A Rapid, Presumptive Procedure for the Detection of *Salmonella* in Foods and Food Ingredients

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A rapid detection procedure was developed in which a lysine-iron-cystine-neutral red (LICNR) broth medium, originally described by Hargrove et al. in 1971, was modified and used to detect the presence of viable *Salmonella* organisms in a variety of foods, food ingredients, and feed materials by using a two-step enrichment technique. Tetrathionate broth was used to enrich samples with incubation at 41 C for 20 hr, followed by transfer to LICNR broth and incubation at 37 C for 24 hr for further enrichment and for the detection of *Salmonella* organisms by color change. One hundred ten samples representing 18 different sample types were evaluated for the presence of viable *Salmonella*. Ninety-four percent of the samples found to be presumptive positive by this method were confirmed as positive by a culture method. Fluorescent-antibody results also compared closely. A second study was conducted under quality-control laboratory conditions by using procedures currently employed for *Salmonella* detection. One hundred forty-three samples representing 19 different sample types were evaluated for the presence of viable *Salmonella*. No false negatives were observed with the rapid-detection method. The usefulness of the LICNR broth procedure as a screening technique to eliminate negative samples rapidly and to identify presumptive positive samples for the presence of viable *Salmonella* organisms was established in this laboratory.

For some time the food industry has needed a rapid, simple, economic, presumptive *Salmonella* detection procedure that could be performed in reduced elapsed test time on large numbers of samples to eliminate negative samples early in the course of examination with minimal fear of false negatives. In addition, such a test should be incorporated easily into the standard *Salmonella* detection procedures (Association of Official Analytical Chemists [AOAC]; U.S. Department of Agriculture [USDA]; Bacteriological Analytical Manual [BAM]; American Public Health Association [APHA]) currently used in food plants without the use of special equipment, antisera, or specially trained personnel.

Culture methods currently used in quality-control laboratories require a minimum of 3 to 4 days for presumptive results. Further biochemical testing requires another 2 to 3 days before the presumptive positive for *Salmonella* can be confirmed as positive. The enrichment serology (15, 16) and fluorescent-antibody (FA) procedures, although more rapid than conventional techniques, require special equipment and antisera. A person having considerable experience with these techniques is usually needed to perform these tests.

A simpler culture method for the rapid detection of *Salmonella* was described by Hargrove et al. (6). This procedure was developed primarily for detecting *Salmonella* in dairy products in a single enrichment step and was tested extensively with known *Salmonella* standards. The purpose of this study was to evaluate this procedure and to modify the technique for routine testing of a variety of foods, food ingredients, and feed materials for the presence of viable *Salmonella*.

**MATERIALS AND METHODS**

**Cultures.** *Salmonella* cultures (*S. montevideo, S. senftenberg, S. senftenberg 775W, and S. typhimurium*) were used in this study. Representative strains of other *Enterobacteriaceae* (*Enterobacter, Escherichia, Shigella, Citrobacter, and Proteus*) were used also to determine the specificity of the method.
Medium. The medium, lysine-iron-cystine-neutral red broth (LICNR), of Hargrove et al. (6) was modified as follows: (i) mannitol was substituted for lactose, (ii) a combination of L-lysine mono- and dihydrochlorides (8:2) was used instead of the monohydrochloride, and (iii) novobiocin was used at two concentrations, either zero added or at concentrations of 10 to 15 μg/ml of broth. The modified LICNR broth had the following composition: 10 g of L-lysine mono- and dihydrochlorides (8:2), 5 g of tryptone, 3 g of yeast extract, 5 g of mannitol, 1 g of glucose, 1 g of salicin, 0.5 g of ferric ammonium citrate, 0.1 g of sodium thiosulfate, 0.1 g of L-cystine, 0.025 g of neutral red, and 1 liter of distilled water. The medium was adjusted to pH 6.2 (1 N NaOH), dispensed in 10-ml quantities in metal-capped tubes, and autoclaved at 121 C for 15 min.

The ability of this modified medium to differentiate Salmonella from non-Salmonella was determined with pure cultures, and its ability to detect Salmonella in various food materials was further confirmed. The basis of this test is a pH response to an indicator dye and formation of a black precipitate when hydrogen sulfide-producing salmonellae are present. All cultures which showed a color change from red to yellow in the LICNR broth after incubation at 37 C for 24 hr were further tested to eliminate the possibility that non-hydrogen sulfide-forming salmonellae were present. This test was accomplished by incubating for another 16 to 24 hr and then adding 0.1 ml of a 0.3% bromothymol blue solution to each tube and recording the color change. When salmonellae were present, the medium changed from yellow to dark green or blue, indicating an alkaline reaction. Color differences were obvious immediately. False results were observed to occur when the modified LICNR broth was incubated beyond 36 hr prior to testing with bromothymol blue.

The bromothymol blue solution was prepared by mixing 0.3 g of bromothymol blue powder with 2 ml of 0.1 N NaOH and diluting to 100 ml with 50% ethanol in distilled water.

Salmonella antiserum. The antiserum used in this study for the direct FA technique was a commercially prepared polyvalent antiserum (Difco “poly”) which had been prepared from motile organisms representative of somatic groups A through S including 0 factors 25, 27, 28, 30, 34 through 41, 45, and 61. The flagellar spectrum included H antigens a through i, n, p, r through w, and y through z. The antiserum was rehydrated by the addition of 5 ml of distilled water and diluted 1:2 to obtain the proper staining titer.

Microscopic examination. A Reichert “Zetopan” immunofluorescence research microscope, equipped with a mercury vapor light source, BG12 ultraviolet filter, and a X97 oil-immersion objective with iris diaphragm, was used.

Test samples. Where possible, samples naturally contaminated with Salmonella were used in this study. In the case of cheddar cheese and powdered milk, Salmonella at 2 to 5 g was added because no naturally contaminated samples were available.

Known culture assays. Viable cultures were inoculated directly into the presumptive broth and incubated up to a maximum of 48 hr. Broths were observed for characteristic color changes and blackening of the medium during incubation.

Foods and food ingredient assays. In the first study samples were enriched using 50 g of food material and 450 ml of tetrathionate broth. Enrichments were incubated at 41 C (±0.5 C) for 20 hr. Following primary enrichment, 1 ml of each enrichment culture was placed into tubes containing 10 ml of the modified presumptive LICNR broth. A similar amount of primary enrichment culture was placed into tubes containing an equal amount of tetrathionate broth (secondary enrichment). Both secondary enrichments (presumptive LICNR and tetrathionate broths) were incubated at 37 C for 24 hr. Cultural testing was performed by streaking these secondary enrichments on Hektoen agar (10) plates. The Hektoen agar plates were incubated at 37 C for 18 to 20 hr. Presumptive colonies (blue-green to blue with or without black centers) picked from Hektoen agar were tested biochemically by placing onto slants of dulcitol lysine iron agar (DLIA) described by Taylor (17), and onto lysine iron agar (LIA) as described by Edwards and Fife (3). Slant and butt reactions were observed after incubation at 37 C for 24 hr. Typical Salmonella reactions on these agars are for DLIA: alkaline (red) slant, hydrogen sulfide blackening, and fractured acid (yellow) butt; and for LIA: alkaline slant (red) and alkaline butt with hydrogen sulfide blackening. DLIA slants which gave reactions characteristic of Salmonella were serologically tested with Difco polyvalent O and H Salmonella antisera (2). A small amount of each slant growth was mixed with a drop of the rehydrated antiserum on a glass slide. Samples were considered positive if a tight granular precipitate was observed in 30 sec.

FA results were obtained from smears made from presumptive broths after characteristic blackening of the medium occurred. Agar-coated slides were used to help retain the bacterial cells during staining and washing. Smears were fixed in an ethanol-chloroform-formaldehyde solution (6:3:1) for 5 min. Staining was accomplished (direct technique) using Difco fluorescein conjugated “poly” Salmonella antiserum. Smears were stained for 30 min followed by rinsing twice in a phosphate-buffered solution (Difco), pH 7.2. After the excess antiserum had been washed free, the slides were rinsed in distilled water and allowed to air dry. Dried smears were mounted using buffered glycerol, pH 8.6, and examined for fluorescence. A smear was considered positive for Salmonella if bright, typically rod-shaped bacteria exhibiting +3 to +4 fluorescence (5) with or without attached flagella were present (4, 18).

In the second study, samples were pre-enriched using 25 g of food material and 225 ml of lactose broth. Samples were blended for 2 min at high speed using an Oster blender. The pre-enrichment culture was incubated at 35 C for 20 to 24 hr. Following pre-enrichment, 1 ml of each enrichment culture was placed into tubes containing 10 ml of tetrathionate broth and incubated at 35 C for 20 to 24 hr. After secondary enrichment in tetrathionate broth, 1 ml of each enrichment was placed in tubes containing 10 ml of the LICNR broth. Novobiocin was used during
enrichment as follows: (i) at zero and at 10 to 15 μg/ml in the LICNR broth and (ii) at zero and at 10 to 15 μg/ml in the tetrathionate broth enrichment. Samples were tested culturally by streaking the tetrathionate broth enrichments without novobiocin added onto Hektoen agar plates and picking typical colonies. These were then identified biochemically and serologically as previously described.

RESULTS AND DISCUSSION

Cultures of various known Salmonella and known type species of non-Salmonella were used in this study to evaluate the modified LICNR broth and to verify the results obtained by Hargrove et al. (6). Freshly grown cultures were inoculated into the modified LICNR presumptive broth. Color reactions were observed at 2-hr intervals. Salmonella were readily differentiated from related enteric bacteria except for Arizona. Results obtained (Table 1) were similar to those observed by Hargrove et al. Most known Salmonella produces a massive black precipitate. Arizona was observed to produce identical reactions to Salmonella. A hydrogen sulfide-negative Salmonella strain (S. senftenberg 775W) turned the presumptive broth yellow without blackening of the medium but was detected by the use of the bromothymol blue indicator which formed a green ring at the top of the tube. Pure cultures of Shigella, Enterobacter, Proteus, and Citrobacter did not change the red color of the LICNR broth. Species of Escherichia changed the LICNR broth from red to yellow without blackening. Escherichia could be distinguished from hydrogen sulfide-negative Salmonella by the fact that no green or blue color was produced upon addition of the bromothymol blue indicator. Food samples which turned the presumptive broth yellow and subsequently were tested for the presence of hydrogen sulfide-negative Salmonella did not give a clear-cut color result. In cases during incubation, competing non-Salmonella were able to raise the pH of the LICNR broth enough to cause questionable color results. This problem became almost non-existent in the later study when novobiocin was used. It should be also pointed out that hydrogen sulfide-negative Salmonella constitute less than 0.5% of all known salmonellas (6, 11). These types have not normally been encountered in foods and food ingredients in this laboratory.

An attempt was made to utilize the procedure as described by Hargrove et al. (6) for a rapid Salmonella detection procedure for foods, food ingredients, and feed materials. However, some food materials were observed to mask and interfere with the color reactions of the presumptive broth. To overcome that problem, the presumptive LICNR broth was used as a secondary enrichment medium and presumptive indicator. All materials were enriched in tetrathionate broth at 41 C because with feed samples this temperature appeared to be optimal for Salmonella detection and isolation. Other workers (1, 7, 12) have also reported that

Original Design

Sample

| Enrichment in | LICNR broth 37 C for presumptive result |
|---------------|------------------------------------------|
| tetrathionate broth 41 C | Cultural results |

Modification 1

Sample

| Pre-enrichment | Selective enrichment |
|----------------|----------------------|
| lactose broth 35 C | Tetrathionate broth 35 C |
| (with and without novobiocin) | LICNR Cultural |
| presumptive results |

Modification 2

Sample

| Pre-enrichment | Selective enrichment |
|----------------|----------------------|
| lactose broth 35 C | Selective enrichment tetrathionate broth 35 C with Nb (10 to 15 μg/ml) |
| presumptive results | LICNR presumptive results |

Fig. 1. Experimental procedure for detection of Salmonella. Nb, novobiocin.
elevated temperature incubation aided in *Salmonella* detection.

Presumptive results were obtained within 32 to 38 hr. Samples that were obtained to contain *Salmonella* by conventional cultural procedures produced a massive black precipitate in the presumptive LICNR broth. Even when high levels of coliforms and *Proteus* species were present, the presence of *Salmonella* was readily indicated by loss of color and blackening of the medium. In 20% of the samples tested, some difficulty was encountered in detecting *Salmonella* by conventional cultural procedures.

Eighteen different types of samples were evaluated for the presence of viable *Salmonella*. These samples included chicken parts, feed materials, powdered milk, raw frozen meats, pure culture slants, and environmental swabs. A positive correlation between this presumptive test and cultural results was obtained. (Table 2). Ninety-four percent of the samples found to be presumptively positive by this method was confirmed by cultural methods (AOAC, USDA, BAM, APHA). Of 110 samples tested, 58% were found to be positive for *Salmonella* by cultural methods as opposed to 62% with LICNR broth. Of the 110 samples tested only 50 were evaluated by all three techniques in parallel: cultural, FA, and the presumptive LICNR method. *Salmonellae* were found in 76% of those 50 samples by the cultural method and in 82% by both the FA and presumptive LICNR broth methods. The high percentage of samples positive for *Salmonella* by all techniques was due to the fact that samples were obtained as presumptive positives from previous screening programs. We think the difference between cultural results and those obtained by the presumptive and FA methods may have been due to the inability of the cultural method to detect *Salmonella* in the presence of high numbers of non-*Salmonella* organisms. False-positive results have been encountered by the FA method due to the presence of non-*Salmonella* organisms which share common antigens with *Salmonella* and consequently fluoresce (8).

The presumptive LICNR broth, after hydrogen sulfide development, yielded smears that exhibited extremely bright (+3 to +4 fluorescence) peripheral staining. Many smears also exhibited excellent flagellar staining. FA smears in a few instances contained low numbers of fluorescing cells, indicating that low levels of *Salmonella* were present in some of the final enrichments. Similar results were observed by Reamer and Hargrove (14).

Tetraionate broth was used in this study because it has been found to be the single most suitable enrichment medium for use in this laboratory. Tetraionate broth allows the enrichment of most *Salmonella* while inhibiting many of the unwanted organisms present in foods and food material (13).

The combination of mono- and dihydrochlo-

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**Table 1. Pure culture reactions of various organisms in the modified lysine-iron-cystine-neutral red presumptive broth**

| Culture              | Incubation for 18 hr at 37 C | Incubation for 42 hr at 37 C |
|----------------------|------------------------------|------------------------------|
|                      | Color                        | Black ppt*                   | Color                        | Black ppt |
| *Citrobacter* 1      | Red                          | –                            | Red                          | –         |
| *Citrobacter* 2      | Red                          | –                            | Red to orange                | –         |
| *Citrobacter* 3      | Red                          | –                            | Red                          | –         |
| *Citrobacter* 4      | Amb to red                   | –                            | Yellowish                    | –         |
| *Citrobacter* 5      | Amb to yellow                | –                            | Yellowish                    | –         |
| *Escherichia coli* 1 | Amb to yellow                | –                            | Yellow                       | –         |
| *E. coli* 2          | Amb to yellow                | –                            | Yellow                       | –         |
| *H₂S Proteus* 1      | Red                          | –                            | Red to yellow                | –         |
| *Proteus* 2          | Red                          | –                            | Red                          | –         |
| *H₂S Proteus* 3      | Red to brown                 | –                            | Brownish                     | –         |
| *Pseudomonas*        | Yellow                       | –                            | Yellow to brown              | –         |
| *Arizona*            | Straw color                  | +                            | Black to blue                | +         |
| *Salmonella* montevideo* | Straw color                  | +                            | Black to blue                | +         |
| *S. senftenberg*     | Straw color                  | +                            | Black to blue                | +         |
| *S. senftenberg* (775W) | Yellow                     | –                            | Bluish green*                | –         |
| *S. typhimurium*     | Straw color                  | +                            | Black to blue                | +         |

*Black precipitate not formed, –; black precipitate formed, +.

*Color change with addition of bromthymol blue solution.*
DETECTION OF SALMONELLA IN FOODS

Table 2. Comparison of Salmonella detection methods for food samples and ingredients*

| Sample type            | No. tested | Modified LICNR broth presumptive results | Cultural† procedure results | FA results‡ |
|------------------------|------------|------------------------------------------|-----------------------------|-------------|
|                        |            | Pos. | Neg. | Pos. | Neg. | Pos. | Neg. |
| Batter mix             | 4          | 1    | 3    | 0    | 4    | 1    | 3    |
| Biben meat             | 13         | 13   | 0    | 13   | 0    | 13   | 0    |
| Cheddar cheese         | 2          | 1    | 1    | 1    | 1    | 1    | 1    |
| Chicken breasts        | 4          | 2    | 2    | 2    | 2    | —    | —    |
| Chicken drumsticks     | 2          | 2    | 0    | 2    | 0    | —    | —    |
| Chicken gizzards       | 3          | 3    | 0    | 3    | 0    | —    | —    |
| Chicken livers         | 10         | 10   | 0    | 10   | 0    | 10   | 0    |
| Chicken livers         | 14         | 12   | 2    | 12   | 2    | —    | —    |
| Cocoa                  | 1          | 0    | 1    | 0    | 1    | —    | —    |
| Corn                   | 2          | 0    | 2    | 0    | 2    | —    | —    |
| Feed materials         | 18         | 8    | 10   | 7    | 11   | —    | —    |
| Feed materials         | 7          | 5    | 2    | 3    | 4    | 5    | 2    |
| Hydrolysate            | 2          | 0    | 2    | 0    | 2    | —    | —    |
| NFDM§                  | 2          | 1    | 1    | 1    | 1    | 1    | 1    |
| Noodles                | 5          | 5    | 0    | 5    | 0    | 5    | 0    |
| Pet food mix           | 2          | 0    | 2    | 0    | 2    | —    | —    |
| Pork sausage           | 2          | 0    | 2    | 0    | 2    | —    | —    |
| Slants                 | 2          | 2    | 0    | 2    | 0    | 2    | 0    |
| Swabs (peptone water)  | 5          | 3    | 2    | 3    | 2    | 3    | 2    |
| Swabs (tet broth)      | 9          | 0    | 9    | 0    | 9    | —    | —    |
| Turkey hearts          | 1          | 0    | 1    | 0    | 1    | —    | —    |

*Subtotals for samples tested: No. tested, 50; (presumptive method) positive, 41; negative, 9; per cent positive, 82; (cultural method) positive, 38; negative, 12; per cent positive, 76; (FA method) positive, 41; negative, 9; per cent positive, 82. Totals for samples tested: No. tested, 110; (presumptive method) positive, 68; negative, 42; per cent positive, 62%; (cultural method) positive, 64; negative, 46; per cent positive, 58.

†Biochemical and serological tests.
‡Positive or negative fluorescence.
§One “spiked” with 2 to 5 Salmonella per g (S. typhimurium).
*Sample not tested.

rides of L-lysine lowered the pH of LICNR broth and resulted in the ingredient materials going into solution more easily. Therefore, these materials were substituted for the monohydrochloride originally used by Hargrove et al. (6).

Further work (pure and mixed culture) showed false-positive reactions (LICNR broth) could occur. These false-positive results were caused by a combination of a coliform and Proteus species that were isolated from eviscerated chicken samples. When grown in combination these organisms produced a false color result in the LICNR broth. None of these organisms alone gave false-positive results. This problem was eliminated by the incorporation of novobiocin at 10 to 15 μg/ml in the LICNR broth. Jeffries (9) used novobiocin for suppressing competing organisms such as Citrobacter and Proteus. This suppressive effect on competing non-Salmonella organisms was substantiated by testing naturally contaminated samples for the presence of Salmonella.

Food materials and ingredients were enriched using procedures currently in use in the quality control laboratory to see if the LICNR broth technique could detect the presence of viable Salmonella. What appeared to be false-positive results were observed when novobiocin was not used during enrichment. When novobiocin was used in the LICNR broth, identical presumptive and cultural results were obtained (Table 3). Presumptive results from samples enriched with novobiocin present in the tetraphionate (rather than in the LICNR broth) broth enrichment, however, did not correlate as closely with those obtained culturally (Table 4). These results suggest that novobiocin was more effective in eliminating false positives when it was used in the LICNR broth. No false negatives were encountered in this study. It should be noted that presumptive LICNR results were compared with cultural results and that further cultural isolation might have resulted in the detection of Salmonella in sam-
### Table 3. Comparison of Salmonella detection methods for food samples and ingredients

| Sample type          | No. tested | Presumptive broth results Without Nb<sup>a</sup> | Presumptive broth results With Nb<sup>b</sup> | Conventional cultural results |
|----------------------|------------|-----------------------------------------------|-----------------------------------------------|-------------------------------|
|                      |            | Pos. | Neg. | Pos. | Neg. | Pos. | Neg. |
| Wings<sup>c</sup>    | 1          | 0    | 1    | 0    | 1    | 0    | 1    |
| Livers<sup>c</sup>   | 1          | 0    | 1    | 0    | 1    | 0    | 1    |
| Drumsticks<sup>c</sup> | 1          | 1    | 0    | 0    | 1    | 1    | 0    |
| Thighs<sup>c</sup>   | 1          | 1    | 0    | 1    | 0    | 1    | 0    |
| Breasts<sup>c</sup>  | 1          | 1    | 0    | 0    | 1    | 0    | 1    |
| Gizzards<sup>c</sup> | 1          | 0    | 1    | 0    | 1    | 0    | 1    |
| Chicken meat<sup>d</sup> | 8          | 0    | 8    | 0    | 8    | 0    | 8    |
| Biben meat           | 1          | 1    | 0    | 0    | 1    | 0    | 1    |
| Dessert              | 6          | 0    | 6    | 0    | 6    | 0    | 6    |
| Vegetables           | 2          | 0    | 2    | 0    | 2    | 0    | 2    |
| Potatoes             | 3          | 0    | 3    | 0    | 3    | 0    | 3    |
| Carrots              | 2          | 0    | 2    | 0    | 2    | 0    | 2    |
| Margarine            | 11         | 0    | 11   | 0    | 11   | 0    | 11   |
| Soup                 | 1          | 0    | 1    | 0    | 1    | 0    | 1    |
| Corn                 | 1          | 0    | 1    | 0    | 1    | 0    | 1    |
| PBP meal             | 12         | 5    | 7    | 4    | 8    | 4    | 8    |
| Fish meal            | 10         | 0    | 0    | 10   | 0    | 10   | 0    |
| Carcass chiller 1    | 2          | 2    | 0    | 2    | 0    | 2    | 0    |
| Carcass chiller 3    | 2          | 2    | 0    | 2    | 0    | 2    | 0    |
| Scald water          | 2          | 1    | 1    | 1    | 1    | 1    | 1    |

<sup>a</sup>Totals for samples tested: No. tested, 69; (presumptive method without novobiocin) positive, 14; negative, 55; per cent positive, 25.5%; (presumptive method with novobiocin) positive, 10; negative, 59; per cent positive, 17; (conventional method) positive, 10; negative, 59; per cent positive, 17%.  
<sup>b</sup>Nb = Novobiocin (10 to 15 µg/ml).  
<sup>c</sup>Poultry parts.  
<sup>d</sup>Deep fat fried.

### Table 4. Comparison of Salmonella detection methods for food samples and ingredients

| Sample type          | No. tested | Presumptive broth results Without Nb<sup>a</sup> | Presumptive broth results With Nb<sup>b</sup> | Conventional cultural results |
|----------------------|------------|-----------------------------------------------|-----------------------------------------------|-------------------------------|
|                      |            | Pos. | Neg. | Pos. | Neg. | Pos. | Neg. |
| Wings<sup>c</sup>    | 2          | 2    | 0    | 0    | 2    | 0    | 2    |
| Livers<sup>c</sup>   | 11         | 2    | 9    | 1    | 10   | 1    | 10   |
| Drumsticks<sup>c</sup> | 3          | 3    | 0    | 1    | 2    | 0    | 3    |
| Thighs<sup>c</sup>   | 2          | 2    | 0    | 2    | 0    | 2    | 0    |
| Breasts<sup>c</sup>  | 8          | 6    | 2    | 3    | 5    | 1    | 7    |
| Gizzards<sup>c</sup> | 6          | 2    | 4    | 2    | 4    | 1    | 5    |
| Biben meat           | 1          | 1    | 0    | 1    | 0    | 1    | 0    |
| Prepared feeds       | 10         | 4    | 6    | 1    | 9    | 1    | 9    |
| Feed ingredients     | 4          | 1    | 3    | 0    | 4    | 0    | 4    |
| PBP meal             | 3          | 1    | 2    | 0    | 3    | 0    | 3    |
| Vegetables           | 3          | 0    | 3    | 0    | 3    | 0    | 3    |
| Potatoes             | 4          | 0    | 4    | 0    | 4    | 0    | 4    |
| Chicken meat<sup>d</sup> | 7          | 0    | 7    | 0    | 7    | 0    | 7    |
| Carrots              | 2          | 0    | 2    | 0    | 2    | 0    | 2    |
| Dessert              | 6          | 0    | 6    | 0    | 6    | 0    | 6    |
| Soup                 | 2          | 0    | 2    | 0    | 2    | 0    | 2    |

<sup>a</sup>Totals for samples tested: No. tested, 74; (presumptive method without novobiocin) positive, 24; negative, 50; per cent positive, 48; (presumptive method with novobiocin) positive, 11; negative, 63; per cent positive, 17.5; (conventional method) positive, 7; negative, 67; per cent positive, 10.4.  
<sup>b</sup>Nb = Novobiocin (10 to 15 µg/ml).  
<sup>c</sup>Poultry parts.  
<sup>d</sup>Deep fat fried.
amples reported as negative. The assumption inherent in this approach is that conventional cultural procedures yield correct and absolute results, and this is not necessarily true.

Using this new medium (LICNR broth), it was possible to detect Salmonella in food samples within 3 days which is 1 day faster than standard Salmonella detection procedures (AOAC, USDA, BAM, APHA) permit. This procedure, using modified LICNR broth, requires no special equipment or antisera. Its use as a routine quality control screening procedure should be of value in shortening the holding time for foods and food ingredients while awaiting cultural results. Presumptive results can be further evaluated by any of several presently recognized confirmatory procedures with no delays or increase in time beyond that presently required. The number of such samples requiring the more extensive confirmatory procedures should be substantially reduced through the use of this screening procedure. The savings from this reduction in sample volume are obvious.

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