

mately  $1 \times 10^6$  CFU/mL to evaluate germicidal properties. Samples were mixed, incubated at 37° C. for 15 minutes, and immediately diluted into phosphate buffered saline (pH 7) to neutralize acidity of acid-adjusted diets. The number of viable bacteria that remained in test diets was quantitated by standard plate counting methods on suitable media. Test bacteria included streptomycin-resistant variants of *Vibrio cholerae* (strain VC2-SR2) and *Salmonella typhimurium* (strain ST1-SR2). Streptomycin-resistant variants were used in these studies to allow quantitation of test bacteria without interference by contaminating bacteria in non-sterile, powder forms of test formulas.

The change in pH following addition of acid to test diets (60 and 120 mL volumes) is shown in FIGS. 3 and 4. The overall pattern for the decrease in pH of reduced buffer formulas was similar to that observed with human milk and considerably lower than the change in pH for a standard milk-based formula. With a pH of 3 defined as a germicidal pH, it required approximately 2.5 mL of acid to render 60 mL of standard formula germicidal compared to about 1.4 to 1.6 mL for the low buffer formulas and human milk. The difference in buffering capacity between reduced buffer formulas and standard formula correlated with germicidal capacity. Addition of 1.0 mL of acid to 60 mL of low buffer formula resulted in a decrease in the number of viable *V. cholerae* from about  $1 \times 10^6$  to  $1 \times 10^2$  while addition of a similar amount of acid to standard formula did not result in bacterial killing (FIG. 5). With the larger meal size (120 mL), a similar reduction in *V. cholerae* viability was observed following addition of 2.0 mL of acid to low buffer formula compared to about 3.5 mL of acid for standard formula (FIG. 6). Killing of *Salmonella typhimurium* was also greater with the low buffer formula (318) compared to high buffer formula following addition of constant amounts of acid (FIGS. 7 and 8). In summary, greater amounts of acid were required to effect the same level of germicidal activity in standard formula when compared to low buffer formulas and human milk.

#### EXAMPLE 5

##### Enhanced Gastric Barrier Function in Animals Fed Reduced Buffer Formula

The high buffer strength of infant formulas combined with the low output of gastric acid by the immature stomach of the infant suggest that the germicidal activity of gastric secretions may be compromised in formula-fed infants compared to breast-fed infants. The impact of formula buffer strength on in vivo germicidal properties of gastric secretions (ie. gastric barrier function) was evaluated by monitoring survival of a standardized bacterial inoculum following gastric transit in a mouse model of bacterial infection. Approximately  $4 \times 10^6$  colony forming units (CFU) of *Vibrio cholerae* were suspended in low buffer strength formula (LBF 318) or high buffer strength formula (Enfamil) and administered intragastrically to adult mice. The effectiveness of gastric barrier function was determined by monitoring recovery of test bacteria from the intestines of mice after 1 hour. Accurate quantitation of test bacteria was made possible by using a streptomycin variant of *V. cholerae* to differentiate test bacteria from normal indigenous intestinal bacteria. Saline was included as a low buffer control to demonstrate maximum killing of test bacteria by gastric secretions.

The number of viable *V. cholerae* recovered from intestines of mice following intragastric inoculation in test liquid diets is shown in FIG. 9. The data represent the mean log recovery of bacteria (CFU/mL) from stomach, small intes-

tine and cecum of 8-10 mice. The total number of test bacteria recovered from mice in the water and low buffer strength formula groups was statistically lower than numbers recovered from mice in the high buffer strength formula group (Enfamil). The number of viable *V. cholerae* that were administered to mice ranged from  $3-5 \times 10^6$  CFU for each group (solid bars). The number of bacteria recovered from intestines of mice is shown in hatched bars. Approximately  $9 \times 10^5$  CFU of test bacteria were recovered from mice that received bacteria suspended in high buffer formula, indicating a 0.74 log reduction in viable cell numbers. Approximately  $1-2 \times 10^5$  CFU of test bacteria were recovered from mice that received bacteria suspended in low buffer formula or water, indicating about a 1.3 log reduction in viable cell numbers.

We claim:

1. A liquid, nutritionally complete infant formula or adult enteral composition having a buffer strength of 18 or lower.

2. The composition of claim 1 having a buffer strength between about 9 and 18.

3. The composition of claim 1 having a buffer strength between about 11 and about 16.

4. The composition of claim 1 having a buffer strength between about 12 and about 15.

5. The composition of claim 1 which comprises about 0.5 g to about 10.0 g protein, about 0.1 g to about 9.0 g lipid, and about 6.0 g to about 25.0 g carbohydrate, said percentages being based on 100 calories of the composition.

6. The composition of claim 1 which comprises about 1.0 g to about 8.0 g protein, about 0.2 g to about 8.0 g lipid, and about 7.0 g to about 22.0 g carbohydrate, said percentages being based on 100 calories of the composition.

7. The composition of claim 1 which comprises about 1.8 g to about 6.2 g protein, about 0.4 g to about 7.0 g lipid, and about 8.0 g to about 20.0 g carbohydrate, said percentages being based on 100 calories of the composition.

8. The composition of claim 5 which further comprises vitamins and minerals.

9. The composition of claim 6 which further comprises vitamins and minerals.

10. The composition of claim 7 which further comprises vitamins and minerals.

11. The composition of claim 1 having less than 0.5% citrates on a solids basis (w/w).

12. The composition of claim 1 having less than 0.25% citrates on a solids basis (w/w).

13. The composition of claim 1 having less than 0.1% citrates on a solids basis (w/w).

14. The composition of claim 5 wherein the protein comprises whey protein, caseinate, sodium calcium caseinate or protein hydrolysate, any of which optionally substituted with amino acids.

15. The composition of claim 1 wherein said composition is an infant formula.

16. A method for treating a subject in need of control of orally ingested pathogenic microorganisms comprising administering to said subject an effective amount of a liquid, nutritionally complete infant formula or adult enteral composition having a buffer strength of 18 or lower.

17. The method of claim 16 wherein said pathogenic organisms are bacteria, parasites or viruses.

18. The method of claim 16 wherein said composition has a buffer strength between about 11 and about 16.

19. The method of claim 16 wherein said composition has a buffer strength between about 12 and about 15.

20. The method of claim 16 wherein said subjects are human infants.