

Nutrient Profiles of Enteral Feeds in Two Selected Hospitals in Accra, Ghana

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ABSTRACT

Background: Hospital-prepared enteral feeds have significant benefits for critically ill patients by maintaining gut integrity and supporting immunity. Research, however, highlighted lower nutrient values of such feeds. With the notable gap in documented research, the study aimed to assess the nutrient profiles of hospital-prepared enteral feeds in two selected hospitals in Accra, Ghana.

Objective: To evaluate the energy and nutrient profiles of hospital-prepared enteral feeds in two hospitals in Accra, Ghana, and compare them with a commercial formula.

Methodology: A mixed-method study design was employed that involved an interview of twenty-one dietitians and six diet cooks in two hospitals. Three (3) hospital-prepared enteral feed samples were collected per hospital, and their energy and nutrient values were analysed in the laboratory. The values obtained were compared to a commercial formula using one sample T-test. Results were described using means and standard deviations.

Results: Majority of dietitians were female (57.1%) and about half (52.4%) had less than five (5) years of practice experience. Dietitians largely utilized hospital-prepared enteral feeds (90% in Hospital A and 73% in Hospital B). Energy and nutrient values of these feeds were significantly lower compared to a commercial formula (Ensure original). When hospital-prepared enteral feeds from the two (2) hospitals were compared, statistically significant differences were found for all nutrients except energy ($p=0.171$), carbohydrate ($p=0.073$), vitamin C ($p=0.215$), and sodium ($p=0.141$).

Conclusion: Low energy and nutrient content in hospital-prepared feeds could lead to suboptimal patient outcomes, including slower recovery times and increased susceptibility to infections. Further research is needed to improve the nutrient profiles of hospital-prepared feeds and develop enteral feeding protocols in hospitals in Ghana.

Keywords: Enteral feeding, Hospital-prepared enteral feeds, Standardized recipe, Commercial formulas

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INTRODUCTION

Enteral nutrition is provided to patients with a functional gut, but who are unable to eat to meet their nutritional requirements. It is a preferred choice of feeding critically ill patients because of its nutritional benefits, safety, and cost-effectiveness (1, 2). Critically ill patients have unique metabolic or immune responses to illness that may be modulated by appropriately targeted nutritional support (1). Some studies noted that inadequate

oral intake, preexisting nutritional deprivation, and significant multi-organ system disease are indications for nutrition support (2, 3). The degree to which patients derive benefits from nutrition support depends on the content of the nutrient substrate, severity of the disease, route, dosing, and timing.

Enteral formula is defined as liquid nutrition that is delivered to patients through the enteral route in

the form of powder or liquid commercial products and blended (4). Clinicians need to consider the efficacy, nutritional status, gastrointestinal function, patients' tolerance, and cost when selecting enteral formulas (5,6). Before commercial enteral formulas were available, hospital foods were blended into thin consistencies and fed to patients through tubes (5). These feeds had several disadvantages, including varying degrees of bacterial contamination and blockage of feeding tubes, as well as inadequate supply of nutrients to the critically ill (7). Despite these disadvantages, it has also been reported that hospital-prepared enteral feeds supply the nutrients needed by the body and lead to better patient outcomes (8).

In developing countries, the provision of hospital-prepared enteral feeds to critically ill patients is a common practice (9). Documented literature in Ghana has focused on the routes of enteral nutrition and named nasogastric as the common route of enteral access (10). However, there is limited research documenting the types and nutrient profiles of formulas provided to the critically ill. Thus, this study aimed to investigate the types of formulas, as well as the nutrient profiles of hospital-prepared enteral feeds given to critically ill patients, in two selected hospitals in Accra.

METHODS

A mixed-method study was carried out in two hospitals in Accra. A purposive sampling method was used to recruit a total number of twenty-one (21) dietitians and six (6) diet cooks who had been involved in providing enteral nutrition support to critically ill patients for more than one year. In the two (2) hospitals, dietitians and diet cooks who were involved in enteral nutrition were the only participants recruited for the study. Dietitians and diet cooks in the two hospitals who were not involved in enteral nutrition were excluded from the study. Six (6) samples of hospital-prepared enteral feeds were collected for the study; one (1) sample from each hospital was collected on three (3) different days. The study was carried out in two phases. In the first phase, structured closed-ended questionnaires were administered to dietitians and diet cooks to collect background information such as number of years of practice, frequency of prescribing enteral feeds, types of enteral feeds prescribed, use of a standardized recipe for preparation of hospital-prepared enteral feeds (for dietitians); and years of cooking, educational level, and training on enteral feed preparation (for diet cooks).

Additionally, in-depth interviews were conducted with the diet cooks to collect information on recipes used in the preparation of hospital-prepared enteral feeds. The recipes collected were the "basic feed," which refers to the hospital-prepared enteral feed provided to patients who did not require modified feeds for special conditions. The diet cooks described food ingredients used in the feed preparation with the aid of household handy measures.

In the second phase, researchers observed the preparation of the feeds in the diet kitchens, and a sample (500ml) of the hospital-prepared enteral feeds was collected in labelled airtight plastic containers on three different days from each hospital, giving a total of six (6) food samples from the two hospitals. Food samples were kept in tightly covered plastic containers and transported to the University of Ghana, Department of Nutrition and Food Science laboratory within two (2) hours of collection for analyses using the Association of Official Analytical Chemists (AOAC) procedures (11, 12). The moisture content of all six (6) food samples was determined before they were stored in the cold room. The nutritional parameters analysed were protein, fat, crude fibre, calcium, sodium, potassium, iron, phosphorus, and vitamin C (11,12). Energy and carbohydrates were calculated by computation. The commercial formula (*Ensure Original*) selected for this study was based on the commonly used commercial formula in the two selected hospitals. Energy and nutrient values for the commercial formula were obtained from the manufacturer's website (13), with moisture alone being determined in the laboratory.

Data analysis

Statistical analysis was performed using IBM SPSS Statistics version 23 (2015). Means and standard deviations were used to summarize results obtained from the questionnaires, chemical, and nutrient analyses, and presented in figures and tables where appropriate. To compare nutrient contents of hospital-prepared enteral feeds obtained from chemical analyses between the two hospitals, an independent samples t-test was used. Nutrient values of hospital-prepared enteral feeds from each hospital were compared with *Ensure Original* using a one-sample T-test, with nutrient values for 100 ml of *Ensure Original* as the standard. Although a few dietitians listed *Complan* and *Casilan* as commercial formulas, these were not included in the analysis, as these feeds were rarely used. Tests were performed based on means of duplicate samples (for the hospital-prepared

enteral feeds), and statistical significance was set at $p \leq 0.05$.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and approval was sought from the University of Ghana College of Health Sciences Ethical and Protocol Review Committee (Protocol number – CHS-Et/M.7-4.8/2018-2019), and the Institutional Review Boards of the two participating hospitals. Participation in the study was purely voluntary, and written informed consent was obtained from the participant

RESULTS

Sociodemographic characteristics of respondents

Dietitians interviewed from the two (2) hospitals were twenty-one (21). A little over half of the dietitians had practised for less than five (5) years (Table 1). The mean practice period for dietitians in Hospital A was 7.9 ± 4.63 years and 3.8 ± 2.42 years for Hospital B.

Table 1 displays the sociodemographic characteristics of participating dietitians

Table 1: Sociodemographic characteristics of participating dietitians

Variable	Hospital A Frequency 10 (%)	Hospital B Frequency 11 (%)	Total Frequency 21 (%)
Gender			
Male	3 (30)	6 (54.5)	9 (42.8)
Female	7 (70)	5 (45.5)	12 (57.1)
Period of practice (years)			
1-4			
5-8	2 (20)	9 (81.8)	11 (52.4)
9-12	5 (50)	1 (9.1)	6 (28.6)
>12	0 (0)	1 (9.1)	1 (4.8)
	3 (30)	0 (0)	3 (14.3)

Sociodemographic characteristics of participating diet cooks

All diet cooks in the two (2) hospitals were females and had attained a higher educational level (Table

2). More than two-thirds of the diet cooks had over five (5) year work experience.

Table 2 highlights the sociodemographic characteristics of participating diet cooks

Table 2 Sociodemographic characteristics of participating diet cooks

Variable	Hospital A Frequency 4 (%)	Hospital B Frequency 2 (%)	Total Frequency 6 (%)
Gender			
Male	0 (0)	0 (0)	0 (0)
Female	4 (100)	2 (100)	6 (100)
Number of years worked			
1-5			
6-10	2 (50)	0 (0)	2 (33.3)
11-15	1 (25)	0 (0)	1 (16.7)
16-20	0 (0)	0 (0)	0 (0)
>20	0 (0)	1 (50)	1 (16.7)
	1 (25)	1 (50)	2 (33.3)
Educational level			
Primary	0 (0)	0 (0)	0 (0)
Junior High	0 (0)	0 (0)	0 (0)
Senior High	0 (0)	0 (0)	0 (0)
Vocational	3 (75)	0 (0)	3 (50)
Tertiary	1 (25)	2 (100)	3 (50)
Training received			
Dietitian	1 (25)	2 (100)	3 (50)
Diet cook supervisor	2 (50)	0 (0)	2 (33.3)
Other	1 (25)	0 (0)	1 (16.7)

Types of enteral feeds used in the hospital

Figure 1 presents the types of enteral feeds used in Hospitals A and B. Dietitians in the two hospitals used both commercial formulas and hospital-prepared enteral feeds to feed patients. More than two-thirds of the dietitians at Hospital A (90%) and Hospital B (73%) used hospital-prepared enteral feeds. Fortified porridges and soups were the types of hospital-prepared enteral feeds used in both hospitals, with fortified soup being commonly used (100%). The various brands of commercial enteral formulas used in Hospitals A and B are shown in

Figure 2. Dietitians in both hospitals used more than one brand of commercial enteral formula. This is shown in the percentage indicated. *Ensure*, *Complan*, and *Casilan* were the three most commonly used brands of commercial enteral formulas in both hospitals, with *Ensure* being the most common due to its widespread availability in urban pharmacies.

All other brands (whey protein, Nutri, Glucerna, Fortisip, Vitamilk, fresh yoghurt, Diapep SR, soymilk) were collectively categorized under *other*.

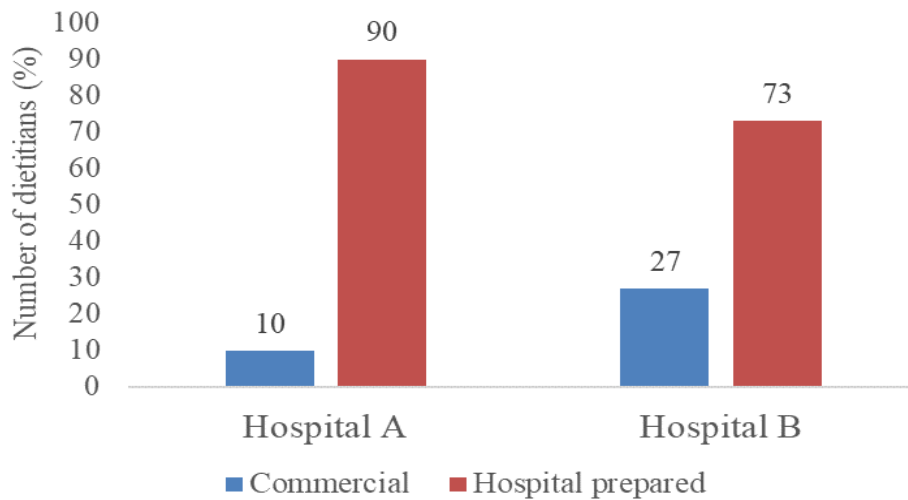


Figure 1: Types of enteral feeds used in Hospitals A and B

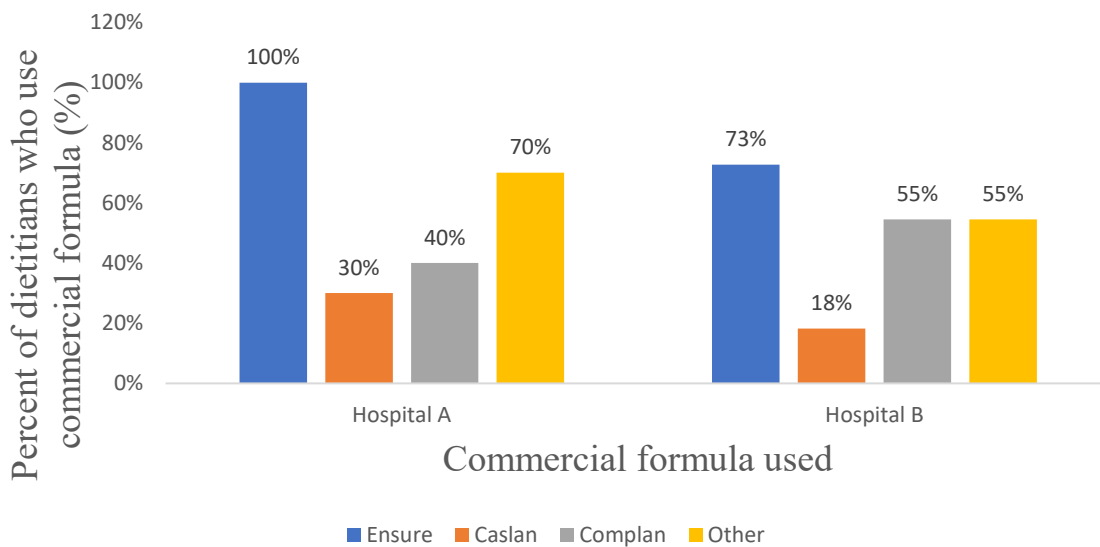


Figure 2: Brands of commercial formulas used in Hospitals A and B

Food ingredients used in preparing hospital-prepared enteral feeds

A description of food ingredients and quantities used is shown in Table 3. In this study, food ingredients used in the preparation of the

investigated sample, "fortified soup" in Hospital A, were fresh tomatoes, onions, fish powder, soya bean flour, and rice flour. In Hospital B, rice, fresh tomatoes, onions, and fish (tuna) were used.

Table 3: Food ingredients and the weights used in Hospitals A and B

Hospital A		Hospital B	
Food Ingredient	Weight (g)	Food Ingredient	Weight (g)
*Light soup	952.00	*Light soup	952.00
Fish powder	24.15	Fish (tuna)	80.00
Rice flour	102.40	Rice	110.00
Soya bean flour	75.84	Vegetable oil	5.99
Salt	5.90	Salt	2.95

*Light soup made up of tomatoes, onions, and water, and analysed as such. Weights derived from handy measures given.

Energy and nutrient values for hospital-prepared enteral feeds (fortified soup)

Table 4 presents the energy and nutrient values of the hospital-prepared enteral feeds obtained by

chemical analyses for the two hospitals. Statistically significant differences were observed in all nutrients except for energy, carbohydrate, vitamin C, and sodium between the two hospitals.

Table 4: Energy and nutrient values of hospital-prepared enteral feeds for Hospitals A and B

Nutritional Parameter	HPEF_A (N=6) (Mean ± SD)	HPEF_B (N=6) (Mean ± SD)	T-value	P-value
Moisture (%)	93.932 ± 0.593	94.827 ± 0.128	-3.61	0.005*
Energy (kcal/100g)	23.190 ± 2.013	21.625 ± 1.640	1.48	0.171
Fibre (g/100g)	0.492 ± 0.067	0.120 ± 0.059	10.26	0.000*
Fat (g/100g)	0.284 ± 0.081	0.495 ± 0.118	-3.61	0.005*
Protein (g/100g)	0.498 ± 0.276	0.002 ± 0.002	4.40	0.007*
Carbohydrate (g/100g)	4.661 ± 0.392	4.290 ± 0.176	2.11	0.073
Vitamin C (mg/100g)	24.437 ± 9.845	30.242 ± 4.265	-1.33	0.215
Calcium (mg/100g)	24.74 ± 7.884	4.745 ± 0.546	6.20	0.002*
Iron (mg/100g)	1.677 ± 0.654	0.205 ± 0.268	5.10	0.002*
Potassium (mg/100g)	72.383 ± 4.601	28.75 ± 5.334	15.17	0.000*
Sodium(mg/100g)	71.953 ± 4.519	175.552 ± 145.413	-2.73	0.141
Phosphorus (mg/100g)	159.917 ± 60.158	20.115 ± 26.338	5.21	0.001*

HPEF_A - Hospital-prepared enteral feed for Hospital A, HPEF_B - Hospital-prepared enteral feed for Hospital B, independent T-test, *significant at $p \leq 0.05$

Comparison of energy and nutrient values of hospital-prepared enteral feeds to a commercial formula (Ensure)

The energy and nutrient values of hospital-prepared enteral feeds (HPEF_A AND HPEF_B) were compared to the "Ensure" commercial formula. These results are presented in Tables 5 and 6.

Table 5 highlights the proximate values of hospital-prepared enteral feeds for hospital A (HPEF_A) and hospital B (HPEF_B) compared to 100ml of "Ensure" commercial formula. Significant differences ($p \leq 0.05$) were observed in all nutrients except for fibre. It is noteworthy that the

Ensure product manufacturer reported a non-specific fibre content value of less than 1 (13). Hence, we chose not to report on fibre for the commercial enteral formula.

Comparison of vitamin and mineral values of hospital-prepared enteral feed for Hospitals A & B compared to "Ensure" commercial formula

Table 6 highlights the vitamin and mineral values of Hospital-prepared enteral feed for both hospitals compared to 100 ml of "Ensure" commercial formula. Significant differences ($p \leq 0.05$) were observed in all the nutritional parameters.

Table 5: Comparison of proximate values of hospital-prepared enteral feed for Hospitals A & B compared to "Ensure" commercial formula

Nutritional Parameter	Hospital A			Hospital B	
	Ensure	HPEF_A	P-value (HPEF_A)	HPEF_B	P-value (HPEF_B)
Moisture (%)	84	93.93 ± 0.59	0.024*	94.83 ± 0.13	0.002*
Energy (kcal)	92.8	23.19 ± 2.01	0.002*	21.63 ± 1.64	<0.001*
Fibre (g/100g)	-	0.49 ± 0.07	-	0.12 ± 0.06	-
Fat (g/100g)	2.53	0.28 ± 0.08	0.006*	0.50 ± 0.12	0.013*
Protein (g/100g)	3.8	0.50 ± 0.28	0.004*	0.002 ± 0.002	<0.001*
Carbohydrate (g/100g)	13.5	4.66 ± 0.39	0.004*	4.29 ± 0.18	0.001*

HPEF_A & HPEF_B - Hospital-prepared enteral feed for Hospitals A & B, one sample T-test, *significant at p ≤ 0.05

Table 6: Comparison of vitamin and mineral values of hospital-prepared enteral feed for Hospitals A & B compared to "Ensure" commercial formula

Nutritional Parameter	Hospital A			Hospital B	
	Ensure	HPEF_A	P-value (HPEF_A)	HPEF_B	P-value (HPEF_B)
Vitamin C (mg/100g)	33.8	24.44 ± 9.85	0.003*	30.24 ± 4.26	0.007*
Calcium (mg/100g)	139.2	24.74 ± 7.88	<0.001*	4.75 ± 0.55	<0.001*
Iron (mg/100g)	1.9	1.68 ± 0.65	0.029*	0.20 ± 0.27	0.004*
Potassium (mg/100g)	168.8	72.38 ± 4.60	<0.001*	28.75 ± 5.33	<0.001*
Sodium(mg/100g)	88.6	71.95 ± 4.52	0.002*	175.55 ± 145.41	<0.001*
Phosphorus (mg/100g)	105.5	159.92 ± 60.16	<0.001*	20.12 ± 26.34	<0.001*

HPEF_A & HPEF_B - Hospital-prepared enteral feed for Hospitals A & B, one sample T-test, *significant at p ≤ 0.05

DISCUSSION

This study explored the nutrient profiles of enteral feeds prepared in two selected hospitals in Accra, Ghana, revealing several key findings with significant implications for both research and practice. Dietitians in the two hospitals predominantly used hospital-prepared enteral feeds over commercial formulas. This preference may be attributed to the availability and lower cost of local ingredients used in hospital-prepared feeds, as highlighted by a systematic review on the effect of enteral tube feeding on patients' quality of life that noted the high usage of such feeds in developing countries due to their cost-effectiveness (14). The commercial formulas used included brands like *Ensure*, *Complan*, and *Casilan*, with *Ensure* being the most common due to its widespread availability in urban pharmacies.

The nutrient analysis revealed that the energy and nutrient values of hospital-prepared feeds were significantly lower compared to commercial formulas and those reported in other studies. For instance, the energy content of the feeds in this study was 23.19 kcal/100g in Hospital A and 21.63 kcal/100g in Hospital B, which is considerably lower than the 40.5 kcal/100g reported in Brazil (15) and the 84 kcal/100ml

found in commercial formulas like *Ensure* (16). The low energy and nutrient values recorded may be due to the process of enteral feed preparation involving continuous sieving to prevent clogging of feeding tubes. This low energy content could potentially put patients at risk for malnutrition.

Similarly, the protein content in the feeds was found to be inadequate, with values of 0.498 g and 0.002 g per 100g in Hospitals A and B, respectively. This is much lower than the 2.10 g reported (15) and the 3.7 g per 100 ml found in *Ensure*. Given the critical role of protein in promoting healing and managing metabolic stress (17), the low protein content is concerning. The high cost of fish, the main protein source in the study area, likely limits its use and contributes to the low protein content of feeds, as neither hospital applies a standardized formulation protocol.

The study also found significantly lower fat and fibre values in the hospital-prepared feeds compared to other studies. For instance, fat and fibre values in this study were 0.28g and 0.49g in Hospital A, and 0.50g and 0.12g in Hospital B, respectively, whereas a study in Brazil reported values of 1.90 g and 0.80 g for fat and fibre, respectively (15). The low values observed may be

due to nutrient loss during preparation, such as sieving or diluting feeds with water to reduce viscosity, for easier passage through feeding tubes (15, 18).

Mineral and vitamin values were also lower than reported in previous studies. Potassium, calcium, sodium, and phosphorus values were lower than those reported by previous studies (19,20). However, iron and vitamin C levels in Hospital A (1.68 mg and 24.44 mg, respectively) were higher than those reported by a study in Saudi Arabia (19). The discrepancies in nutrient content between the two hospitals, coupled with the lack of standardized recipes, suggest inconsistencies in ingredient usage and preparation methods.

To the best of our knowledge, this study is the first to describe and compare nutrient profiles of hospital-prepared enteral feeds in Ghana. It has significant implications for practice and has contributed new data to aid the planning and provision of enteral nutrition support in hospitals in Ghana. These strengths notwithstanding, the study had some limitations. The study was conducted in two (2) public hospitals in Accra; the results thus reflect the unique enteral feed preparation practices and nutrient profiles of hospital-prepared enteral feeds of these two hospitals. Consequently, the study's conclusions are based on a narrow scope, which might overlook important factors or trends that could have been identified with a broader dataset from multiple hospitals. This limitation underscores the need for future research to include a more extensive range of hospitals to validate the findings and ensure broader applicability.

CONCLUSION

Hospital-prepared enteral feeds were highly preferred in both hospitals due to cost-effectiveness. However, these feeds were low in energy and nutrient values when compared to a commercial formula. The low energy and nutrient content of hospital-prepared feeds highlight the need for standardized recipes and protocols to ensure adequate nutrition for patients. Due to their low energy and nutrient content, dietitians and healthcare providers should, whenever possible, consider supplementing hospital-prepared enteral feeds with commercial formulas or other nutrient-dense options to meet patient needs. Hospitals should offer training for dietitians and kitchen staff on techniques that help preserve nutrients during food preparation. Future research should investigate how specific methods, such as sieving

and dilution, affect nutrient retention. Additional studies should also explore the development of affordable, nutrient-dense recipe options that use locally available ingredients. Addressing these gaps will improve enteral nutrition care and lower the risk of hospital malnutrition.

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Authors' contributions

L.B. and R.A. conceived, designed, and carried out the study, analysed data, and wrote the manuscript. D.M. and M.A. contributed to the study's design, provided critical revisions, and approved the final version. E.N. assisted with data collection and analysis and contributed to manuscript preparation. All authors have reviewed and approved the final manuscript.

Conflict of interest

The authors declare that they have no competing interests.

Availability of data and materials

The data supporting this study will be made available upon reasonable request from the corresponding author.

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