGB (Red-Green-Blue) color chart. In addition, catalase testing provided more selective identification of food samples. This study demonstrated the time savings and cost effectiveness of using rapid methods of monitoring food safety standards in a foodservice operation.

INTRODUCTION

Food safety has become an important issue in the United States (U.S.). According to the National Restaurant Association, 44 cents of every food dollar in the U.S. is spent away from home, accounting for an estimated $476 billion in retail foodservice sales during 2005 (NRA 2005). Therefore, food safety in all segments of the food chain is unquestionably important to all in society. The retail foodservice industry must take a leadership role in improving food safety in foodservice operations, in order to help assure the safety of the 70 billion meals served annually in the U.S. (NRA 2005).

The Centers for Disease Control and Prevention estimated that foodborne illnesses (FBI) cause "approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year. Known pathogens account for an estimated 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths….while unknown agents account for the remaining 62 million illnesses, 265,000 hospitalizations, and 3,200 deaths" (Mead *et al.* 1999). McNab (1998) estimated the cost of microbial food poisoning in the U.S. at $5 billion to $6 billion annually.

Between 1973 and 1999, a reported total of 15,831 foodborne illness outbreaks resulted in 447,483 cases of FBI, 20,119 hospitalizations, and 457 fatalities (U.S. GAO 2003). Of these 15,831 reported outbreaks, 53.5% originated in restaurants; 15.2% in private homes; 3.5% in schools; 23.4% in other locations; and 4.5% were of unknown origin (U.S. GAO 2003). The United States Department of Agriculture has estimated FBI to cost the U.S. between $7 billion and $37 billion annually (U.S. GAO 2002).

Despite a projected increase in restaurant sales from $426.1 billion in 2002, to $1 trillion in 2010, customer confidence in food safety is on the decline. Allen (2000) stated that 50% of

consumers rated the restaurant industry's ability to ensure food safety as excellent in 1995 compared to 39% in 2000. Customer perceptions of food safety and foodborne illness are influenced by media accounts of food-related outbreaks and the resulting publicized aftermath of expensive litigation and ruinous financial consequences.

Foodservice owners and operators increasingly are faced with maintaining high standards of food quality and food safety within their operations. Cross-contamination from food contact surfaces remains a serious challenge for restaurant operators. For example, food production typically reaches a peak during mealtimes, and busy foodservice employees may unintentionally neglect basic cleaning procedures, such as wiping a countertop or cleaning a cutting board. Food, kitchen utensils, and employee's hands may become cross-contaminated if exposed to unclean food contact surfaces, providing the potential to cause foodborne illness.

In a study conducted by Henroid *et al.* (2004), food contact surfaces were evaluated in Iowa schools using microbial standards based upon Food and Drug Administration (FDA) 1997 Food Code standards for cleaned and sanitized foodservice equipment (US PHS/FDA 1997). Standards of less than 1.3 $\log_{10}$ CFU/cm^2 for APC, less than 1.0 $\log_{10}$ CFU/cm^2 for *Enterobacteriaceae*, and less than 1.3 $\log_{10}$ CFU/cm^2 for *Staphylococcus aureus* were used as a basis for acceptability of food contact surfaces (Henroid *et al.* 2004). Thirty-six out of 40 food school kitchens evaluated had an acceptable number of colony forming units on food preparation surfaces. Despite these acceptable results, only four of the 40 operations met the standards for *all* tests on *all* surface areas sampled, including: (a) equipment; (b) handwashing sinks; (c) refrigerator handles; and (d) meal trays (Henroid *et al.* 2004). Fung and Goetsch (2004) suggested a microbiological scale for contact surfaces as: (a.) *low* - $10^{0\text{-}2}$ / cm^2, gm, ml, (b.)

intermediate – 10^{3-4} / cm^2, gm, ml, (c.) *high* - 10^{5-6} / cm^2, gm, ml, (d.) *index of spoilage* – 10^7 / cm^2, gm, ml, (e.) *odor* – 10^8 / cm^2, gm, ml, and (f.) *slime* – 10^9 / cm^2, gm, ml.

In another study by Toro (2005), foodservice employees' food handling behaviors were observed and compared with results obtained from food safety knowledge and attitude questionnaires administered to the same employees. The purpose of the study was to explore the relationships among food safety knowledge, attitudes, and behaviors. It was hypothesized that foodservice employees' knowledge and attitudes would positively influence food handling practices. However, the hypothesis was rejected with a lack of statistical support. This suggests that employee's prior participation in food safety training programs and high self-reported food safety knowledge may not always equate with good employee food safety performance during actual food production.

Regular sampling of foodservice environments for cleanliness validation is an effective way to monitor food safety standards and employees' food safety performance. However, it can also present challenges to foodservice operators, who must either hire an outside laboratory technician or commit company resources to train a designated employee to accurately conduct microbiological sampling. Furthermore, using traditional microbiological collection methods, such as swab sampling and agar contact methods (including storage and transport to a laboratory for analysis), can be time and cost prohibitive for restaurateurs.

An alternative to traditional microbiological sample collection is the use of rapid detection methods, which can assist foodservice operators in maintaining their standards of food quality at a minimal investment of time, training costs, and commitment of company resources. In a study by Snyder (2005), microbiological testing of foodservice contact surfaces in retail foodservice operations was performed initially to validate the efficacy of standard cleaning

processes. Petrifilm™ (3M, St. Paul, Minnesota) was selected for enumerating food contact surface samples primarily because Petrifilm™ is uncomplicated to use and foodservice employees can easily be trained to use it. The testing protocol and results were used to educate employees, validate new cleaning processes, and to increase morale of the kitchen staff through their involvement and empowerment in hazard identification and control in their foodservice operations (Snyder 2005). This study underscores the primary and peripheral advantages of employing rapid methods of detection in a foodservice operation to evaluate the effectiveness of standard operating cleaning procedures.

A quick and economical method for monitoring food safety in restaurants is the FLASH™ Rapid Cleaning Validation device (BioControl Systems, Bellevue, WA). Results from the FLASH™ device are immediately observable (in 10 seconds) and do not require further laboratory analysis. After swabbing, if the FLASH™ device tip changes from its original yellow color to a greenish-blue color, a positive result for the presence of residual protein is evident. Conversely, if the device tip shows no color change and remains a yellow color, results are negative for residual protein. The ability to inexpensively detect residual proteins on a food contact surface has application in maintaining food safety in retail foodservice establishments. Despite strong recommendations to use plastic cutting boards as an alternative to wooden cutting boards in foodservice operations to control for cross-contamination, plastic cutting boards can still retain microorganisms, such as *Campylobacter* spp., for an extended period of time (Wanyenya *et al.* 2005). Detection of residual proteins on a food contact surface may indicate the possibility of the presence of microorganisms, which can alert the foodservice operator to take corrective actions.

To our knowledge, there has been no published study using the FLASH™ Rapid Cleaning Validation device to evaluate commonly-used food contact surfaces (plastic cutting boards) contaminated with typical retail foodservice food samples. The paucity of research in this area served as impetus for this pilot study. The purpose of this study was to use the FLASH™ device to detect residual protein on plastic cutting boards using six food types. Quantification of color change in the FLASH™ detection tip for each food sample was conducted by comparing the color of the sampled detection tip to an established color chart in an attempt to selectively identify differing food types. Finally, an alternate form of rapid detection, catalase testing (Fung and Petrishko 1973), was run parallel with the FLASH™ testing to allow for a more in-depth analysis.

MATERIALS AND METHODS

FLASH™ units are available in a round container (2" [5.08 cm] diameter X 6" [15.24 cm] length). The activation compound is housed in a unit on the top portion of the container. To sample a food contact surface, a restaurant operator needs only to: (a) remove a pencil-like FLASH™ device from its portable container; (b) press the device tip on the container's built-in chemical activation pad for ten seconds; (c) swab a 2.5 cm x 4 cm (10 cm^2) food contact surface area; and (d) observe the device tip for a positive (greenish-blue) or negative (yellow or no color change) result. For this study, residual protein samples of ground beef, ground turkey, ground pork, raw catfish nuggets, shredded cheese and shredded vegetables (all obtained from local grocery stores) were tested with the FLASH™ Rapid Cleaning Validation device. Three replications were performed for each of the six tested residual proteins. Plastic Chop & Chop®

Flexible Cutting Boards (NAP Inc., Tallahassee, FL) measuring 11.5” x 15” (29.21 cm x 38.1 cm) were divided into ten 3” x 5.75” (7.62 cm x 14.61 cm) quadrants as shown in Figure 1. Quadrants 1 – 5 were used for testing food surface samples at 2-hour intervals. Quadrants 6 – 10 were kept clean and were used as control for the same 2-hour intervals.

Insert Figure I here

Only one food sample was tested per cutting board at a time. Each respective food sample was spread evenly over one half of the cutting board (14.61 cm x 38.1 cm), completely covering one of the quadrants labeled 1 – 5 (on Figure 1, this quadrant was labeled as the “dirty” upper half of the cutting board). Slight pressure was applied to each food sample to permit adherence to the cutting board surface. After five minutes of contact, the food sample was scraped off of the cutting boards using a sterile knife. Following the recommended protocol, one FLASH™ device was activated on a chemical activation pad for 10 seconds. A series of 2.5 x 4 cm (10 cm^2) areas were tested for Q1, Q2, Q3, Q4, and Q5 at respective 0, 2, 4, 6, and 8-hour intervals. A series of 10 cm^2 areas were also tested concurrently for Q6, Q7, Q8, Q9, and Q10 (labeled as the “clean” lower half of the cutting board as shown in Figure 1) at the same respective 0, 2, 4, 6, and 8-hour intervals and were used as control for the FLASH™ testing.

Color groups in the FLASH™ device were identified using established RGB (Red, Green, Blue) color quantification parameters (Wikipedia 2005). A RGB color chart assigns red, green, and blue numerical values to all colors in the color spectrum based on a scale ranging from 0 (no value) to 255 (maximum value). For example, the color yellow is quantified as 255, 255, 0 in RGB. This indicates that the maximum values of red (255) and green (255) and the minimal

value of blue (0) were combined to form the color yellow. A standardized RGB color chart was modified into an alphanumerical grid for rapid color coding during data collection (see Table 1). RGB alphanumeric values (visually derived from the color changes in the FLASH™ devices following swabbing) were plotted on the RGB chart and groupings of differing food types were identified.

In addition to the FLASH™ Rapid Cleaning Validation device, catalase testing was employed to further identify the presence of biological material on a foodservice surface. The catalase test is used to indicate presence of catalase positive microorganisms or catalase-like enzymes from biological sources such as blood, meat, saliva, etc. (Fung and Petrishko 1973, Phebus 2004).

Catalase testing was conducted concurrently with FLASH™ testing. Three replications were performed for each of the six tested residual proteins. Catalase testing was performed on samples that had not been previously swabbed with the FLASH™ device. A series of 2.5 x 4 cm (10 cm^2) areas were swabbed using a Q-tip moistened with 3% H_2O_2 for Q1, Q2, Q3, Q4, and Q5 at respective 0, 2, 4, 6, and 8-hour intervals. The identical procedure was also employed for Q6, Q7, Q8, Q9, and Q10 at the same respective 0, 2, 4, 6, and 8-hour intervals, and used as control for the catalase testing. Immediately following swabbing, all swabs were placed into their own individual test tube filled with 5 ml of 3% H_2O_2, and observed for catalase reaction. For the purpose of this experiment, a semi-quantitative scale was developed to assess the strength of the catalase reaction from 0 (no bubbles, indicating a negative result) to 5 (rapid bubbling, indicating a positive result). The catalase swab test was developed by Fung at the Kansas State University Food Microbiology Laboratory in 1991 (Kustyawati 1991). Qualitative observations of catalase reactions were also recorded.

RESULTS AND DISCUSSION

Table 1 presents the compiled results of the three replications of the FLASH™ testing. Data from all replications of FLASH™ testing were plotted on a RGB chart as shown in Table 2, and groupings of distinct types of food products (meats, cheese, vegetables) were elucidated. Slight variations between replications were indicated by minimal changes in color hue or brightness. This could be due to slight variance in purchased food samples, different lots of FLASH™ devices, and pressure applied during hand-swabbing. These variations also appear more conspicuous as result of a highly accurate RGB color chart that identifies minor fluctuations in color hue and brightness.

Interestingly, all meat samples showed similar color grouping, in a common location on the RGB color chart (Table 2). Turkey samples (T) were in C3 and C4 group. Pork samples (P) were in C3, C4, C5, D4, and D5 group. Ground beef samples (G) were in D3 and D4 group. Catfish samples (F) were in D3, D4, and D5 group. Furthermore, cheddar cheese samples (C), grouped under A16 and A17, were identified as having a distinct location on the RGB color chart, clearly separate from the meat and vegetable samples. Finally, vegetables (V) also occupied a common, distinct grouping on the RGB color chart, as A29 and A30. Because all three different types of food samples (meat, cheese, and vegetables) showed distinct and separate color groupings, it is not unreasonable to suggest that foodservice operators could identify distinct residual food types using the RGB color chart after testing food contact surfaces using the FLASH™ device.

Insert Tables 1 & 2 here

Catalase testing data provided further semi-identification of residual proteins on food contact surfaces (Table 1). Catalase activity comes from microorganisms or biological materials. Cheese and vegetables samples showed very little or no catalase activity, respectively, probably because of the presence of catalase negative lactic-acid bacteria in cheese and low adhesion of vegetable material on the cutting board. All meat samples showed robust catalase reactions. Although meat samples were grouped closely together on the RGB color chart, further selective identification of proteins found on food contact surfaces may be possible through proper interpretation of qualitative observations from the catalase testing. For all meat samples (0, 2, 4, 6, and 8-hours), swab samples immersed in 5 ml of 3% H_2O_2 bubbled rapidly, at regular intervals. However, the *size* of bubbles forming on the swab may provide further clues of the type of meat being tested, which may harbor different types of bacteria or numbers of bacteria. For example, low-fat meat samples (ground turkey and catfish) both showed small to medium sized bubbles adhering to swabs with rapid bubbling of small sized bubbles in the test tube. High-fat meat samples (ground beef and pork) developed large bubbles on swabs and showed rapid bubbling of medium to large sized bubbles. This phenomenon needs further testing.

An experienced foodservice operator (or a health inspector) may be able to make a semi-accurate assessment as to the type of protein on a food contact surface using a combination of the FLASH™ device and catalase testing. Furthermore, these two tests are an inexpensive investment to help monitor cleanliness in a foodservice operation. Individual FLASH™ tests are priced very reasonably, at approximately $2.00 per test. Catalase testing requires 5 ml of H_2O_2 (approximately $0.01) and one swab (approximately $0.01) per test. A one-time expense for

reusable 10 mm x 72 mm glass test tubes (approximately $0.50 each x 20 tubes = $10.00) and a test tube rack (approximately $15.00), will be necessary to conduct catalase testing. Therefore, for $2.02 in supplies (excluding one-time, sunk costs of $25.00), a manager can economically test the cleanliness of their foodservice establishment contact surfaces. In addition, testing procedures can be custom-tailored for individual establishments by using FLASH™ and catalase testing to develop a standard identification protocol for food samples commonly prepared in a given foodservice operation (e.g. hamburger, poultry, pork, seafood, dairy, or vegetable products).

In conclusion, this study has enhanced the application of the FLASH™ Rapid Cleaning Validation device through systematic RGB color coding for selected food samples and by the addition of catalase identification testing. Practical benefits of this study include inexpensive identification of biological material in a foodservice operation without the need for (and cost of) a professional microbiological laboratory. Furthermore, the ease of use, relatively simple training procedures, and rapid results may likely appeal to foodservice professionals interested in monitoring cleanliness in their operations using procedures outlined in this study. Future studies may explore the testing of different food samples on different food contact surfaces. In addition, future research could track time and cost savings for foodservice operators using FLASH™ Rapid Cleaning Validation combined with catalase testing and/or other rapid methods of microbiological testing.

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FIGURE I.
Cutting board diagram and photograph for food contact samples.

0 Hours	2 Hours	4 Hours	6 Hours	8 Hours
Dirty Q1	Dirty Q2	Dirty Q3	Dirty Q4	Dirty Q5
Clean Q6	Clean Q7	Clean Q8	Clean Q9	Clean Q10

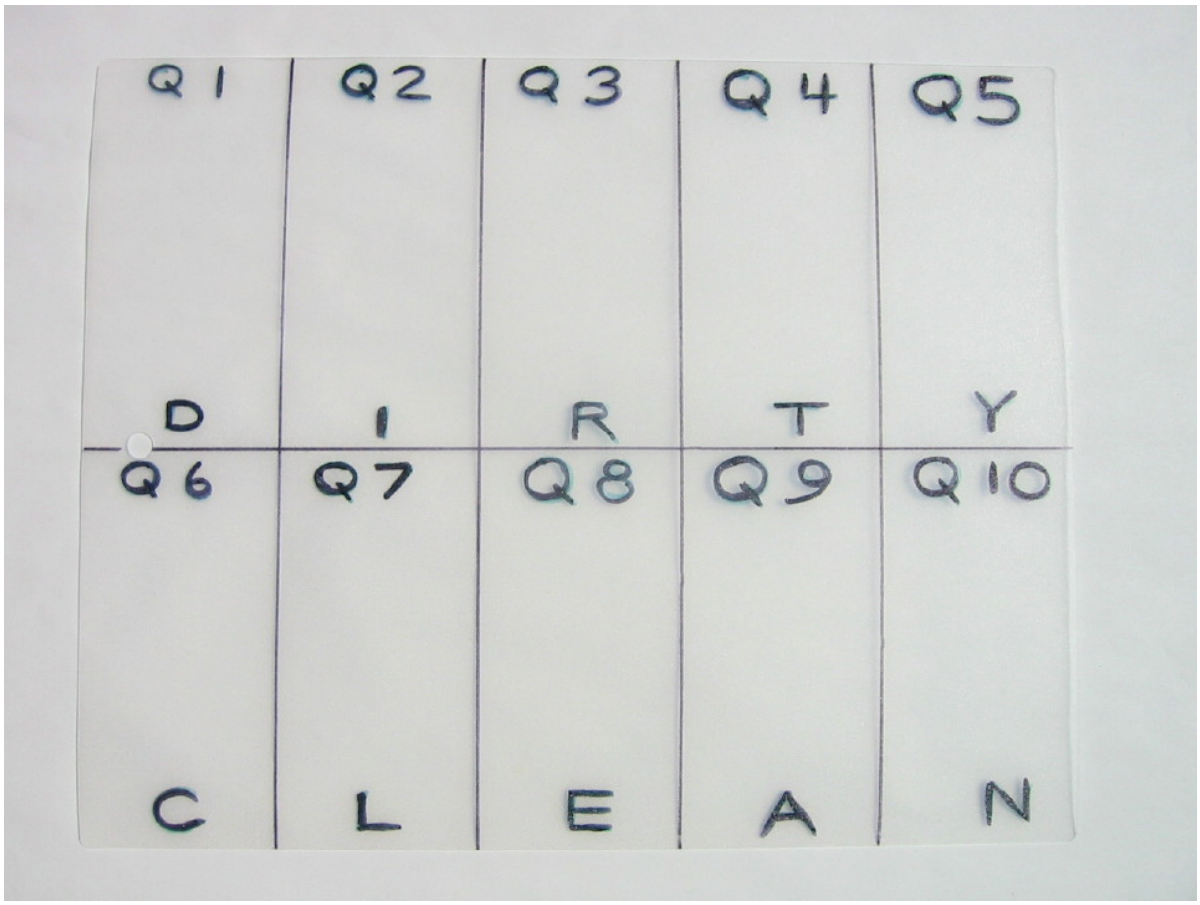

TABLE 1
Results of FLASH™ Rapid Cleaning Validation and Catalase Testing on Ground Beef, Ground Turkey, and Ground Pork

Sample	Quadrant	Time In Hours	RGB[1] Color Code			Catalase Activity		
			Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
Ground Beef[2]	Q1	0h	D4	D4	D3	5	5	5
" "	Q2	2h	D4	D3	D4	4	4	5
" "	Q3	4h	D4	D4	D4	5	5	5
" "	Q4	6h	D4	D3	D3	4	4	5
" "	Q5	8h	D4	D3	D4	4	4	4
Control	Q6	0h	N/C	N/C	N/C	0	0	0
"	Q7	2h	N/C	N/C	N/C	0	0	0
"	Q8	4h	N/C	N/C	N/C	0	0	0
"	Q9	6h	N/C	N/C	N/C	0	0	0
"	Q10	8h	N/C	N/C	N/C	0	0	0
Ground Turkey[3]	Q1	0h	C4	C3	C4	5	5	5
" "	Q2	2h	C4	C3	C3	5	5	5
" "	Q3	4h	C4	C4	C4	5	5	5
" "	Q4	6h	C4	C4	C4	5	5	4
" "	Q5	8h	C4	C4	C4	5	4	4
Control	Q6	0h	N/C	N/C	N/C	0	0	0
"	Q7	2h	N/C	N/C	N/C	0	0	0
"	Q8	4h	N/C	N/C	N/C	0	0	0
"	Q9	6h	N/C	N/C	N/C	0	0	0
"	Q10	8h	N/C	N/C	N/C	0	0	0
Ground Pork[4]	Q1	0h	D5	C5	C3	5	5	5
" "	Q2	2h	D5	C4	C3	5	4	5
" "	Q3	4h	D4	C4	C3	4	4	5
" "	Q4	6h	D4	C4	C3	4	4	5
" "	Q5	8h	D4	C4	C3	4	4	4
Control	Q6	0h	N/C	N/C	N/C	0	0	0
"	Q7	2h	N/C	N/C	N/C	0	0	0
"	Q8	4h	N/C	N/C	N/C	0	0	0
"	Q9	6h	N/C	N/C	N/C	0	0	0
"	Q10	8h	N/C	N/C	N/C	0	0	0

N/C = No change in color = negative FLASH™ test

[1] Slight variations between replications were indicated by minimal changes in color hue. This could be due to slight variance in food samples, FLASH™ devices, and pressure applied during swabbing. These variations may appear more conspicuous as result of a highly accurate RGB color chart that identifies minor fluctuations in color hue.
[2] Large-sized bubbles adhering to swab; large bubbles at regular intervals; catalase positive (+)
[3] Small to medium-sized bubbles adhering to swab; small bubbles at regular intervals; catalase positive (+)
[4] Medium to large-sized bubbles adhering to swab; medium/large bubbles at regular intervals; catalase positive (+)

TABLE 1 - continued
Results of FLASH™ Rapid Cleaning Validation and Catalase Testing on Catfish, Cheddar Cheese, and Vegetables

Sample	Quadrant	Time In Hours	RGB[1] Color Code			Catalase Activity		
			Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
Catfish[5]	Q1	0h	D4	D4	D3	5	5	5
"	Q2	2h	D4	D4	D3	5	5	5
"	Q3	4h	D4	D5	D4	5	5	5
"	Q4	6h	D4	D4	D4	5	5	5
"	Q5	8h	D5	D4	D4	5	5	5
Control	Q6	0h	N/C	N/C	N/C	0	0	0
"	Q7	2h	N/C	N/C	N/C	0	0	0
"	Q8	4h	N/C	N/C	N/C	0	0	0
"	Q9	6h	N/C	N/C	N/C	0	0	0
"	Q10	8h	N/C	N/C	N/C	0	0	0
Cheddar Cheese[6]	Q1	0h	A17	A17	A17	0	0	0
" "	Q2	2h	A16	A17	A17	0	0	0
" "	Q3	4h	A17	A16	A16	0	0	0
" "	Q4	6h	A16	A16	A16	0	0	0
" "	Q5	8h	A16	A17	A17	0	0	0
Control	Q6	0h	N/C	N/C	N/C	0	0	0
"	Q7	2h	N/C	N/C	N/C	0	0	0
"	Q8	4h	N/C	N/C	N/C	0	0	0
"	Q9	6h	N/C	N/C	N/C	0	0	0
"	Q10	8h	N/C	N/C	N/C	0	0	0
Vegetables[7]	Q1	0h	A30	A30	A30	0	0	0
"	Q2	2h	A29	A30	A30	0	0	0
"	Q3	4h	A29	A30	A30	0	0	0
"	Q4	6h	A30	A30	A30	0	0	0
"	Q5	8h	A30	A30	A30	0	0	0
Control	Q6	0h	N/C	N/C	N/C	0	0	0
"	Q7	2h	N/C	N/C	N/C	0	0	0
"	Q8	4h	N/C	N/C	N/C	0	0	0
"	Q9	6h	N/C	N/C	N/C	0	0	0
"	Q10	8h	N/C	N/C	N/C	0	0	0

N/C = No change in color = negative FLASH™ test

[1] Slight variations between replications were indicated by minimal changes in color hue. This could be due to slight variance in food samples, FLASH™ devices, and pressure applied during swabbing. These variations may appear more conspicuous as result of a highly accurate RGB color chart that identifies minor fluctuations in color hue.
[5] Small-sized bubbles adhering to swab; small bubbles & rapid "fizzing" at regular intervals; catalase positive (+)
[6] No bubbles; although lots of protein, lactic acid bacteria is catalase negative (-)
[7] No bubbles; low protein and low adhesion to cutting board surface; catalase negative (-)

TABLE 2.
Data From All Replications of FLASH™ Testing, Plotted on a RGB Color Chart*

	A	B	C	D	E	F
1	A1	B1	C1	D1	E1	F1
2	A2	B2	C2	D2	E2	F2
3	A3	B3	C3 **T(3), P(5)**	D3 **G(5), F(2)**	E3	F3
4	A4	B4	C4 **T(12), P(4)**	D4 **G(10), P(3), F(11)**	E4	F4
5	A5	B5	C5 **P(1)**	D5 **P(2), F(2)**	E5	F5
6	A6	B6	C6	D6	E6	F6
7	A7	B7	C7	D7	E7	F7
8	A8	B8	C8	D8	E8	F8
9	A9	B9	C9	D9	E9	F9
10	A10	B10	C10	D10	E10	F10
11	A11	B11	C11	D11	E11	F11
12	A12	B12	C12	D12	E12	F12
13	A13	B13	C13	D13	E13	F13
14	A14	B14	C14	D14	E14	F14
15	A15	B15	C15	D15	E15	F15
16	A16 **C(7)**	B16	C16	D16	E16	F16
17	A17 **C(8)**	B17	C17	D17	E17	F17
18	A18	B18	C18	D18	E18	F18
19	A19	B19	C19	D19	E19	F19
20	A20	B20	C20	D20	E20	F20
21	A21	B21	C21	D21	E21	F21
22	A22	B22	C22	D22	E22	F22
23	A23	B23	C23	D23	E23	F23
24	A24	B24	C24	D24	E24	F24
25	A25	B25	C25	D25	E25	F25
26	A26	B26	C26	D26	E26	F26
27	A27	B27	C27	D27	E27	F27
28	A28	B28	C28	D28	E28	F28
29	A29 **V(2)**	B29	C29	D29	E29	F29
30	A30 **V(13)**	B30	C30	D30	E30	F30
31	A31	B31	C31	D31	E31	F31
32	A32	B32	C32	D32	E32	F32
33	A33	B33	C33	D33	E33	F33
34	A34	B34	C34	D34	E34	F34
35	A35	B35	C35	D35	E35	F35
36	A36	B36	C36	D36	C36	F36

*Source: <www.theodora.com/html_colors.html>, used with permission (Coutsoukis 1998). Go to website to view specific colors.

Rows: 1 → 36 (Red color values increase); Columns: A → F (Blue color values increase).
RGB (Red, Green, Blue) values for data-identified cells: A16 (102, 153, 0); A17 (102, 204, 0); A29 (204, 204, 0); A30 (204, 255, 0); C3 (0, 102, 102); C4 (0, 153, 102); C5 (0, 204, 102); D3 (0, 102, 153); D4 (0, 153, 153); D5 (0, 204, 153).

Key: G = Ground Beef T = Turkey P = Pork
F = Catfish C = Cheddar Cheese V = Vegetables
Number of occurrences are shown in parenthesis (#).