MICROBIAL QUALITY OF ENTERAL FEEDS

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ABSTRACT

BACKGROUND: Hospital-prepared enteral tube feedings (Home based Intact Polymeric Formula and Standard Commercial Formula) from two intensive care units in a multispeciality tertiary care hospital in India were analyzed for microbial contamination. **METHODS:** A total number of 4 samples (2 samples each at the time of preparation and 2hours following preparation) were collected. Colony count and *Antibiotic Susceptibility tests* for all samples were conducted. **RESULTS:** At the time of preparation, all samples had detectable colony counts. The concentration of microrganisms in both the samples of enteral feeding solutions was $>10^2$ CFU/mL as against the permissible level which is (10^2 CFU/mL or less) (Jalal, 2003) that increased over 4 hours. Microbial contamination varied between sites. The types of organisms identified in both the formulas were *Bacillus species, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Staphylococcus aureus.* **CONCLUSIONS:** There is a high degree of variability in microbial contamination of enteral feeds. It is concluded from this study, that home based intact polymeric formula need not be a source of bacterial contamination, if the feed preparation is carried out under aseptic conditions with care. Failing of these would lead to bacterial contamination of the feeds, regardless of the type of feeds used.

KEYWORDS: Home based Intact Polymeric Formula and Standard Commercial Formula, Microbial Contamination, Colony Count

Enteral feeding is the most common and preferred modality for providing nutritional support to hospitalised patients with a functional gastrointestinal tract that can not satisfy their nutritional requirements. Enteral feeding may be cause of bacterial infection. Home based Intact polymeric formulas are generally not recommended because of increased risk of contamination when compared to standard commercial formulas which are assumed to be sterile (Tanchoco, 2001).

Enteral tube feedings being administered to the patients in the intensive care unit in a tertiary care multispeciality hospital was analysed for microbial safety. Samples of water and feeds were collected at various time intervals (0 hour from area of preparation, 0 and 4 hours after the feeds were hung at the bedside of the patient) from the ICU. Colony count and antibiotic sensitivity testing of the microrganisms isolated was then done to determine their level of significance and susceptibility or resistance to antibiotics respectively.

STEPS

The steps followed to determine the microbial safety of the two formulas is as follows:

Collection of Water sample - It was collected from the enteral feed preparation unit in the ICU in a sterile flask and then used for microbial analysis.

Collection of Feeds - Sample of feeds were collected from the enteral feed preparation unit in the ICU in screw cap test tubes as follows:

- At 0 hours, (immediately following preparation) from the area of preparation
- At 0 hours and 4 hours once administered to the patient through the Ryles tube

Inoculation – The water sample and the feeds were inoculated into Mac Conkey broth, Nutrient broth, and Thioglycolate broth as presented in table 1, and incubated at 37 degrees centigrade.

Table 1: Inoculation of feeds

Sample	Mac-Conkey Broth (10ml) (5tubes)	Nutrient Broth (10ml) (1tube)	Thioglycolate Broth (10ml) (1 tube)
Water	10ml	1ml	1ml
Feeds	0.5ml	0.5ml	0.5ml

Culture – After 24 hours of incubation, inoculum from each tube was taken and cultured onto Mac Conkey agar plate, Blood agar plate, Chocolate agar plate (as shown in the plates 1,2,3) and incubated for 24 hours. Microbial growth in water and feeds was observed as shown in plates 4 to 10.

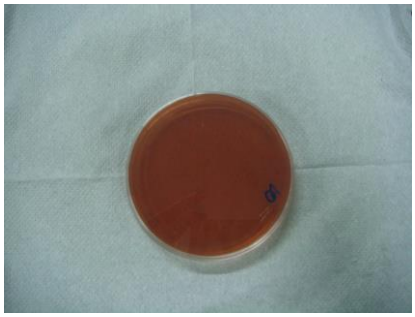

Plate 1 - Mac Conkey agar

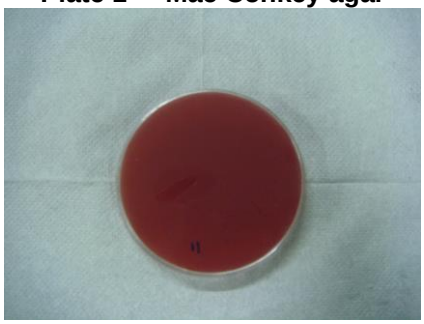

Plate 2- Blood agar

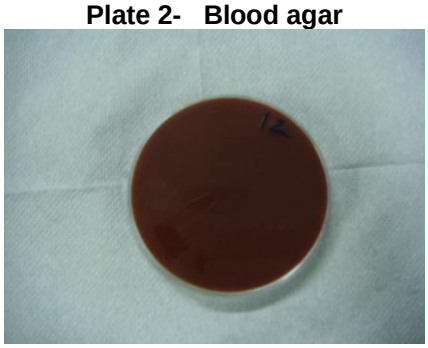

Plate 3 Chocolate agar

Plate 4- Water Sample used for preparation of CF

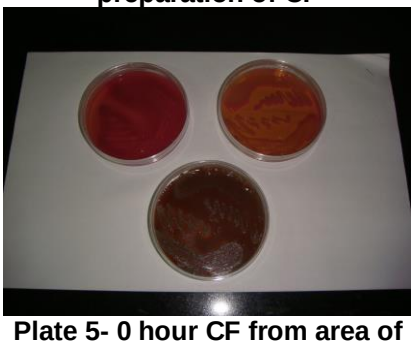

Plate 5- 0 hour CF from area of preparation

Plate 6- CF at initiation after administration

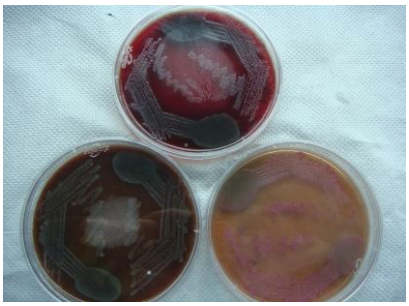

Plate 7- CF at 4hrs after administration

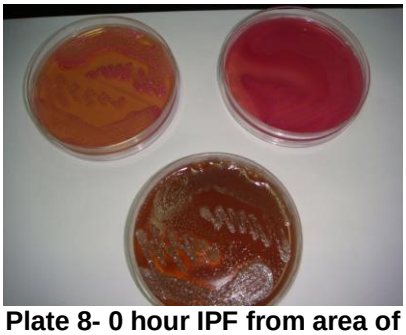

Plate 8- 0 hour IPF from area of preparation

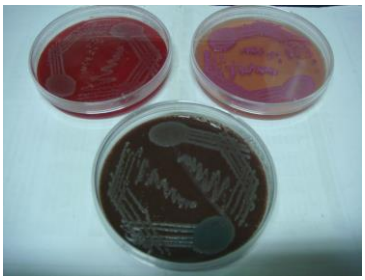

Plate 9- IPF at initiation after administration

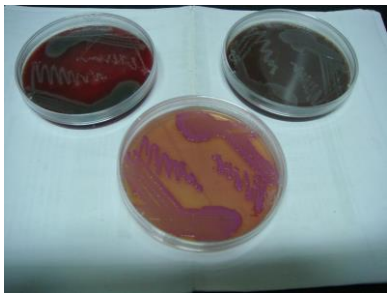

Plate 10- IPF at 4hrs after administration

Identification of organisms was done by Gram's stain and **Colony count** was determined.

Antibiotics Susceptibility testing was also done to determine the susceptibility or resistance power of the organisms. The test organisms were inoculated in peptone water and incubated at 37 degrees. The turbidity was matched with 0.5 Mc. Farland standard. Mueller – Hinton agar plates was swabbed with the test organisms grown in peptone water. The antibiotic discs were placed on the agar plates and incubated at 37 degrees for 24 hours. The zone of inhibition (as shown in the plates 11 and 12) was measured using a ruler in millimetre and the values were compared to the Kirby Bauer chart. The tests organisms were then interpreted as resistant, intermediate or sensitive to the antibiotics used.

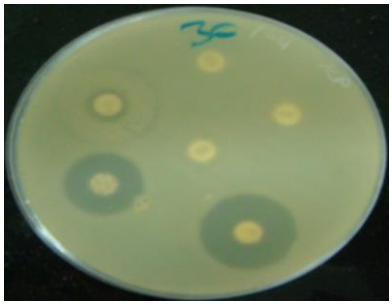

Plate 11- Zone of inhibition seen for *Klebsiella pneumoniae*

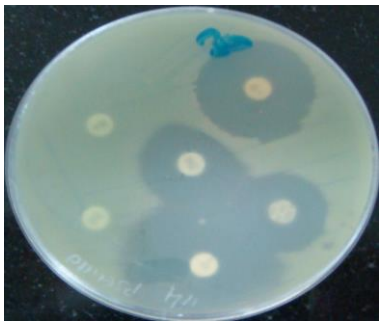

Plate 12: Zone of inhibition seen for *Pseudomonas aeruginosa*

Results and Discussion:

The results of the microbial analysis carried out for water and both the formulas are presented below:

Types of organisms identified in Water sample: Water can itself be a potential source for microbial contamination of feedings if it is not sterile. The water sample used for reconstituting the commercial formula was seen to be contaminated with *Bacillus species and Escherichia coli.* However, the water sample used for preparation of intact polymeric formula did not show any microbial growth.

Types of microrganisms identified in Intact polymeric formula and Standard commercial formula samples

The various types of microrganisms which were identified in Intact polymeric formula and Standard commercial formula are presented in the table 2.

Table 2: Types of microrganisms in both IPF and CF

Sampling	IPF	CF
0 hour (from area of Preparation)	*Bacillus species,* *Escherichia coli*	*Bacillus species,* *Escherichia coli*
0 hour after Hung	*Bacillus species,* *Escherichia coli* *Klebsiella pneumoniae*	*Bacillus species* *Escherichia coli* *Pseudomonas aeruginosa*
4 hour after hung	*Bacillus species,* *Escherichia coli* *Klebsiella pneumoniae* *Staphylococcus aureus*	*Bacillus species* *Escherichia coli* *Pseudomonas aeruginosa*

As can be observed from the table 2, the types of organisms identified in both the formulas were *Bacillus species, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Staphylococcus aureus.* All these organisms have been implicated in the development of serious gastrointestinal complications such as diarrhoea, nosocomial infections, enterocolitis, pneumonia, and sepsis (Jalal, 2003)

Contamination of enteral feedings has been implicated in the development of serious nosocomial infections including diarrhoea, salmonella infection; entero colitis, pneumonia, and sepsis. Nosocomial infections result in substantial morbidity and mortality and tremendous costs to both patients and health care institutions. The development of a food borne illness is particularly dangerous in hospitalized patients who are immunocompromised or who are receiving immunosuppressive therapy. Food-borne pathogens can cause symptoms such as nausea, vomiting, diarrhoea, fever and abdominal cramps, and may be responsible for chronic diseases such as hepatitis, septic and aseptic arthritis, and Guillain-Barré syndrome (Jalal et al, 2003).

Colony Count

Enteral feeding solutions contaminated with numbers of Gram negative bacilli ranging from 10^3 to 10^9 CFU/ml have been reported as cause of various clinical symptoms (Thurn, 1990). Some researchers have reported that 10^4 organisms/mL of feed are enough to result in colonization (Anderton,1998) In this study the concentration of microrganisms in both the samples of enteral feeding solutions has been presented in the table 3.

Table 3: Colony Count

	Colony Count (CFU/ml)	
Sampling	**IPF**	**CF**
0 hour (Area of Preparation)	$3x\ 10^2$	$5x\ 10^4$
0 hour after hung at bedside	5×10^2	5×10^4
4 hour after at bedside	5×10^2	5×10^4

In recent decades, the enteric gram negative bacilli- *E.coli, Klebsiella, Enterobacter, Proteus and Serratia, Staphylococcus aureus* frequently called "Hospital Staphylococci" and *Pseudomonas aeruginosa* and other pseudomonas species have become the most important group of hospital pathogens (Paniker, 2000).

It can be demonstrated from the table 3, that there is an increase in micro organism concentrations with time, which poses an additional problem with both the enteral formulas. The concentration of microrganisms in both the samples of enteral feeding solutions was $>10^2$

CFU/mL as against the permissible level which is (10^2 CFU/mL or less) (Jalal, 2003)

There are many potential sources for contamination of enteral feedings. Microrganisms can reside in utensils and blenders, as well as on counters and hands, resulting in bacterial contamination during the preparation and mixing of ingredients, the dilution or decanting of feedings into the nutrient container or the assembly and handling of the feeding system. In general, the more a product is handled or manipulated, the more opportunities for contamination arise. Hang time is an additional factor to consider in the risk of bacterial contamination and development of food-borne illness.

The preparation of the feeding may typically take 30 minutes to one hour, followed by 30 minutes to one hour to deliver the product to the patient. Additional hang time is then required to actually feed the product to the patient. During this time period, the degree of microbial contamination may increase which can be devastating to critically ill hospitalized patients who are immunocompromised.

Antibiotic Susceptibility Test :
Antibiotic susceptibility test was done to determine if highly pathogenic organisms such as *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* which causes Nosocomial infection, were resistant or sensitive to antibiotics. The observation of the test has been presented in the following table.

Table 4: Antibiotic Susceptibility Test

Antibiotics	***Pseudomonas aeruginosa***	***Klebsiella pneumoniae***
Cefotaxim	Sensitive	Resistant
Imipenem	Sensitive	Sensitive
Cepelexin	Resistant	Resistant
Ciprofloxacin	Sensitive	Resistant
Amikacin	Sensitive	Intermediate
Ampicillin	Resistant	Resistant

It can be observed that *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* can be sensitive, resistant or intermediate depending on the type of antibiotic used. In case of serious gastrointestinal complication or other related complications, antibiotics to which the organisms are sensitive can be used. However, in our study there was no serious gastrointestinal complication or other related complications for the patients receiving the formula and therefore these antibiotics were not prescribed.

Conclusion
It is concluded from this study, that home based intact polymeric formula need not be a source of bacterial contamination, if the feed preparation is carried out under aseptic conditions with care. Failing of these would lead to bacterial contamination of the feeds, regardless of the type of feeds used. Nosocomial contamination of the feeds from the ICU, suggest that adequate care need to be taken by the health care team members while reconstituting and administering the enteral feeds to minimize the contamination. Although the colony counts were high, there was no serious gastrointestinal complication or other related complications for the patients receiving the formula. However, it is necessary to assure strict hygiene during the preparation and handling of all enteral feed in order to avoid bacterial growth. The implementation of HACCP (Hazard Analysis and Critical Control Points) system will be required to ensure for better quality of enteral nutrition mixtures.

References

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