**UNIVERSITY OF GHANA**

# NUTRIENT PROFILES OF ENTERAL FEEDS IN SELECTED HOSPITALS IN ACCRA, GHANA.

**BY**

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# DECLARATION

I, Rosa Adom declare that this thesis was carried out by me under supervision in the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, College of Health Sciences, University of Ghana, Legon towards the award of Master of Science Degree in Dietetics. I affirm that this thesis is my original work and has never been presented for a degree in any institution. All information from other authors used in this thesis have been duly acknowledged.

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# DEDICATION

This thesis is dedicated to my mother, Madam Dinah Adjo Akrofi (of blessed memory) for believing in me and showing me that it is possible to do anything you set your mind to.

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*"Father, I know that all my life is portioned out for me,*

*And the changes that are sure to come I do not fear to see;*

*But I ask Thee for a present mind intent on pleasing Thee"*

Methodist Hymn 602 stanza 1(Anna Laetitia Waring, 1820-1910)

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# ABSTRACT

**Background:** During critical illness, the body goes through hypermetabolic stress which can lead to serious complications when not immediately reversed. Nutrition support in the form of enteral nutrition is provided to help the body recover. Commercial formulas have been designed to cater for nutrient needs of the critically ill however, due to financial costs and tolerability on the part of patients, hospital-prepared enteral feeds are provided. Some studies have focused on the benefits of hospital-prepared enteral feeds to the critically ill. In other parts of the world, the provision of such feeds have faded. The practice is done in Ghana but there is limited documented research for its use.

**Aim:** To assess the nutrient profiles of hospital-prepared enteral feeds in two selected hospitals in Accra.

**Methods:** A cross-sectional study design was employed. Twenty-one (21) dietitians and six (6) diet cooks were interviewed in the study. Three (3) hospital-prepared enteral feed samples were collected from the two hospitals on three different days and their energy and nutrient values were analysed. The recipes used in the preparation of the feeds were then analysed using ESHA Food Processor and Nutrient Analysis software. Means and standard deviation were used to describe results. The energy and nutrient values obtained from the chemical analyses of the hospital-prepared enteral feeds were compared to commercial formulas using independent sample t-test.

**Results:** *Ensure, Complan, Casilan* and hospital-prepared enteral feeds (fortified porridges and soups) were the types of enteral feeds used in the two hospitals. Hospital-prepared enteral feeds were commonly used although there were no standardized documented recipes for their preparation in the two hospitals. Statistically significant differences were observed in all nutrients with the exception of energy, carbohydrate, vitamin C and sodium between the two hospitals. Statistically significant differences were observed in the energy and nutrient values of hospital-prepared enteral feeds compared to commercial formulas in both hospitals with the exception of vitamin C ($p = 0.331$), iron ($p = 0.765$), sodium ($p = 0.160$) phosphorus ($p = 0.090$) in Hospital A, fibre ($p = 0.770$) and sodium ($p = 0.094$) in Hospital B.

**Conclusions:** The study showed that fortified porridges and soups were the types of hospital-prepared enteral feeds used in the two hospitals with fortified soup being commonly used. The commercial enteral formulas frequently used in the two hospitals were *Ensure*, *Complan*, *Casilan*. There were no documented standardized recipes in the two selected hospitals. Significant differences were observed in all nutrient values with the exception of energy, carbohydrate, vitamin C and sodium of hospital-prepared enteral feed samples investigated by chemical analyses between the two hospitals. Again, the energy and nutrient values of hospital-prepared enteral feeds samples differed from the commercial enteral formulas. Therefore, documented standardized recipes should be developed in all hospitals to guide cooking that will help improve nutrition and prevent inconsistencies in nutrient values

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| ASPEN | American Society for Parenteral and Enteral Nutrition |
| KBTH | Korle-Bu Teaching Hospital |
| PEG | Percutaneous Endoscopic Gastrostomy |

# CHAPTER ONE

# 1.0 INTRODUCTION

## 1.1 Background

During the incidence of diseases, cells get worn out therefore nutrients are highly needed to replenish worn-out cells. According to McClave *et al.* (2009), during critical illness, patients undergo catabolic stress which leads prolonged length of stay, morbidity or mortality. Hyper-catabolism can lead to visceral organ dysfunction, severe loss of lean body mass and in addition affect the functional capabilities of the gastrointestinal tract (Barton, 1994; Heyland, 2000). Therefore, in a bid to reverse these complications, nutrition support is given during critical illness (McClave *et al.*, 2009). Nutrition support for that reason, has emerged as a primary therapeutic intervention rather than simply alleviating malnutrition.

Critically ill patients have unique metabolic or immune response to illness which may be modulated by an appropriate focused nutrition support (McClave *et al.*, 2014). According to Akbaylar (2002), inadequate oral intake, preexisting nutritional deprivation and significant multi organ system disease are indications for nutrition support. 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. Nutrition support therefore, according to the National Collaborating Centre for Acute Care (2006) is “the provision of nutrients and any necessary adjunctive therapeutic agents to patients orally and/or enterally by administration into the stomach or intestine and/or by intravenous infusion (parenterally) for the purpose of improving or maintaining a patient's nutrition status''. Parenteral nutrition is provided to patients with paralysed and non-functional gut (Chowdary & Reddy, 2010). It is also administered when there is evidence of protein energy malnutrition (McClave *et al.*, 2009). Enteral nutrition is provided to patients with functional gut but are unable to eat to meet the nutritional requirements (Howard, 2009).

Enteral nutrition is the preferred choice of feeding the critically ill because of its nutritional benefits (McClave *et al.*, 2014). A systematic review conducted by Ojo *et al.* ( 2019) showed that enteral nutrition leads to an improvement in the quality of life. Furthermore, enteral nutrition is a less costly and safe feeding method provided to the critically ill (Bowling, 2004). As a result, continuous provision of enteral nutrition prevents gastric mucosal atrophy (Lloyd & Powell-Tuck, 2004).

CODEX (1991) defines medical foods as "foods for special medical purposes and are a category of foods for special dietary uses which are specially processed or formulated and presented for the dietary management of patients and may be used only under medical supervision. These foods are intended for the exclusive or partial feeding of patients with limited or impaired capacity to take, digest, absorb or metabolize ordinary foodstuffs or certain nutrients contained therein, or who have other special medically-determined nutrient requirements, whose dietary management cannot be achieved only by modification of the normal diet, by other foods for special dietary uses, or by a combination of the two". This definition was modified by ASPEN and therefore enteral formula is defined as liquid nutrition that is delivered to patients through enteral route in the form of powder, liquid commercial products or blenderized feeds (Robinson *et al.*, 2018).

Before commercial enteral formulas were available, hospital foods were blended into thin consistencies and fed to patients through tubes (Brown *et al.,* 2015). These however subjected the patients to varying degrees of bacterial contamination and blockage of feeding tubes as well as inadequate supply of nutrients to the critically ill (Bowling, 2004). Commercial enteral formulas were then designed to provide macro and micronutrient needs for the body as well as prevent deficiencies (Pearce & Duncan, 2002). Enteral formulas are composed of whole protein representing the nitrogen source, carbohydrates from oligosaccharides, maltodextrins or starch, lipids from vegetable oils and minerals, vitamins and trace elements (Zadak & Kent-Smith, 2009).

It is important for clinicians to consider the efficacy, patients' tolerance and cost when selecting enteral formulas (Brown *et al.*, 2015). In addition, patients' related factors (Toit & Blaauw, 2017) as well as physical and nutrition assessment, gastrointestinal function and outcomes expected (Klek *et al.,* 2011) could influence the choice of enteral formula selection. After selection of enteral formulas, the volume of enteral feeding that is prescribed is then calculated based on the nutritional requirements of the patient (Sudenis *et al*., 2012) nutritional intake and nutrient malabsorption (Silk, 1999). The types of enteral formulas that are available are polymeric, semi-elemental, disease-specific, modular, immuno-nutrition and immune modulating, pulmonary, renal, hepatic, diabetes mellitus/glucose intolerance and blenderized (Brown *et al*., 2015).

A study conducted in the Philippines by Sullivan *et al.* ( 2004) showed that hospital-prepared enteral feeds had inadequate amounts of nutrients and therefore when provided to the critically ill is likely to offer less nutrients to the body. On the contrary, Hron *et al.* (2019) revealed that hospital-prepared enteral feeds supply the nutrients needed by the body and leads to better patient outcomes. Whiles the trend of hospital-prepared enteral feeds seem to fade in some developed countries giving way to commercial enteral formulas (Bowling, 2004), in developing countries however the provision of hospital-prepared enteral feeds is a common practice (Nyati *et a*l., 2016).

In Ghana, the common type of enteral route is nasogastric (Alhassan *et al*., 2019) however, there is limited documented research on the formulas provided to the critically ill.

## 1.2 Problem Statement

Studies conducted in some parts of the world observed that the use of blended feeds and milk products delivered through feeding tubes to the critically ill failed to provide the amount of nutrients needed by the body (Bowling, 2004) and are not suitable for patients with digestive disorders (Pearce & Duncan, 2002). This has led to the introduction of commercial enteral formulas that had predigested nutrients and designed to target specific disease conditions and the nutrient needs of the body (Pearce & Duncan, 2002). Other studies however claimed that hospital-prepared enteral feeds are less costly and provided the nutritional needs of the critically ill compared to commercial formulas (Epp, 2018). In some developed countries there is a shift from the use of hospital-prepared enteral feeds to commercial formulas. However, in developing countries, hospital-prepared enteral feeds have gained grounds and are provided to the critically ill. Dietitians are involved in formulating recipes for hospital-prepared enteral feeds. These feeds are prepared in the hospital kitchens by trained diet cooks. Documented literature in Ghana have focused on the routes of enteral nutrition and named nasogastric as the common route of enteral access in Ghana however, there is limited research documenting the types of formulas provided to the critically ill. Thus, the purpose of this study was to assess the nutrient profiles of hospital-prepared enteral feeds in two selected hospitals in Accra.

### 1.3 Significance of Study

Studies on enteral nutrition in Ghana have focused on routes of enteral access and therefore this study will help fill the gap in literature in identifying the enteral feeds used in Ghanaian hospitals and the nutrient profiles of hospital-prepared enteral feeds. Knowledge on the nutrient profiles of enteral feeds prepared in hospitals will help dietitians to formulate standardized recipes for feed preparation for patients' nutrition care. Determining the nutrient profiles of hospital-prepared enteral feeds will assist dietitians to make appropriate nutrient estimates for nutritional intervention when feeding hospital-prepared enteral feeds in order to provide nutritionally adequate feeds that will lead to positive health outcomes. Knowledge of the nutrient profiles of hospital-prepared enteral feeds will help in training diet cooks in the preparation of enteral feeds.

### 1.4 Aim

This study sought to assess the nutrient profiles of hospital-prepared enteral feeds in two selected hospitals in Accra.

### 1.5 Specific Objectives

The specific objectives of the study were as follows;

1. To identify the formulas used for enteral feeding and to collect recipes for the preparation of hospital-prepared enteral feeds.

2. To analyse the energy and nutrient content of enteral feeds prepared in hospital kitchens using both chemical and nutrient analyses.

3. To compare the energy and nutrient values of hospital-prepared enteral feeds obtained from chemical analyses to commercial formulas.

# CHAPTER TWO

# 2.0 LITERATURE REVIEW

## 2.1 Nutrition Support

The human body undergoes catabolic stress during injury and trauma and therefore there is the need to provide nutrition support to reverse any complications that may arise. "Nutrition support refers to the provision of nutrients and any necessary adjunctive therapeutic agents to patients orally and or enterally by administration into the stomach or intestine and or by intravenous infusion (parenterally) for the purpose of improving or maintaining a patient's nutrition status (National Collaborating Centre for Acute Care, 2006)". Nutrition support is considered as an adjunctive care to provide exogenous fuels to support the patient during illnesses (Sharada & Vadivelan, 2014). It also aids in the management of the critically ill patient when oral food intake is inadequate or not possible. Therefore, the timing for nutrition support is very important in order to meet the nutrient needs of the patients appropriately. In some instances, nutrition support is provided within 24-48 hours after admission to the intensive care unit or 72 hours after admission. However, the timing of nutrition support provided, poses effects to the critically ill patients. Elamin & Camporesi (2009) opined that nutrition support that is provided after 72 hours of acute illness leads to undesirable consequences. Similarly, provision of nutrition support within 24-48 hours of admission during critical illness reduce length of stay in hospitals, infections as well as mortality (McClave *et al*., 2014). Therefore, the provision of nutrition support is beneficial in managing the critically ill.

## 2.2 Enteral Nutrition

Enteral nutrition, a form of nutrition support is provided to the critically ill in order to improve nutritional status. Enteral nutrition is the provision of nutritionally adequate feed by means of a tube placed directly into the gut either through the stomach or the parts of the small intestines (National Collaborating Centre for Acute Care, 2006). Nutrients are delivered through the nose or mouth into the stomach, duodenum and jejunum based on underlying medical and surgical conditions (Bowling, 2004). In infants and children, the most common method of gaining access into the gastrointestinal tract is through nonsurgical placement of feeding tubes through the nose or mouth. Enteral nutrition is also a safe access to provide essential nutrients to the body (Bowling, 2004).

According to Mcclave *et al.* (2014), enteral nutrition provides adequate delivery of calories, protein and micronutrients to the body. It also helps patients gain proper nutrition status which otherwise would not achieve from normal diet (Iturbide-casas *et al*., 2019). Apart from the nutritional benefits enteral nutrition provides to the critically ill, it also confers non-nutritional benefits such as in the maintenance of a functional gut integrity (McClave *et al*., 2014). It is in no doubt that enteral nutrition is the preferred access for feeding the critically ill.

## 2.3 Indications and Contraindications to Enteral Nutrition

When enteral nutrition is provided early and appropriately, the body derives adequate benefits from it. According to McClave *et al.* (2016), enteral nutrition should be preferred when a patient on admission does not require volitional nutrition support. It is also required for patients who have difficulty taking sip feeds (Pearce & Duncan, 2002). Similarly, Howard (2009) stated that enteral nutrition is considered when a patient has an effective gastrointestinal tract but has the inability to meet nutritional needs of the body through food intake. Culkin & Gabe (2002) also showed that patients with difficulty in swallowing represented the main indication for enteral feeding. Therefore, when it is no longer ideal for patients to take foods orally, enteral nutrition is considered (Ferrie *et al*., 2018) and it takes a day to three days to be provided (Sharada & Vadivelan, 2014). The NICE guidelines outlined some indications for enteral nutrition and these are patients with obstructed upper gastrointestinal tract or dysfunction, increased nutrient needs as well as in patients who are not conscious (National Collaborating Centre for Acute Care, 2006). Bowling (2004) added that it is provided to children with growth failure and increased needs when oral intake of nutrients is inadequate.

The provision of enteral nutrition in some instances can be fatal to the critically ill. According to Culkin & Gabe (2002) in situations where there is complete blockage of the oesophagus and risk of aspiration, enteral nutrition should not be indicated. Ferrie *et al*. (2018), added that any obstruction in the intestines that prevents enteral access contraindicates for enteral nutrition. In addition, severe diarrhea and circulatory shock (Sharada & Vadivelan, 2014), total obstruction of the intestines, difficulty in accessing the gut, intestinal function failure (Howard, 2009) also represent contraindications to enteral nutrition.

### 2.4 Routes of Enteral Nutrition

In selecting the right enteral route for feeding, it is necessary to consider the duration for feeding, the function of the patient's gastrointestinal tract and risk of aspiration (Akbaylar, 2002). Common tube placements used in enteral feeding are nasogastric, nasoduodenal or nasojejunal (Pearce & Duncan, 2002). Other types of feeding are by enterostomy tubes.

### 2.4.1 Feeding by Nasogastric Tubes

When enteral feeds are to be administered via tubes into the stomach, the mouth or the nose are routes of access. The provision of enteral feeds into the stomach via the nose is referred to as nasogastric feeding. According to Pearce & Duncan (2002), nasogastric feeding is the commonly used route of access since most patients who require nutrition support do so normally for a month. In Ghana, nasogastric feeding is the frequently used route of access for short period enteral feeding (Alhassan et al., 2019). Nasogastric feeding is recommended for use when enteral nutrition is to be initiated (McClave *et al*., 2016). Tubes used for nasogastric feeding are nasogastric tubes. These tubes are used for short term access as well as long term in cases where other enteral routes are not safe (National Collaborating Centre for Acute Care, 2006). Nasogastric tubes are easily inserted and must be done by only a trained staff. Professionals and auxilliary nurses are trained to perform such insertion in rural areas in Ghana (Alhassan *et al*., 2019). Feedings via these tubes are provided by bolus or intermittent infusions (Mahan & Raymond, 2017) and therefore complications such as clogging of tubes, nasopharyngeal discomfort, gastroesophageal reflux and trachea-oesophageal fistula can arise.

### 2.4.2 Feeding by Nasoduodenal and Nasojejunal Tubes

Feeding via the nasoduodenal or nasojejunal route of access is also commonly used in feeding the critically ill. Nasoduodenal routes present decreased risk of aspiration (Akbaylar, 2002). These routes are used when feeding beyond the ampulla is identified as ideal. The tubes have coiled ends and are placed blindly in the stomach and via peristalsis into the duodenum or jejunum (Pearce & Duncan, 2002) and are used in feeding that last for less than a month (Akbaylar, 2002). Patients that had to be given increased calories are usually fed through these routes. A study conducted by Huang *et al.* (2012) revealed that nasoduodenal route is suitable for feeding patients with high nutritional intake than nasogastric route. It also leads to reduced length of stay in hospitals. However, a problem associated with these types of routes is inadvertent removal.

### 2.4.3 Feeding by Enterostomy Tubes

Enterostomy tubes are placed surgically, non-surgically, radiologically and endoscopically when there is need for long term feeding greater than four (4) weeks (Bowling, 2004). These tubes are placed past the abdominal wall and into the stomach, duodenum or jejunum and are used in patients who have the inability to tolerate gastric feeds (National Collaborating Centre for Acute Care, 2006). Examples of the routes of feeding via gastrostomy and jejunostomy are percutaneous endoscopic gastrostomy (PEG), percutaneous endoscopic duodenostomy/jejunostomy, cervical pharyngostomy/oesophagostomy, surgical gastrostomy, surgical jejunostomy and fluoroscopic percutaneous gastrostomy. Percutaneous endoscopic gastrostomy tubes are commonly used for long term feeding and lead to minimal aspiration, tube displacement and reflux (Pearce & Duncan, 2002). Although, these routes of feeding have been identified as safe, complications such as tube blocking, fracture and leaking as well as inadvertent tube removal could arise (Pearce & Duncan, 2002). Percutaneous endoscopic duodenostomy/jejunostomy routes are used for feeding patients with risk of pneumonia by aspiration and in patients with unfitting access to the stomach. Cervical pharyngostomy/oesophagostomy tubes are used in patients who have undergone head and neck surgery. Surgical gastrostomy tubes are used in patients with oesophageal atresia, cancer, difficulty in swallowing as a result of neuromuscular disorders when PEG cannot be provided. Some complications that can arise from its use are wound infections and dehiscence, haemorrhage among others. Surgical jejunostomy is used for either short term or long term feeding and preferred when it is not suitable to feed into the stomach (Pearce & Duncan, 2002). Fluoroscopic percutaneous gastrostomy is used when the use of PEG is contraindicated such as in patients with ascites (Pearce & Duncan, 2002).

### 2.5 Enteral Feeds or Formulas

"Medical foods are foods for special medical purposes and are a category of foods for special dietary uses which are specially processed or formulated and presented for the dietary management of patients and may be used only under medical supervision. These foods are intended for the exclusive or partial feeding of patients with limited or impaired capacity to take, digest, absorb or metabolize ordinary foodstuffs or certain nutrients contained therein, or who have other special medically-determined nutrient requirements, whose dietary management cannot be achieved only by modification of the normal diet, by other foods for special dietary uses, or by a combination of the two" (CODEX, 1991). Enteral feeds are types of medical foods and therefore nutritionally complete feeds that comprise of protein, energy, vitamins, minerals, trace elements, fluid, with or without fiber (National Collaborating Centre for Acute Care, 2006). They are needed to satisfy the nutritional needs of the critically ill (Bowling, 2004). The choice for the right type of enteral feeds to use depends on the patient's nutrient needs, nutritional intake as well as the function of the gastrointestinal tract (Silk, 1999). Different ranges of enteral feeds are available to the critically ill based on their nutritional requirements. Enteral feeds could be commercially manufactured, hospital-prepared or home-prepared. Commercially manufactured feeds are available as polymeric (standard), elemental and specialized (Malone, 2005). Hospital or home-prepared enteral feeds are also termed blenderized feeds or diets.

### 2.5.1 Types of Commercial Enteral Formulas

#### 2.5.1.1 Polymeric Formulas

These types of formulas are designed precisely to cater for the nutrient needs of the individual. Malone (2005) defined polymeric formulas as formulas that have whole proteins with balanced quantities of macronutrients. They are also known as standard formulas and are administered to patients either in the hospitals or at home with their nutrient content designed to match the needs of a healthy population. The normal function of the digestive system is needed when administering polymeric formulas (Brown et al., 2015). Polymeric formulas are composed of whole protein that represents the nitrogen source, carbohydrates from oligosaccharides, maltodextrins or starch, lipids from vegetable oils as well as minerals, vitamins and trace elements (Zadak & Kent-Smith, 2009). Maltodextrins are the common source of carbohydrate used in polymeric formulas due to their solubility as compared to starch (Zadak & Kent-Smith, 2009). The protein content as reported by Zadak & Kent-Smith (2009) ranged from 15-25% and included soy protein isolate, egg white and cow milk with the quantity of nitrogen 200g/l or 500g/l (Pearce & Duncan, 2002). Fats are derived from polyunsaturated fats (Bowling, 2004) although some monounsaturated fats may be present (Zadak & Kent-Smith, 2009). Both Zadak & Kent-Smith (2009) and Brown *et al.* (2015) recorded considerable amounts of fiber in formulas with Brown *et al.* (2015) emphasizing the growth of prebiotics and health of gastrointestinal tract as advantages of fiber in the formulas. There are some traces of vitamins and minerals in polymeric formulas (Pearce & Duncan, 2002).

#### 2.5.1.2 Elemental Formulas

Elemental formulas contain enzymatically hydrolyzed macronutrients that require minimal digestion (Zadak & Kent-Smith, 2009) and low in fat (Tignanelli & Bukowiec, 2017). Elemental formulas are recommended for patients who have difficulty in digesting and absorbing polymeric formulas (Brown *et al.*, 2015). Similar studies by Toit & Blaauw (2017), Bowling (2004) and Pearce & Duncan (2002) stated that semi-elemental formulas contain hydrolyzed macronutrients that aid digestion and as such are well tolerated by people with impaired gastrointestinal tract.

#### 2.5.1.3 Special Formulas (Disease specific)

These enteral formulas are designed to address specific metabolic abnormalities and changes in nutritional needs (Akbaylar, 2002). They provide therapeutic benefits (Bowling, 2004) and can be organ specific (Tignanelli & Bukowiec, 2017). ASPEN 2016 guidelines however does not recommend the routine use of such special formulas among the critically ill (McClave *et al., 2016)*. Hepatic, renal, pulmonary, immunomodulatory and diabetes mellitus formulas are some examples of the disease-specific formulas.

**Hepatic formulas**

Hepatic formulas consider the provision of lower protein content whiles the amount of branched chain amino acids (BCAA) such as valine, leucine and isoleucine is increased. There is also a lower amount of aromatic amino acid (AAA) and this is with the view that

BCAA do not compete with AAA in the brain during transport thereby reducing the symptoms of hepatic encephalopathy and thus restore muscle mass (Brown *et al*., 2015). Examples of AAA are phenylalanine, tryptophan and tyrosine. In the short term, hepatic formulas have been shown to reduce symptoms of hepatic encephalopathy however, in the long term they could result in diminishing nitrogen balance (Elamin & Camporesi, 2009).

**Renal formulas**

In order to satisfy the nutrient needs of patients with renal problems, renal formulas are designed. According to Toit & Blaauw, (2017), such formulas focus on restriction of protein, sodium, potassium, phosphorus and fluid and as a result address issues by increasing or decreasing respective nutrients. Most clinicians switch to renal formulas in order to prevent hyperkalemia, hypermanganesemia or hyperphosphatemia when polymeric formulas are used (Elamin & Camporesi, 2009). The formulas are given until the problem is resolved. Renal formulas have low content of protein in order to reduce the production of urea but have increased amounts of essential amino acids to aid the synthesis of protein (Akbaylar, 2002). Furthermore, the provision of such formulas is beneficial to people with chronic renal failure and not on dialysis due to the inability of the kidneys to excrete urea and electrolytes. Other formulas are designed to provide high protein in order to satisfy the catabolic needs of patients on dialysis (Brown *et al*., 2015).

**Pulmonary formulas**

Pulmonary formulas are designed with the basis of reducing the amount of carbon dioxide produced by reducing the carbohydrate content and rather increasing the fat content since higher carbohydrates have effect on the respiratory quotient (Toit & Blaauw, 2017).

Omega-3 sources of food are added to these formulas to introduce fatty acids in order to enhance the anti-inflammatory properties of the individual (Brown *et al*., 2015). Patients with marginal respiratory reserve are suggested to be given such formulas (Elamin & Camporesi, 2009).

**Immuno-nutrition and immune modulatory formulas**

Made up of arginine, omega 3 fatty acids, glutamines, nucleotides, BCAA, these formulas offer improved resistance to infections (Akbaylar, 2002) and are particularly functional in malnourished and critically ill children (Bowling, 2004). The aim of providing such formulas is to boost immune system in order to aid recovery and therefore are recommended to be used for elective surgical patients (Toit & Blaauw, 2017).

**Diabetes Mellitus formulas**

Diabetes mellitus formulas aid in controlling glucose in the blood of patients by increasing fibre and fats particularly monounsaturated fats that slow down gastric emptying (Toit & Blaauw, 2017). Such formulas contain monounsaturated fats, antioxidants for cardiovascular health and a macronutrient breakdown of 40%, 20% and 40% for carbohydrates, protein and fats respectively (Brown *et al.*, 2015). Akbaylar, (2002) however believed that diabetics could be placed on standard formulas whiles their nutrient needs adjusted with regards to protein- 15%, carbohydrates -55% and fats -30%. According to Elia *et al*. (2005) diabetes-specific formulas given to diabetics improved their glycemic control and in the long term reduced chronic complications.

#### 2.5.1.4 Modular Diets

Modular diets are formulas that contain macronutrients tailored to meet special needs of patients (Zadak & Kent-Smith, 2009). Carbohydrate modules are designed to increase calories and improve palatability, protein modules are used to improve the nitrogen intake and fat modules to increase intake of essential fatty acids and energy (Akbaylar, 2002). These diets are also added to existing formulas to enrich them (Toit & Blaauw, 2017).

#### 2.5.1.5 Blenderized feeds

Blenderized feeds have increased consumer patronage owing to the fact that patients have the opportunity of having access to locally available food ingredients as compared to manufactured formulas (Brown *et al*.2015). Blenderized feeds are prepared by blending foods into thin consistencies to be fed to patients via feeding tubes. In the past blended foods and milk products were administered to patients via feeding tubes (Bowling, 2004).

Blenderized feeds are affordable however, the practice have gradually faded in some developed countries mainly due to the risk of contamination and tube occlusion (Brown *al et.*, 2015). Policy statement issued by the British Dietetic Association (BDA) on the use of blenderized feeds in the United Kingdom encouraged dietitians to provide such feeds when there is the need to, since studies have shown that the feeds are well tolerated by some patients (Durnan *et al*., 2019). A study conducted by Epp (2018) on Oley Foundation members in New York discovered that 65.9% of the adults preferred blenderized feeds because such feeds were well tolerated. Similarly, the health outcomes of patients improved when fed on blenderized feeds (Hron et al., 2019). However, a study conducted by Nyati et al. (2016) showed that adult patients fed on hospital blended feeds in Zambia had inconsistent levels of energy and other nutrients and in addition recommended the provision of commercial formulas. Another study by Ezz El-Regal *et al*. (2016) in Egypt observed that patients received inadequate nutrient intake when fed on hospital blended feeds. Similarly, findings of a review by Ojo *et al*. (2020) revealed that blenderized feeds had inconsistent macro and micronutrients values when compared to commercial enteral formulas.

## 2.6 Food Ingredients Used in Preparing Blenderized Enteral feeds

Food ingredients used in the preparing blenderized enteral feeds are mainly vegetables, chicken, fish, beef, eggs. In Egypt, vegetables such as zucchini, potatoes and carrots were often used (Ezz El-Regal *et al*., 2016). The main source of protein was obtained from milk and egg. Fruit juices represent the main source of calories. In some homes, food ingredients used in preparing blenderized feeds identified are lean meat, poultry, eggs, legumes, milk, meat, soft fruits, grain, vegetables, cooking oil and salt (Vieira *et al*., 2018). In another study, beef or chicken together with cooked beans, eggs (cooked, cooked egg white), cow or soya milk and vegetable oil were used (Araujo *et al*., 2013). Fresh fruits, vegetables, meat, eggs, milk and fruit juices as food ingredients used in preparing blenderized feeds (Mokhalalati *et al*., 2004 ; Shabanpur *et al*., 2018).

## 2.7 Proximate and Nutrient Composition of Blenderized Feeds

### 2.7.1 Carbohydrate

Carbohydrates in enteral formulas ranges from 30% to 85% of total kilocalories (Mahan & Raymond, 2017). The carbohydrates in the formulas are in the form of corn syrup solids, maltodextrin and corn starch. In a study by Mokhalalati *et al.* (2004), the ranges of non-ferrous extracts of carbohydrates in 100ml blenderized feeds of three hospitals in Saudi

Arabia were from 6.01-11.15g. The least mean recorded for the hospitals was 6.36g and the highest was 10.79g. Vieira *et al.* (2018) documented the mean carbohydrates in 100g of thirty-three home-made enteral diets as 3.40g. With the study conducted by Sullivan *et al.* (2004*)* in four hospitals the mean values of carbohydrates observed were 13.40g, 12.00g, 15.20g and 18.70g. However, Felicio *et al*. (2012) identified 19.35g, 14.01g and 16.89g as the mean values of carbohydrates from 300mls feeds collected from one hospital on three consecutive days.

### 2.7.2 Protein

According to Mahan & Raymond (2017), protein amount in a commercial feed ranged from 6% to 25% of total calories and it is obtained from soy protein isolates, casein and whey. Depending on the type of formula, a specific type of amino acid may be used. ASPEN recommended the amount of protein for enteral nutrition to be in the range of 1.2 to 2.0g/kg body weight (McClave *et al*., 2016). The ranges of protein content of three blenderized feeds that were observed by Mokhalalati *et al.* (2004) in their study was 2.42-7.87g. The least mean recorded was 2.63g while 6.31g was the highest. Vieira *et al.* (2018) recorded the mean protein value of 2.10g. The mean values of protein noted by Felicio *et al.* (2012) were 6.54g, 6.63g and 4.20g. Sullivan *et al.* (2004) however documented 2.83g, 3.00g, 3.63g and 2.13g as mean values for protein.

### 2.7.3 Fat

According to Mahan & Raymond (2017) the fat content in standard formulas provides 15% to 30% of total calories and the fats are in the form of long-chain triglycerides (LCT) and medium-chain triglycerides (MCT). MCTs are directly absorbed into circulation and are well tolerated than LCTs (Hegazi & Wischmeyer, 2011). The range of fat identified by

Mokhalalati *et al.* (2004) from three hospitals in Saudi Arabia was 2.44-5.63g with least mean of 1.67g and highest mean of 3.72g. The mean values of fats noted by Sullivan *et al*. (2004) in 100g blenderized feeds in four hospitals in Philippines were 1.77g, 2.16g, 1.63g and 2.57g. Felicio *et al*. (2012) recorded 2.01g, 2.40g and 2.73g as the mean values of fats studied. however The mean fat value in home-made enteral diets documented by Vieira *et al.* (2018) was 1.90g.

### 2.7.4 Calories

Mokhalalati *et al.* (2004) recorded the range of calories or energy to be 56.7-123.7kcal in a study conducted in Saudi Arabia in three hospitals. The mean value of calories noted by Vieira *et al*. (2018) was 40.50kcal in 100g of home-made enteral diet. Sullivan *et al.* (2004) identified the mean values of calories to be 80.90kcal, 85.90kcal, 90.20kcal and 106.50kcal. Felicio *et al*. (2012) recorded the mean values as 121.83kcal, 104.34kcal and 109.02kcal.

### 2.7.5 Fibre

Fibre values ranged from 0.46-1.51g with least mean recorded from hospitals as 0.59g and highest mean of 1.22g (Mokhalalati *et al.*, 2004). In 100g home-made enteral diet, the mean value of fibre was 0.80g (Vieira *et al*., 2018). In a study conducted by Felicio *et al*. (2012), the mean values of fibre were 1.86g, 3.24g and 2.70g.

### 2.7.6 Vitamins and Minerals

Mahan & Raymond (2017) explained that formulas mostly have the amounts of vitamins and minerals recommended. In a study conducted by Vieira *et al.* (2018), the mean value of minerals in 100g home-made enteral diets was 0.70g. Felicio *et al.* (2012) recorded the mean values of ash representing mineral residue as 1.71g, 2.70g and 2.19g.

Micronutrient values of blenderized feeds in several studies have shown unpredictable levels. Mokhalalati *et al*. (2004) found sodium values in blenderized feeds to range between 90.30-467.30mg. The mean values of sodium in four hospitals in Philippines documented by Sullivan *et al*. (2004) were 679mg, 672mg, 405mg and 280mg. The lowest and highest means for potassium recorded were 112.40mg and 274.20mg respectively (Mokhalalati *et al.*, 2004). Sullivan *et al.* (2004) however documented the mean values of potassium as 998mg, 1095mg, 757mg and 822mg.

The lowest mean for calcium was 41.10mg and a highest mean 80.50mg and ranged between 33.30-103.40mg in blenderized feeds (Mokhalalati *et al.*, 2004). The mean values documented by Sullivan *et al.* (2004) were 467mg, 406mg, 313mg and 139mg. Phosphorus range from 30.40-82.20mg in blenderized feeds among the three hospital sites (Mokhalalati *et al*., 2004). The lowest mean recorded was 30.20mg and the highest was 64.7mg. However, Sullivan *et al.* (2004) noted the lowest mean value for phosphorus as 293mg while 499mg was the highest.

The ranges of iron in the blenderized feeds among three hospital sites in Saudi Arabia were low and ranged from 0.12-0.72mg with the least mean of 0.15mg and highest mean of 0.65mg (Mokhalalati *et al*., 2004). Sullivan *et al*. (2004) also recorded low values for iron in all four hospitals in Philippines although slightly higher than that of Mokhalalati *et* al. (2004). The mean values documented were 11.20mg, 8.50mg, 3.40mg and 4.50mg. Vitamin C was very low in the samples of blenderized feeds analysed with means of 0.89mg and 2.09mg for the lowest and highest means respectively and a range from 0.78-2.55mg (Mokhalalati *et al*., 2004).

In instances where patients fed on concentrated formulas are not properly provided enough fluid, it may lead to constipation and inadequate urine output (Mahan & Raymond, 2017). The amount of fluid in enteral feeds is very important. The mean value of water in 100g home-made enteral diet recorded by Vieira *et al.* (2018) was 91.10g. The mean values of moisture in the study conducted by Felicio *et al.* (2012) were 268.50ml, 270.96ml and 271.29ml. The composition of humidity identified in their study was high which according to them could lead to a decrease in the nutritional quality of feeds. The increase in water that is added to blenderized feeds is likely to allow free flow of feeds to prevent clogging of tubes; however this further decreases the nutritional value (Carter *et al*., 2018).

**2.8 Effects of Cooking on Foods**

According to Bergström (1994), one importance of cooking foods is to make nutrients readily available. Nutrients that are readily available to the body helps in growth and development. However, factors such as cooking method, cooking time, amount of liquid added may affect nutrients in foods during cooking. Cooking techniques involving longer duration of cooking foods may affect nutrients in the foods (Coro & Aaron, 2020). Water may be lost in vegetables during storage, protein and fat losses occur when meat is trimmed and peeling of foods lead to losses in carbohydrates and dietary fibre (Bergström, 1994). Tyagi *et al.* (2015) indicated that protein losses occurred less in boiling than other cooking methods. Vitamin C is easily destroyed during cooking and some losses occur by leaching into water with the greater loss occurring in boiling water (Tyagi *et al*., 2015). However, when the water is consumed, the nutrients are received by the body. Storage practices as well as transport of food ingredients play a role in the loss of vitamin C (WHO/FAO, 1998).

Potassium losses occur in cooking water and phosphorus and calcium losses occur in boiling water ( Bergström, 1994 ;Yong *et al*., 2019).

## 2.9 Review of Studies on Nutritional Adequacy of Enteral Feeds

Blenderized feeds have been shown by several studies to supply inconsistent levels of macro and micronutrients. The unpredictable levels of nutrients identified further impact on the nutritional status of the critically ill. A study conducted by Nyati *et al.* (2016) on the adequacy of energy, zinc and selenium intakes among adults receiving total nasogastric tube feeding in Zambia discovered that hospital-prepared feeds had unpredictable levels of energy, macronutrients, selenium and zinc. Patients fed on these feeds had lower albumin levels and decrease macronutrient levels (Mohammad *et al.*, 2016). In contrast, Hron et al. (2019) in a prospective cohort study of seventy (70) children who were eighteen (18) years and below and fed blenderized feeds as against commercial formulas showed that children who were fed on blenderized feeds had less rates of hospital visitations inferring that blenderized feeds reduce hospital costs as well as increased feed tolerability. The study concluded that blenderized feeds led to an improvement in health outcomes in the population studied.

## 2.10 Causes of Inconsistent Nutrient Levels of Blenderized Feeds

Blenderized feeds are prepared from local food ingredients that are readily available and accessible. These types of feeds have been shown to render unpredictable levels of nutrients. Several studies have identified some causes of the inconsistent nutrient levels. Some of the causes are mistakes by humans resulting from measurement of ingredients used, nutrient composition of the food ingredients used, the geography of the land from which the food ingredients were cultivated as well as the stage of maturity of the food ingredients, different amounts of food ingredients (Mokhalalati *et al.*, 2004). In addition, the method of storing raw food ingredients (Sullivan *et al.,* 2004), loss of some nutrients in the feeds during cooking lead to low levels of nutrients in blenderized feeds (Paula *et al., 2017)*. In some situations, food ingredients with high densities are not readily accessible for use in preparing blenderized feeds and this may lead to the patronage of food ingredients of low density. Feeds prepared from such food ingredients are low in calories (Araujo *et al.*, 2013). The personnel involved in cooking such feeds also lack knowledge on the density of prepared feeds (Ezz El-Regal *et al.*, 2016). In some instances, during preparation, feeds become viscous and therefore water is added to reduce the viscosity to allow feeds to flow freely in feeding tubes (Vieira *et al.*, 2018). Furthermore, the absence of a standardized formulation to guide cooking leads to variations in feeds which in turn impact on patients' nutrition status (Jolfaie *et al.,* 2017).

## 2.11 Nutrient Requirements of the Individual

Energy requirements in the critically ill is calculated by use of indirect calorimetry and studies have shown this as the gold standard for energy estimation (Mcclave *et al*., 2016; Singer *et al*., 2018). Predictive equations are used in the absence of indirect calorimetry and 25-30kcal/kg/day is estimated for the critically ill (McClave *et al.,* 2009). During critical illness, nutrients are provided to reverse metabolic stress due to injury and trauma.

Carbohydrates play a role of providing energy to the body specifically the brain. The cells of the body make use of the energy for daily activities and the simplest unit is glucose. The minimum requirement for carbohydrate is dependent on the glucose needs of the brain. The recommended intake of carbohydrates is 130g per day for adults and children (Institute of Medicine, 2005). In the critically ill, carbohydrates is estimated to supply 70% of the total caloric requirement (Sharada & Vadivelan, 2014).

Fats is essential for absorption of fat-soluble vitamins and carotenoids. It is also a source of energy for the body. The acceptable macronutrient distribution range (AMDR) for total fats is 20-35% of energy (Institute of Medicine, 2005). In the critically ill, fats intake should supply about 30% of the daily energy needs (Sharada & Vadivelan, 2014).

Protein is very important to the critically ill because it aids in wound healing (McClave *et al.*, 2016) . In identifying the protein needed in enteral feeds or formulas there is the need to consider origin of protein, quality of protein and the protein content (Savino, 2018). The origin of protein could influence the tolerability or utilization of the protein in the body. Protein quality which is the biological value of the protein provides an approximation of the body effectively integrating dietary protein into tissues and muscles (Paddon-jones *et al.*, 2017). Proteins act as enzymes, hormones, transport carriers and also as the structural components of the body. Several amino acids are needed to make proteins and these amino acids serve as precursors for nucleic acids. The recommended intake of protein is 0.8g/kg/body weight based on the needs of the body for protein (Institute of Medicine, 2005). Other studies suggested 1.5-2.0g/kg per day (McClave *et al*., 2016), 1.0g/kg/day for patients but limited higher intakes to 1.5g/kg/day (National Collaborating Centre for Acute Care, 2006), 1.2-1.6g/kg/day (Sharada & Vadivelan, 2014).

Dietary fibre is the non-digestible part of carbohydrates and it functions in delaying gastric emptying time which helps in weight control as well as reduction in postprandial blood glucose concentration. Another important function of dietary fibre is in interfering with dietary fat and cholesterol and as a result helps reduce blood cholesterol levels. Dietary fibre provided in enteral feeds helps in preventing constipation. The recommended intake of dietary fibre is 38 and 25g/d for men and women (Institute of Medicine, 2005).

Studies have shown that critically ill patients usually meet the daily nutrient requirements for micronutrients when adequate quantity of feed is administered (National Collaborating Centre for Acute Care, 2006). According to WHO/FAO (1998), calcium is needed by the body for bone metabolism and other metabolic processes. The amount of calcium in the body is regulated by the intake of calcium as well as losses in urine and faeces. The recommended intake of calcium for an adult is 1000mg and this would cater for urinary and faecal losses. This recommendation varies among populations that are at risk such as pregnant and lactating women, menopausal women, the aged and children.

Potassium is needed to reduce blood pressure, decrease risk of cardiovascular disease as well as beneficial for bone-mineral density. The WHO (2012) stated that an increase in potassium intake should be derived from foods in order to reduce the risk of cardiovascular diseases and stroke. It is therefore suggested that potassium intake of at least 3510mg/day for adults and below 3510mg/day for children based on the energy requirement of the children should be considered.

Iron is responsible for the transport of oxygen from lungs to tissues. Iron is stored in the liver in the form of ferritin and haemosiderin. Iron is essential during growth from infancy into adulthood. Loss of iron occurs through the skin surface, urinary tract and intestinal surfaces (WHO/FAO, 1998). In addition, absorption of iron is largely determined by the kind of iron- haem and non-haem. Haem iron is rapidly absorbed and examples are meat, fish and poultry (WHO/FAO, 1998). Non-haem is iron obtained from plant sources. In order for non-haem to be bioavailable to the body, ascorbic acid is added to the diet. However, iron intake can be inhibited by the presence of phytates and some fruits. Iron requirement varies among populations however the recommended intake for an adult male is 9.1-11.4mg/day and 19.6-24.5mg/day for adult female which is dependent on their bioavailability (WHO/FAO, 1998).

Phosphorus is crucial for the formation of bones and teeth, maintenance of a normal pH and also helps in tissue growth. The Institute of Medicine, (2006) revealed that minimal amounts of phosphorus are excreted by the kidneys and oftentimes by shedding of skin. Intake of phosphorus through diets therefore helps replace phosphorus losses. The recommended intake of phosphorus for adult men and women is 700mg/day (Institute of Medicine, 1997).

Sodium is an essential electrolyte that helps in maintaining water balance in the body, helps in the function of nerves and muscles. Sodium however has been strongly linked to increased blood pressure leading to several health conditions. The WHO (2012b) therefore recommended the reduction of sodium to daily intake of less than 2grams per day or 5grams of salt per day for adults in order to reduce the risk of stroke, cardiovascular diseases and coronary diseases. In children, the daily intake of sodium should be less than 2g/day.

Vitamin C also known as ascorbic acid is responsible for acting as an electron donor for enzymes that are involved in the synthesis of catecholamine norepinephrine and tyrosine metabolism. It also acts as an antioxidant in stabilizing folate in foods. The recommendation varies among populations however, recommended intake for adult is 30-45mg/day and this takes into consideration its losses (WHO/FAO, 1998). Sharada &

Vadivelan (2014) estimated the amount of vitamin C needed by the critically ill to be 60mg and this help meet daily needs.

**2.12 Role of Dietitians in Enteral Nutrition**

Malnutrition in patients have usually not been identified in hospitals and as a result have led to increased morbidity and mortality as well as decreases in the patient's ability to cooperate during management (Pearce & Duncan, 2002). Most critically ill patients on admission become exposed to the risk of malnutrition (Fletcher, 2015). Identification of malnourished patients enables appropriate nutrition therapy to be provided in order to restore and maintain nutritional status (Mahan & Raymond, 2017). Appropriate nutritional therapy also provides clinical and cost effective benefits in managing non-communicable diseases (Bednarczuk & Czekajło-Kozłowska, 2019). Dietitians are therefore responsible for identifying patients who need nutrition therapy, educating caregivers, patients, hospital cooks, nurses and other medical staff, daily monitoring of dietary intake of patients and standardizing feedings (Russell, 1986). In identifying patients need for nutrition therapy, dietitians can assess nutritional intake, estimate nutritional requirements, prescribe and monitor feedings (Russell, 1986). The NICE guideline identified nutritional assessment, screening and provision of nutrition support to be the roles of dietitians (National Collaborating Centre for Acute Care, 2006). They are also responsible for identifying suitable alternatives for nutrition (Howard *et al*., 2006). Dietitians further provide training for cooks who are responsible for preparing feeds that are fed to patients in hospitals (Russell, 1986).

# CHAPTER THREE

# 3.0 METHODS

## 3.1 Study Design

A cross-sectional design was employed for the study.

## 3.2 Study Sites

The study sites were Dietherapy Units of Korle Bu Teaching Hospital and 37 Military Hospital. Study sites were conveniently selected by researcher.

### Study Site 1

Korle Bu Teaching Hospital (KBTH) is a public tertiary hospital in Ghana that doubles as a teaching hospital affiliated to the University of Ghana medical school. KBTH is located at Korle Bu in the Greater Accra region of Ghana. Currently, it is the largest referral hospital in West Africa and the leading national referral center with a bed capacity of 2,000 and 17 clinical diagnostic Departments / Units (Korle Bu Teaching Hospital, 2016) . The Dietherapy Unit is responsible for the dietary management of patients. The diet kitchen provides meals for patients on admission who have been referred to dietitians for dietary management.

### Study Site 2

The 37 Military Hospital is a specialist hospital located in Greater Accra region of Ghana. The hospital receives referral cases from several hospitals in the country with a 600-bed capacity and five (5) major departments (Adjei, Armah, & Narter-Olaga, 2014). It also runs a 24-hour accident and emergency services with four (4) units for emergency. The hospital runs clinical training of nursing and midwifery students from thirty-five (35) public nursing training institutions across the country. The Dietherapy Unit is responsible for dietary management of patients.

## 3.3 Study Participants

All the dietitians and diet cooks in the selected hospitals were eligible to participate in the study.

### 3.3.1 Inclusion Criteria

Dietitians who were involved in enteral nutrition support for more than a year as well as those who prescribed enteral feeds in the selected hospitals and consented to participate in the study were recruited for the study. Again, diet cooks who were involved in the feeding preparations were included in the study.

### 3.3.2 Exclusion Criteria

Dietitians who were not involved in providing enteral nutrition support as well as those with less than one-year experience with enteral nutrition support were excluded from the study. Again, dietitians who did not consent to participate in the study were excluded from the study. Diet cooks who were not involved in feeding preparations were excluded in the study.

## 3.4 Sampling Technique

All dietitians and diet cooks were eligible to participate in the study and therefore purposive sampling method was adopted. The study procedure was explained to consenting dietitians and diet cooks.

### 3.5 Procedure for Data Collection

The study was carried out in two phases.

#### 3.5.1 Phase One

Twenty-seven structured closed-ended questionnaires were administered to participating dietitians and diet cooks. The questionnaires administered to the dietitians covered number of years of practice and frequency of prescribing enteral feeds. They were also required to indicate the types of enteral feeds used as well as brands of commercial formulas. Information obtained from diet cooks focused on the number of years of cooking, educational level and training on enteral feed preparation. The questionnaires were pre-tested at a hospital which was not included as a selected hospital to assess the ease of understanding the questions. Based on the pre-test, adjustments were made to the questionnaire. Recipes of hospital-prepared enteral feeds used in the two hospitals were collected via interaction with the diet cooks. The recipes collected represented a "basic" feed. Basic feed refers to hospital-prepared enteral feeds provided to patients who did not require modified feed for special cases. Diet cooks estimated the quantities of food ingredients used in the preparation of hospital-prepared enteral feeds and with the aid of handy measures, weights were generated for the various ingredients. ESHA Food Processor and Nutrient Analysis software version 6.02 (1994) was used to generate energy and nutrient values.

#### 3.5.2 Phase Two

The researcher observed feeds preparation and plastic containers with air-tight covers to be used for food sample storage were purchased, washed with warm water and labelled.

Three food samples (500ml) each of hospital-prepared enteral feeds were collected from each hospital on three different days giving a total of six (6) food samples from the two hospitals. This method of collection was used to cater for discrepancies that may arise owing to the fact that two different groups of diet cooks were involved in preparing enteral feeds in the selected hospitals on different days. Food samples kept in tightly covered plastic containers were transported to the University of Ghana, Department of Nutrition and Food Science laboratory within two (2) hours of collection for analyses. Moisture was determined on all six (6) food samples before they were stored in the cold room.

### 3.6 Methods of Analyses of Nutritional Parameters

Moisture, protein, fats, ash, micronutrients were analysed in the laboratory.

The underlisted methods of analyses were performed.

Table 3.1 presents the methods of analyses of nutritional parameters

**Table 3.1 Methods of analyses of nutritional parameters**

| NUTRITIONAL PARAMETER | METHOD OF ANALYSIS |
|---|---|
| Moisture | Air-oven |
| Protein | Kjeldahl Method |
| Fat | Soxhlet Method |
| Crude fibre | Weende Method |
| Micronutrients (Calcium, Sodium, Potassium, Iron) | Atomic Absorption Spectrophotometer |
| Micronutrients (Phosphorus) | Gravimetric method |
| Vitamin C | Titration method |

Carbohydrates and Energy were calculated from computation.

### 3.6.1 Determination of Moisture Content

Moisture is the quantity of free water and unstable substances lost when food samples are dried under measured temperature in an air oven. In order to express the nutrient content in dry weight basis, content of moisture is determined (ASEAN Network of Food Data Systems, 2011).

#### 3.6.1.1 Procedure

A drying container was prepared with 15-20g of acid washed sand and stirring rod. The container was placed in an oven for 1-2 hours in 100 ± 5$^0$C and a constant weight attained. The container was then cooled for about 30 minutes in a desiccator and weighed (**$\ddot{W}_1$**). Food Sample was thoroughly mixed and 20g weighed and put into a pre-weighed drying container with acid washed sand and stirring rod (**$\ddot{W}_2$**). The sample was dried over a boiling water bath into a thick paste consistency and then dried in an oven. Sample was then placed in an air-oven preheated to 100 ± 5$^0$C for 2-3 hours. The dried sample in the container was transferred into a desiccator and cooled for 30 minutes and reweighed (**$\ddot{W}_3$**). The heating process was repeated until a constant weight was attained with the differences in weight below 5mg.

**Moisture (g/100g) =** $\frac{(\ddot{W}_2 - \ddot{W}_3) \times 100}{(\ddot{W}_2 - \ddot{W}_1)}$

The representations are as follows:

$\ddot{W}_1$ = weight of the empty container (g)

$\ddot{W}_2$ = weight of the empty container and the sample before drying (g)

$\ddot{W}_2 - \ddot{W}_1$ = weight of the sample (g)

$\ddot{W}_3$ = weight of the empty container and the sample after drying (g)

$\ddot{W}_2 - \ddot{W}_3$ = loss of weight (g)

Results of the test recorded in g per 100g to two decimal places

**3.6.2 Determination of Protein Content**

This is based on digesting proteins and other organic food components in the sample together with sulphuric acid and a catalyst such as potassium sulphate. The catalyst aids the release of nitrogen from the protein and retains it as ammonium salt. Upon addition of excess alkali in the form of concentrated sodium hydroxide, ammonia gas is released and distilled into a boric acid solution in order to form ammonium-borate complex. The ammonia that is released from the complex is titrated with standardized hydrochloric acid. The nitrogen amount in the sample is then determined from the milligram equivalent of the acid that is used. The nitrogen content is further multiplied with a conversion factor (6.25) to determine the crude protein content (ASEAN Network of Food Data Systems, 2011).

The protein content was determined by using Kjeldahl method (AOAC, 1990).

**3.6.2.1 Procedure**

About 2g of the sample was weighed into macro-Kjeldahl flask and 2g of copper sulphate and 10g of sodium sulphate were added to the macro-Kjeldahl flask and shaken carefully. Twenty-five (25) ml of sulphuric acid was carefully poured down the sides of the macro-Kjeldahl flasks. The sample was then transferred to macro-Kjeldahl apparatus for digestion and placed in an inclined position. The mixture was digested slowly until frothing ceased and clear solution was observed. The digest was further heated for about an hour and clear liquid was obtained. About 100ml of distilled water was then added to the digested sample to transfer sample from the macro-Kjeldahl flask into volumetric flask. After that, 5ml of sodium hydroxide was added to 5ml of the sample and flask connected to the distillation apparatus. Boric acid of 5ml was added to sample and placed in conical flask and connected to the distillation apparatus to collect nitrate at 75ml mark and colour of distillate changed to blue. The distillate that turned to blue was then titrated with 0.01N hydrochloric acid until a faint pink colour was seen at the end point.

Results of the test recorded in g per 100g to two decimal places

**Percent Nitrogen** = $\frac{\mathbf{T(0.0014 \times Normality\ of\ HCL \times 100)}}{\mathbf{Weight\ of\ sample}}$

**Protein (g/100g) = Percent nitrogen × 6.25**

Where:

T represents titre

### 3.6.3 Determination of Total Fat Content

This involves extracting lipids from sample using solvents such as hydrochloric acid either manually or in a solvent extraction unit (ASEAN Network of Food Data Systems, 2011). The method used was the Soxhlet Extraction method.

#### 3.6.3.1 Procedure

About 10g of sample was weighed and poured into a container ($\ddot{\mathbf{W}}_1$) and 100ml of 4 N hydrochloric acid was added to the sample and glass beads put in. The flask was connected to an air condenser and reflux with moderate boiling for about 30 minutes – 1 hour. The mixture was then filtered and residue washed with warm water to rid the filtrate from acids. The filter paper that contained the residue was dried in an oven overnight at 50-60$^0$C and transferred to an extraction thimble. The thimble was placed in the Soxhlet apparatus and a round flat bottom flask was dried in an oven for an hour at $100^0$C. The round flat bottom flask was then allowed to cool in a desiccator and weighed ($\ddot{W}_2$). About 50ml of petroleum ether was poured into the round flat bottom flask and placed in the fat extraction system. The sample in the thimble was immersed in warmed solvent for 30 minutes and then extracted. The solvent in the round flat bottom flask was evaporated on a water bath. The round flat bottom flask was then dried in an oven for 30 minutes at $100 \pm 5^0$C and further allowed to cool in a desiccator. It was re-heated and re-weighed until constant weight was attained ($\ddot{W}_3$).

Results of the test recorded in g per 100g to two decimal places

**Total fat (expressed in g/100g) =** $\frac{(\ddot{W}_3 - \ddot{W}_2) \times 100}{\ddot{W}_1}$

Where:

$\ddot{W}_1$ = weight of sample

$\ddot{W}_2$ = weight of dried round flat bottom flask before extraction of fat

$\ddot{W}_3$ = weight of dried round flat bottom flask after extraction of fat

### 3.6.4 Determination of Ash Content

In the process of determining ash, all organic matter is oxidized by incinerating in a furnace under controlled temperature (ASEAN Network of Food Data Systems, 2011).

#### 3.6.4.1 Procedure

Crucibles marked were heated in a furnace for 2-3 hours at a temperature of $500\text{-}550^0$C. The temperature was reduced to $180^0$C and the crucibles were transferred into a desiccator and cooled for 30 minutes and weighed (**$\ddot{W}_1$**). About 10g of sample was weighed into the pre-weighed crucible (**$\ddot{W}_2$**). The sample was pre-dried over a boiling water bath and charred over a hotplate at low temperature and gradually increased until the smoking ended. The sample that was charred was then incinerated in a furnace at 500-550$^0$C until a uniformly white residue was seen. The temperature of the furnace was then reduced to 180$^0$C, cooled in a desiccator for 3 minutes and weighed (**$\ddot{W}_3$**).

Results of the test recorded in g per 100g to two decimal places

**Ash (expressed in g/100g) =** $\frac{(\ddot{W}_3 - \ddot{W}_1) \times 100}{(\ddot{W}_2 - \ddot{W}_1)}$

Where:

$\ddot{W}_1$= weight of the crucible

$\ddot{W}_2$ = weight of crucible and the sample

$\ddot{W}_3$ = weight of crucible and ash

### 3.6.5 Determination of Crude Fibre

Crude fibre involves the materials that is not digestible in the human or animal. A part of carbohydrate that remains after acidic and alkaline digestion is crude fibre (Burham, 2017). The Weende Method was used to determine crude fibre content (Möller, 2014).

#### 3.6.5.1 Procedure

About 2g of the sample (**$\ddot{W}_1$**) was boiled with sulphuric acid ($H_2SO_4$) of 0.26 N and followed by potassium hydroxide (KOH) of 0.23 N. The boiled sample solution was then separated by filtration. The filtered solution was washed and transferred into a crucible dish and kept in an oven overnight at a temperature of $105^0$C. The crucible dish that contained the sample was then weighed (**$\ddot{W}_2$**) and further placed in a muffle furnace at $500^0$C. The crucible dish containing the sample was then removed from the furnace, cooled in a desiccator and was then weighed (**$\ddot{W}_3$**).

Results of the test recorded in g per 100g to two decimal places.

**Crude fibre =** $\frac{(\ddot{W}_2 - \ddot{W}_3) \times 100}{\ddot{W}_1}$

Where:

$\ddot{W}_1$ = weight of the sample

$\ddot{W}_2$ = weight of the crucible dish with the sample before ashing

$\ddot{W}_3$ = weight of the crucible dish with the sample after ashing

### 3.6.6 Sample Preparation for Determination of Mineral Content

In determining the mineral content of foods, the organic matter of the food matrix was destroyed by wet digestion. About 10g of sample was weighed in a Teflon cup with a screw cap and 10mL of nitric acid ($HNO_3$) and 1-2mL of perchloric acid ($HClO_4$) added and kept overnight in room temperature for digestion of sample. The cup was then placed in an oven for 5-8 hours at $100^0$C and later completely cooled under room temperature in a fume hood until the sample was clear. The digested sample was then transferred into a volumetric flask, diluted with deionized water to reach 100mL mark and carefully mixed together. The solution was then filtered with a filter paper and kept in a plastic bottle for analysis.

#### 3.6.6.1 Determination of Sodium and Potassium

The method used to determine the content of sodium and potassium was atomic absorption spectrophotometer (ASEAN Network of Food Data Systems, 2011).

The prepared sample from wet digestion was transferred into a beaker and cesium chloride solution ($CsCl_2$) added to reach dilution of 1% w/v $CsCl_2$. The solution was further diluted to reach an appropriate volume and the absorbance or intensity was measured at wavelengths 589.0 nm and 766.5 nm for sodium and potassium respectively.

**Sodium or potassium (expressed in mg/100g) =** $\frac{\mathbf{c \times v \times đ \times 100}}{\mathbf{wt \times 1000}}$

Where:

c = concentration of sample from calibration curve (mg/L)

v = total volume, mL

đ = dilution factor

wt = weight sample

1000 = conversion of mL to L

#### 3.6.6.2 Determination of Calcium

The atomic absorption spectrophotometer (AAS) was used to determine the calcium content at a specific wavelength (ASEAN Network of Food Data Systems, 2011).

An aliquot of the solution from sample prepared for mineral analysis was pipetted into a volumetric flask and 1% weight per volume (w/v) Lanthanum chloride ($LaCl_3$) solution was added to reach 0.1% w/v $LaCl_3$. The solution was then diluted with deionized water.

AAS was set up to its optimum conditions and absorbance of the standards prepared as well as test solutions were measured at wavelength (422.7nm).

**Calcium (expressed in mg/100g) =** $\frac{\mathbf{C \times total\ volume \times dilution \times 100}}{\mathbf{Weight\ of\ sample \times 1000}}$

Where:

C represented sample concentration in mg/L from calibration curve (mg/L)

1000 = mL to L conversion

### 3.6.6.3 Determination of Phosphorus

The method used for determining the content of phosphorus was gravimetric method (ASEAN Network of Food Data Systems, 2011).

About 5mL aliquot of the solution from the sample prepared for mineral analysis was transferred into a beaker and deionized water was added to reach the 40mL mark and boiled for 3 minutes. About 10mL of concentrated $HNO_3$ was added, boiled for 10 seconds and 50mL ammonium molybdate solution added. The solution was covered with watch glass and swirled every 3 minutes for 2 hours. The solution was then left overnight to precipitate. A glass filter crucible was cleaned with 95% ethanol and ether, dried in a desiccator for 1 hour under vacuum and weighed (**$\ddot{W}_1$**). The precipitate is then transferred from the beaker into the glass filter crucible and filtered with a vacuum pump. The precipitate is then rinsed with 95% ethanol and diethyl ether and later dried in a desiccator for an hour under vacuum (**$\ddot{W}_2$**).

**Phosphorus (expressed in mg/100g) =** $\frac{(\ddot{W}_2 - \ddot{W}_1) \times \mathbf{1559.4557}}{\boldsymbol{Wt}}$

Where:

$\ddot{W}_1$ = Weight of the dry glass filter

$\ddot{W}_2$ = Weight of glass filter with the precipitate

Wt = Weight of sample before sample preparation for mineral analysis

1559.4557 represented factor used to calculate phosphorus in precipitate

#### 3.6.6.4 Determination of Iron

The atomic absorption spectrophotometer (AAS) was used to determine the iron content at a specific wavelength (ASEAN Network of Food Data Systems, 2011).

An aliquot of the sample prepared for mineral analysis was diluted to an appropriate volume. AAS was set up to its optimum conditions and absorbance of the standards prepared as well as test solutions were measured at wavelength (248.3nm).

**Iron (expressed as mg/100g) =** $\frac{\mathbf{c \times v \times đ \times 100}}{\mathbf{wt \times p \times 1000}}$

Where:

c = concentration of sample in mg/L

v = total volume, mL

đ = dilution factor

wt = weight sample

p = sample solution taken

1000 = conversion of mL to L

### 3.6.7 Determination of Vitamin C Content

Titration method for determining the vitamin C content in food was used. Ascorbic acid is determined when 2, 6-dichloroindophenol is reduced to colourless dye (ASEAN Network of Food Data Systems, 2011). Due to the unstable nature of the vitamin as it can easily be oxidized or alkalized, the extraction method was quick.

The sample with weight 5g was transferred into a 100 mL volumetric flask and diluted with $HPO_3.CH_3COOH$ and tested with indicator. Triplicate 7mL $HPO_3.CH_3COOH$ solution was measured into a flask and titrated with indophenol solution until a rose pink colour lasting for 5 seconds was observed and values recorded. This represented the blank test. Aliquot of about 5mL of the sample containing ca 2mg of ascorbic acid was pipetted into 50mL flask. $HPO_3.CH_3COOH$ was added to the sample to reach 7mL mark and then titrated with indophenol solution.

**Ascorbic acid standard (mg/mL) =** $\frac{\textbf{weight ascorbic acid standard}}{\textbf{Total dilution volume}}$

**Factor (F) =** $\frac{\textbf{2mL} \times \textbf{ascorbic acid standard}}{(\textbf{mean V (ind)std} - \textbf{mean volume (blank)})}$

**Vitamin C (expressed in mg/100g) =** $\frac{(\textbf{vb})\textbf{F} \times \textbf{V} \times \textbf{D} \times \textbf{100}}{\textbf{Weight} \times \textbf{Aliquot}}$

Where:

V (ind)std = volume of indophenol standard

vb = volume of indophenol solution

F = factor

D = dilution

### 3.6.8 Determination of Carbohydrate Content

According to FAO (2003), carbohydrates was calculated from summation of percent of individual constituents of protein, fats, ash and moisture and subtracted from 100. The values are then expressed in grams.

**Carbohydrate = 100 – (% {fat + protein + moisture + ash} in 100g of food)**

### 3.6.9 Determination of Energy Content

The "general Atwater factor" was used to determine energy content. This took into account the values for protein, carbohydrates and fats based on their heats of combustion (FAO, 2003). Single factors used for the substrates are proteins (4 kcal/g), carbohydrates (4 kcal/g) and fats (9 kcal/g).

The energy values were obtained by multiplication of the values for the substrates by the "Atwater factor" for the substrates.

The results were expressed in kcal per 100g sample.

## 3.7 Nutrient Analysis

In-depth interviews were conducted with the diet cooks in the two hospitals and recipes used in the preparation of hospital-prepared enteral feeds were collected by word of mouth. The diet cooks presented food ingredients used in the feed preparation by aid of household handy measures. The quantities were then converted to grams and analysed using ESHA Food Processor and Nutrient Analysis software version 6.02 (1994). The researcher matched each ingredient to the appropriate representation found in ESHA Food Processor and Nutrient Analysis software database and the values of calories, carbohydrate, protein, fat, dietary fibre, vitamin C, calcium, iron, potassium, sodium, phosphorus and water were generated.

### 3.8 Data Management

Data from the questionnaires were entered and stored on a password protected personal computer. Questionnaires used were packed, sealed and stored in a locked cabinet in the Department of Dietetics. Codes were assigned to each participant whilst participants' and hospital names and details on the questionnaires were kept anonymous.

### 3.9 Data Analysis

Data from the questionnaires, chemical and nutrient analyses were described using charts, figures and tables where appropriate. Means and standard deviation were used to summarize the results. Values used for commercial enteral formulas were obtained from nutritional information from products' label. Independent-samples t-test was used to compare nutrient contents of hospital-prepared enteral feeds obtained from chemical analyses between the two hospitals as well as hospital-prepared enteral feeds and commercial enteral formulas in the two hospitals. Statistical tests were performed on the basis of means of duplicate samples and statistical significance was set at $p \leq 0.05$. The program that was used for statistical analysis was IBM SPSS Statistics version 23 (2015). ESHA Food Processor and Nutrient Analysis software version 6.02 (1994) was used to analyse nutrients from orally described recipes.

### 3.10 Ethical Considerations

This thesis was approved by University of Ghana, College of Health Sciences Ethical and Protocol Review Committee and the institutional review boards of 37 Military hospital and

Korle Bu Teaching hospital. Written informed consent was obtained from participants before they were recruited into the study. Participants were informed they could withdraw from the study at any point in time when they felt the need to, and it would not be held against them. Confidentiality of all information received from the study was ensured. This was done by the identities of participants and hospitals being kept anonymous and data collected stored on a personal computer with a password. Only personal data that was relevant to the study was collected.

# CHAPTER FOUR

# 4.0 RESULTS

## 4.1 Sociodemographic Characteristics of Respondents in the Study

Twenty-one (21) dietitians and six (6) diet cooks were interviewed from the two hospitals. Hospitals A and B represented 37 Military hospital and Korle Bu Teaching hospital respectively. Majority of the dietitians (57.1%) interviewed in both hospitals were females. Table 4.1 displays the sociodemographic characteristics of participating dietitians

**Table 4.1 Sociodemographic characteristics of participating dietitians**

| Variable | Hospital A Frequency (%) | Hospital B Frequency (%) | Total Frequency (%) |
|---|---|---|---|
| **Gender** | | | |
| Male | 3 (30) | 6 (54.5) | 9 (42.8) |
| Female | 7 (70) | 5 (45.5) | 12 (57.1) |
| **Total** | **10 (100)** | **11(100)** | **21(100)** |
| **Period of practice** | | | |
| 1-4years | 2 (20) | 9 (81.8) | 11 (52.4) |
| 5-8years | 5 (50) | 1 (9.1) | 6 (28.6) |
| 9-12years | 0 (0) | 1 (9.1) | 1 (4.8) |
| >12years | 3 (30) | 0 (0) | 3 (14.3) |
| **Total** | **10 (100)** | **11 (100)** | **21 (100)** |

All diet cooks interviewed from the two hospitals have obtained formal education.

Table 4.2 highlights the sociodemographic characteristics of participating diet cooks

**Table 4.2 Sociodemographic characteristics of participating diet cooks**

| Variable | Hospital A Frequency (%) | Hospital B Frequency (%) | Total Frequency (%) |
|---|---|---|---|
| **Gender** | | | |
| Male | 0 (0) | 0 (0) | 0 (0) |
| Female | 4 (100) | 2 (100) | 6 (100) |
| **Total** | **4 (100)** | **2 (100)** | 6 (100) |
| **Number of years worked** | | | |
| 1-5years | 2 (50) | 0 (0) | 2 (33.3) |
| 6-10years | 1 (25) | 0 (0) | 1 (16.7) |
| 11-15years | 0 (0) | 0 (0) | 0 (0) |
| 16-20years | 0 (0) | 1 (50) | 1 (16.7) |
| >20years | 1 (25) | 1 (50) | 2 (33.3) |
| **Total** | **4 (100)** | **2 (100)** | 6 (100) |
| **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) |
| **Total** | **4 (100)** | **2 (100)** | **6 (100)** |
| **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) |
| **Total** | **4 (100)** | **2 (100)** | **6 (100)** |

### 4.1.2 Frequency of Prescribing Enteral Feeds

Figure 4.1 shows the frequency of prescribing enteral feeds in Hospitals A and B

In Hospital A, no dietitian prescribed enteral feeds daily however half (50%) of the dietitians prescribed enteral feeds monthly. In Hospital B, more than half (55%) of the dietitians prescribed enteral feeds weekly. Thirty percent and 18% of dietitians in both hospitals chose "other" when prescribing enteral feeds. This represented dietitians who reported that prescriptions of enteral feeds were irregular.

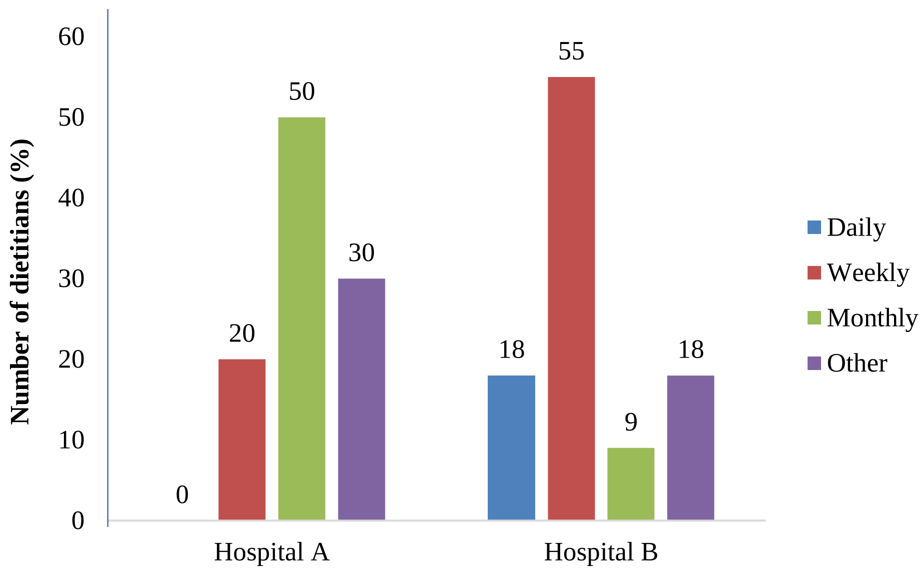



**Figure 4.1 Frequency of prescribing enteral feeds in Hospitals A and B**

## 4.2 Types of Enteral Feeds and Recipes Used for Preparation of Hospital-Prepared Enteral Feeds

### 4. 2.1 Types of Enteral Feeds

Figure 4.2 presents the types of enteral feeds used in Hospitals A and B.

All dietitians in the two hospitals use both commercial formulas and hospital-prepared enteral feeds to feed patients. More than two- thirds of the dietitians in Hospital A (90%) and Hospital B (73%) use hospital-prepared enteral feeds more often. Fortified porridges and soups were the types of hospital-prepared enteral feeds used in both hospitals with fortified soup being commonly used (100%).

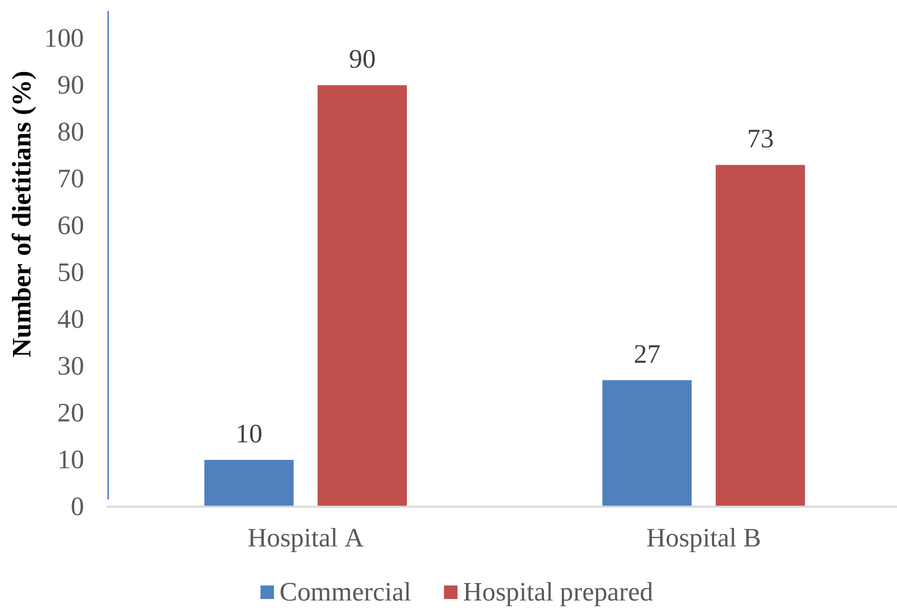



**Figure 4.2 Types of enteral feeds used in Hospitals A and B**

### 4.2.2 Brands of Commercial Enteral Formulas

The various brands of commercial enteral formulas used in Hospitals A and B are shown in Figure 4.3.

Dietitians in both hospitals use more than one brand of commercial enteral formula. *Ensure*, *Complan*, *Casilan* were the common commercial enteral formulas used in both hospitals. All dietitians in Hospital A use "*Ensure*" together with the other brands. Other commercial enteral formulas commonly used were *Nutri, Glucerna*. In addition, other commercial products used as enteral feeds but may not qualify as commercial enteral formulas were whey protein, fresh yoghurt, , soya milk and vita milk.

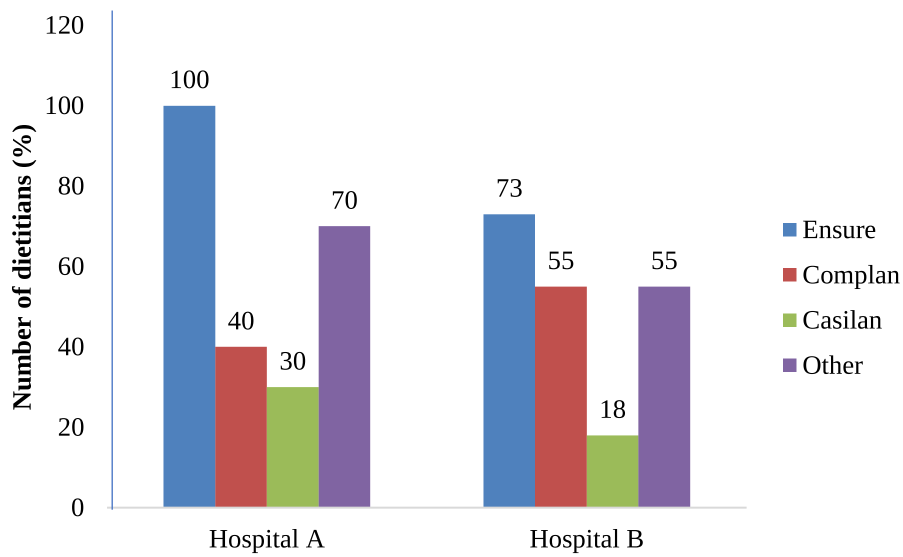
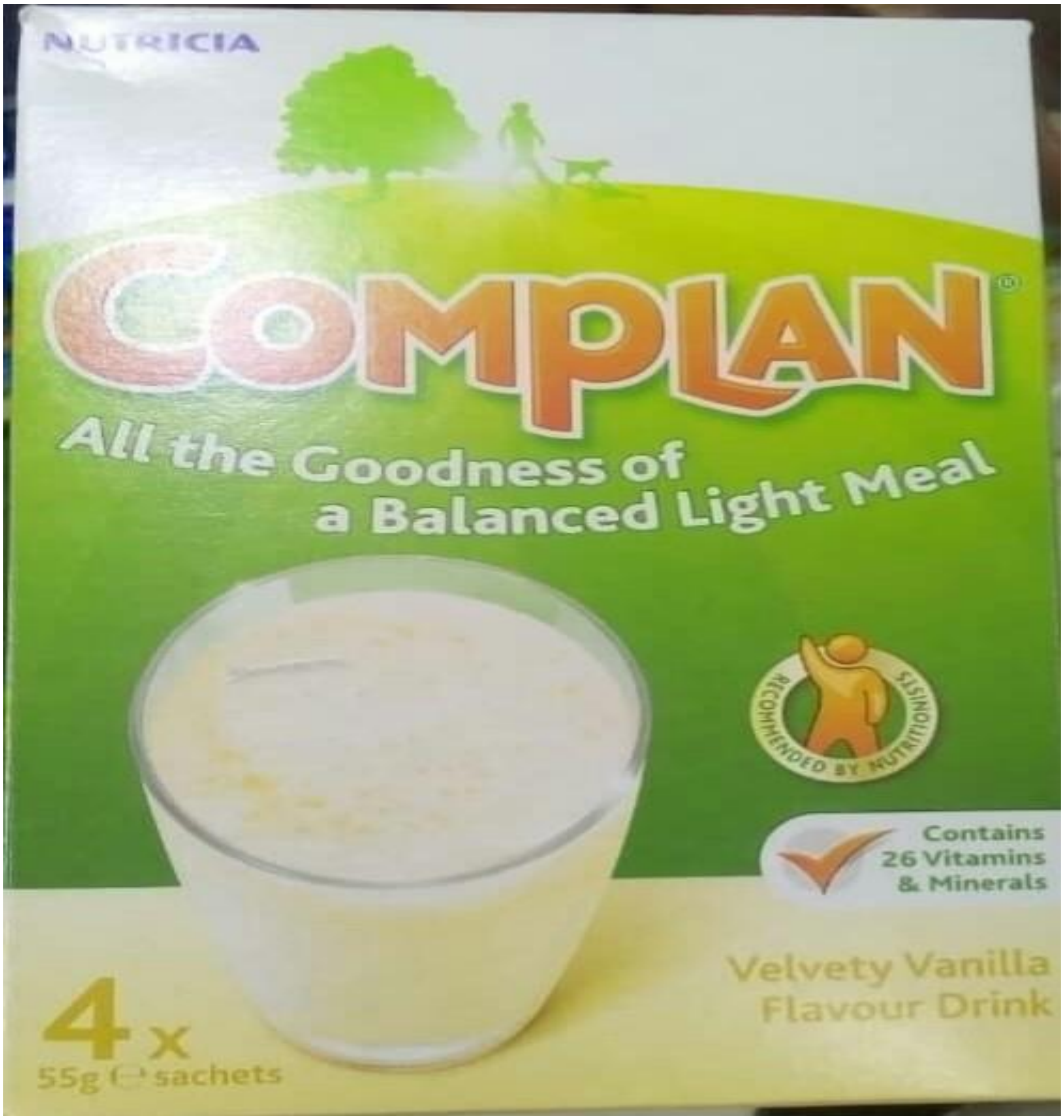



**Figure 4.3 Brands of commercial formulas used in Hospitals A and B**

Figures 4.4, 4.5 and 4.6 show images of two commonly used commercial enteral formulas

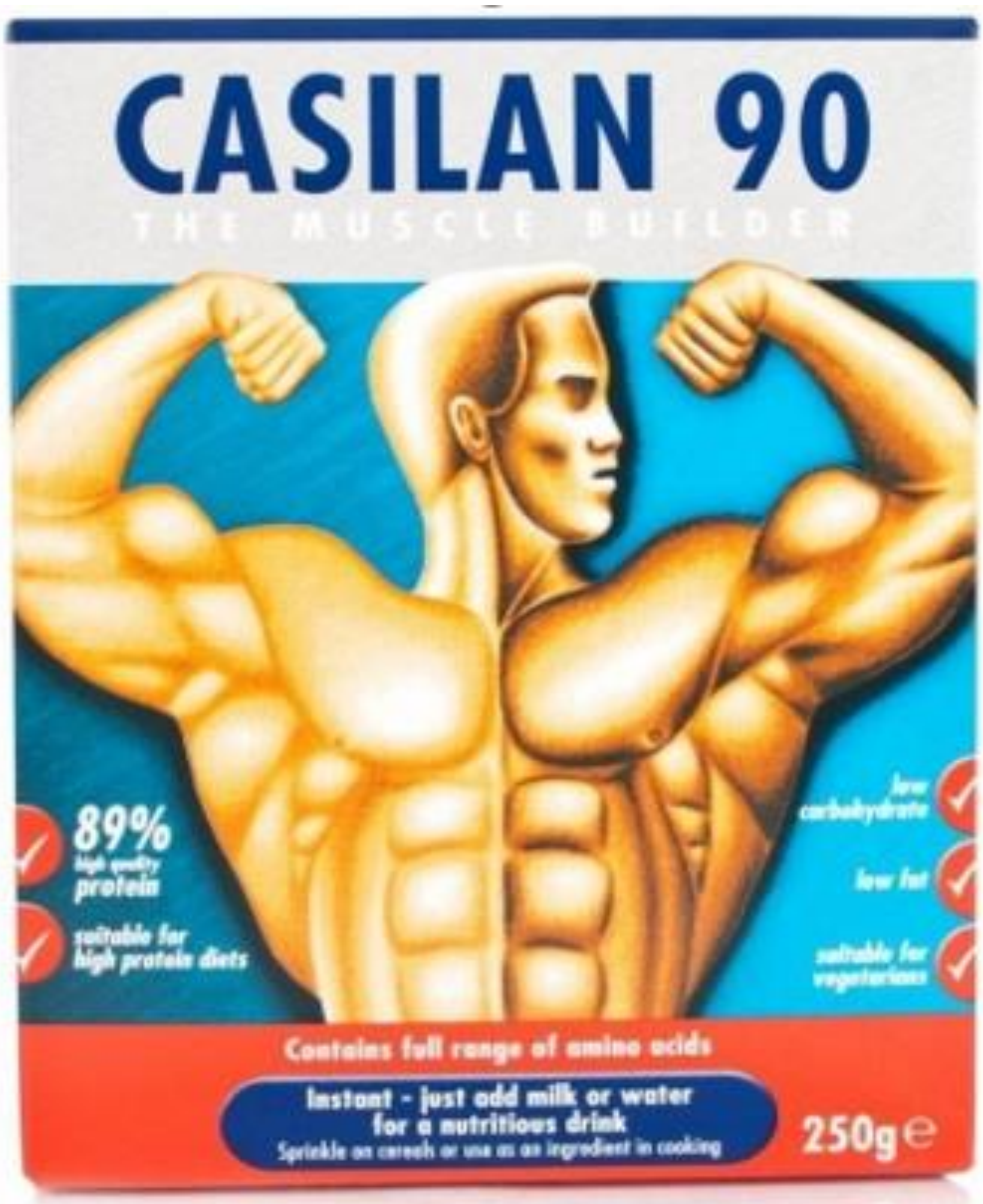

Source: https://www.cwimedical.com/ensure-nutritional-drinks/ensure-plus-drink-ens-pl

**Figure 4.4 Image of "*Ensure*" commercial formula**




Source: https://www.amazon.co.uk/complan

**Figure 4.5 Image of "*Complan*" commercial formula**




Source: https://addpharma42.com/product/casilan-90-instant-milk-protein-250g/

**Figure 4.6 Image of "*Casilan*" commercial formula**

Figure 4.7 shows the image of hospital-prepared enteral feed (fortified soup)

**Figure 4.7 Image of hospital-prepared enteral soup (fortified soup)**

### 4.2.3 Existence of a Documented Standardized Recipe

None of the hospitals had a documented standardized recipe however oral description of recipes each was given to the researcher in the two hospitals.

### 4.2.4 Food Ingredients Used in Preparing Hospital-Prepared Enteral Feeds

Sixty percent of the dietitians in Hospital A as well as 91% in Hospital B stated that local enteral feeds were prepared by diet cooks. Food ingredients used in preparing hospital-prepared enteral feeds in Hospital A listed by diet cooks were fresh tomatoes, onions, garden eggs, fish, chicken, garlic, ginger, carrot, cabbage, rice flour, soya bean flour and fish powder. In Hospital B, the food ingredients used in the preparation of hospital-prepared enteral feeds were yam, fresh tomatoes, onions, fish, vegetable oil, rice, "*kaffa*", "*kenkey"*, "*banku*" and potatoes. 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 whiles rice, fresh tomatoes, onions and fish (tuna) were used in Hospital B.

Table 4.3 presents the food ingredients and the handy measures used in Hospitals A and B.

**Table 4.3 Food ingredients and the handy measures used in Hospitals A and B**

| Hospital A | | Hospital B | |
|---|---|---|---|
| **Food Ingredient** | **Handy measure** | **Food Ingredient** | **Handy measure** |
| Light soup | 4 soup ladles | Light soup | 4 soup ladles |
| Fish powder | 1 stew ladle | Fish (tuna) | 4 matchboxes |
| Rice flour | 2 soup ladles | Rice | 2 stew ladles |
| Soya bean flour | 2 stew ladles | Vegetable oil | 1 dessertspoon |
| Salt | 1 teaspoon | Salt | ½ teaspoon |

NB: Sample food ingredients presented above are used to generate 1litre for daily feed for a patient

Table 4.4 shows the food ingredients and their weights as used in Hospitals A and B

**Table 4.4 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.

NB: Orally described recipes by diet cooks are presented in Appendix IV

### 4.3 Energy and Nutrient Values for Hospital-Prepared Enteral Feeds (fortified soup) Obtained by Chemical Analyses

Table 4.5 presents the energy and nutrient values of the hospital-prepared enteral feeds (fortified soup) obtained by chemical analyses for Hospital A. There were variations in the nutrient values between the two hospitals. Statistically significant differences were observed in all nutrients with the exception of energy, carbohydrate, vitamin C and sodium between the two hospitals.

**Table 4.5 Energy and nutrient values of hospital- prepared enteral feeds (fortified soup) for Hospitals A and B**

| Nutritional Parameter | Hospital A (Mean ± SD) | Hospital B (Mean ± SD) | P-Value |
|---|---|---|---|
| Moisture (%) | 93.932 ± 0.593 | 94.827 ± 0.128 | 0.005 |
| Energy (kcal/100g) | 23.190 ± 2.013 | 21.625 ± 1.640 | 0.171 |
| Fibre (g/100g) | 0.492 ± 0.067 | 0.120 ± 0.059 | <0.001 |
| Fat (g/100g) | 0.284 ± 0.081 | 0.495± 0.118 | 0.005 |
| Protein (g/100g) | 0.498 ± 0.276 | 0.002 ± 0.002 | 0.001 |
| Carbohydrate (g/100g) | 4.661 ± 0.392 | 4.290 ± 0.176 | 0.061 |
| Vitamin C (mg/100g) | 24.437 ± 9.845 | 30.242 ± 4.265 | 0.215 |
| Calcium (mg/100g) | 24.740 ± 7.884 | 4.745 ± 0.546 | <0.001 |
| Iron (mg/100g) | 1.677 ± 0.654 | 0.205 ± 0.268 | <0.001 |
| Potassium (mg/100g) | 72.383 ± 4.601 | 28.750 ± 5.334 | <0.001 |
| Sodium(mg/100g) | 71.953 ± 4.519 | 175.552 ± 145.413 | 0.112 |
| Phosphorus (mg/100g) | 159.917 ± 60.158 | 20.115 ± 26.338 | <0.001 |

N=6, Independent samples t-test, significant at $p \leq 0.05$

### Nutrient Analysis

A recipe each was presented to the researcher by the heads of the diet kitchens in the two selected hospitals. The energy and nutrient values obtained from the analysis using ESHA Food Processor and Nutrient Analysis software are presented below. Only one recipe each was obtained for the investigated hospital-prepared enteral feeds (fortified soup) from the two hospitals and therefore it was not possible to run statistical analysis for comparison between the two hospitals.

Table 4.6 reports the results of the nutrient analysis of hospital-prepared enteral feeds (fortified soup) for Hospitals A and B

**Table 4.6 Nutrient analysis of hospital-prepared enteral feeds (fortified soup) for Hospitals A and B**

| Nutritional parameter | Hospital A | Hospital B |
|---|---|---|
| Moisture (%) | 79 | 89 |
| Energy (kcal/100g) | 1494 | 1007 |
| Fibre (g/100g) | 7.85 | 2.01 |
| Fat (g/100g) | 23.50 | 13.20 |
| Protein (g/100g) | 64.50 | 44.90 |
| Carbohydrate (g/100g) | 128 | 50.80 |
| Vitamin C (mg/100g) | 61.70 | 57.10 |
| Calcium (mg/100g) | 1330 | 330 |
| Iron (mg/100g) | 25.40 | 2.95 |
| Potassium (mg/100g) | 78.20 | 0.24 |
| Sodium(mg/100g) | 2287 | 1143 |
| Phosphorus(mg/100g) | 1754 | 580 |

## 4.4 Comparison of Energy and Nutrient Values of Hospital-Prepared Enteral Feeds Obtained from Chemical Analyses to Commercial Formulas.

The energy and nutrient values of hospital-prepared enteral feeds (fortified soup) obtained from chemical analyses were compared to *"Ensure*" and "*Complan*" commercial formulas for both hospitals. These results are displayed in Tables 4.7 and 4.8

Table 4.7 highlights the energy and nutrient values of hospital-prepared enteral feeds (fortified soup) to 100ml "*Ensure*" and "*Complan*" commercial formulas for Hospital A. Statistically significant differences ($p \leq 0.05$) were observed in moisture, energy, macronutrients, calcium and potassium when the hospital-prepared enteral feeds were compared with "*Ensure*" commercial formula in Hospital A. Vitamin C, iron, sodium and phosphorus were however not significant ($P \geq 0.05$) which implies that the content of these nutrients were similar to that of "*Ensure*" commercial formula. Statistically significant differences ($p \leq 0.05$) were observed in energy and all nutrients with the exception of phosphorus ($p = 0.09$) when compared to "*Complan*" commercial formula.

**Table 4.7 Comparison of energy and nutrient values of hospital-prepared enteral feeds (fortified soup) to 100ml commercial formulas for Hospital A**

| **Nutritional Parameter** | **Fortified soup (N=6)** | ***Ensure* (P-value)** | ***Complan* (P-value)** |
|---|---|---|---|
| Moisture (%) | 93.932 ± 0.593 | 84 (<0.001) | - |
| Energy (kcal/100g) | 23.190 ± 2.013 | 106 (<0.001) | 444 (<0.001) |
| Fibre (g/100g) | 0.492 ± 0.067 | - | 0.1 (0.003) |
| Fat (g/100g) | 0.284 ± 0.081 | 2.6 (<0.001) | 14.8 (<0.001) |
| Protein (g/100g) | 0.498 ± 0.276 | 3.7 (<0.001) | 15.4 (<0.001) |
| Carbohydrate (g/100g) | 4.661 ± 0.392 | 17 (<0.001) | 62.4 (<0.001) |
| Vitamin C (mg/100g) | 24.437 ± 9.845 | 13 (0.331) | 53 (0.044) |
| Calcium (mg/100g) | 24.740 ± 7.884 | 127 (<0.001) | 560 (<0.001) |
| Iron (mg/100g) | 1.677 ± 0.654 | 1.9 (0.765) | 6.7 (0.001) |
| Potassium (mg/100g) | 72.383 ± 4.601 | 156 (<0.001) | 719 (<0.001) |
| Sodium(mg/100g) | 71.953 ± 4.519 | 80 (0.160) | 500 (0.001) |
| Phosphorus (mg/100g) | 159.917 ± 60.158 | 127 (0.634) | 296 (0.090) |

Independent samples t-test, significant at $p \leq 0.05$

The results for the energy and nutrient values for Hospital B prepared enteral feeds (fortified soup) and "*Ensure*" commercial formula shown in Table 4.8 indicates that there was no statistically significant difference ($p \leq 0.05$) in sodium in hospital-prepared enteral feeds (fortified soup) compared to "*Ensure*" commercial formula. This implies that the sodium content in hospital-prepared enteral feeds is similar to "*Ensure*" commercial formula. Statistically significant differences ($p \leq 0.05$) were observed in all other nutrients. There was no statistically significant difference in sodium ($p = 0.094$) and fibre ($p = 0.770$) in hospital-prepared enteral feeds (fortified soup) compared to "*Complan*" commercial formula.

**Table 4.9 Comparison of energy and nutrient values of hospital-prepared enteral feeds (fortified soup) to 100ml commercial formulas for Hospital B**

| **Nutritional Parameter** | **Fortified soup (N=6)** | ***Ensure (P-value)*** | ***Complan* (P-value)** |
|---|---|---|---|
| Moisture (%) | 94.827 ± 0.128 | 84 (<0.001) | - |
| Energy (kcal) | 21.625 ± 1.640 | 106 (<0.001) | 444 (<0.001) |
| Fibre (g/100g) | 0.120 ± 0.059 | - | 0.1 (0.770) |
| Fat (g/100g) | 0.495± 0.118 | 2.6 (<0.001) | 14.8 (<0.001) |
| Protein (g/100g) | 0.002 ± 0.002 | 3.7 (<0.001) | 15.4 (<0.001) |
| Carbohydrate (g/100g) | 4.290 ± 0.176 | 17 (<0.001) | 62.4 (<0.001) |
| Vitamin C (mg/100g) | 30.242 ± 4.265 | 13 (0.013) | 53 (0.004) |
| Calcium (mg/100g) | 4.745 ± 0.546 | 127 (<0.001) | 560 (<0.001) |
| Iron (mg/100g) | 0.205 ± 0.268 | 1.9 (0.002) | 6.7 (<0.001) |
| Potassium (mg/100g) | 28.750 ± 5.334 | 156 (<0.001) | 719 (<0.001) |
| Sodium(mg/100g) | 175.552 ± 145.413 | 80 (0.157) | 500 (0.094) |
| Phosphorus (mg/100g) | 20.115 ± 26.338 | 127 (0.013) | 296 (<0.001) |

Independent samples t-test, significant at $p \leq 0.05$

# CHAPTER FIVE

# 5.0 DISCUSSION AND CONCLUSION

## 5.1 Introduction

Enteral nutrition support is administered to patients with a functional gastrointestinal tract but are not able to feed orally to meet their energy and nutrient intake. The extent to which the critically ill obtain enough benefits from enteral nutrition is reliant on the content of the food. Dietitians and diet cooks play an important role in the nutrition care of patients. Adequate nutrition care provided to patients leads to reduced duration in the hospital and improved health outcomes.

### 5.1.1 Sociodemographic Characteristics of Study Participants

Majority of the dietitians (57.1%) interviewed from the two hospitals were females. This may be explained by the fact that the food and nutrition professions are mostly female dominated. This finding is similar to the study by Gheller & Lordly (2015) in Canada that discovered majority of dietitians (95%) to be females.

Again, in this study, 75% of the diet cooks in Hospital A had vocational education whiles all diet cooks in Hospital B had tertiary education (Table 4.2) which implies that majority of diet cooks had formal education. This could be attributed to the fact that the requirement for job employment in the hospital for diet cooks could be formal education. The finding is consistent with a study by Akabanda *et al.* (2017) on food handlers in 29 institutions including 9 district hospitals across Ghana that revealed that 85.5% of the respondents interviewed had formal education. Donini *et al*. (2008) stated that educational improvement was key to food service providers in playing a vital role in the nutrition care of patients.

### 5.1.2 Frequency of Prescribing Enteral Feeds

Dietitians are responsible for identifying the nutrient needs of patients and therefore may be in a better position of prescribing enteral feeds that may help improve nutritional status. From the resuts shown in Figure 4.1, half of the dietitians (50%) in Hospital A prescribe enteral feeds monthly and majority of the dietitians (55%) in Hospital B prescribe enteral feeds weekly. This is possible because Hospital B is a major referral centre in the country (Korle Bu Teaching Hospital, 2016) and therefore it is very likely that most patients requiring enteral nutrition support may frequently be referred for medical and nutritional care.

## 5.2 Types of Enteral Feeds and Recipes Used for Preparation of Hospital-Prepared Enteral Feeds

### 5.2.1 Types of Enteral Feeds

Dietitians in the two hospitals use both commercial formulas and hospital-prepared enteral feeds to feed patients however, majority of the dietitians in Hospital A (90%) and Hospital B (73%) use hospital-prepared enteral feeds more often as shown in Figure 4.2. The types of hospital-prepared enteral feeds used in the two hospitals are "fortified soups" and "fortified porridges" with fortified soups being commonly used. Hospital-prepared enteral feeds may be used more often possibly because they are made of readily available local ingredients and may be less expensive to use than commercial formulas. This finding is in line with a systematic review conducted by Ojo et al. (2020) that recorded a high rate of usage of blenderized feeds in developing countries and linked this to the fact that these types of feeds were less expensive compared to commercial enteral formulas. Similarly, a study conducted in New York on Oley Foundation members discovered that 65.9% of adults interviewed used blenderized feeds more often basically because such feeds were well-tolerated (Epp, 2018)

### 5.2.2 Brands of Commercial Enteral Formulas

Dietitians in the two hospitals use more than one brand of commercial formula. The brands of commercial enteral formulas used in the two hospitals as seen in Figure 4.3 were *Ensure*, *Complan* and *Casilan*. The other products used were *Glucerna*, *Nutri*, whey protein, fresh yoghurt, soya milk and vita milk. *Ensure* was the most common brand used in the two hospitals. This is likely to be because it is readily for sale on the Ghanaian markets, in supermarkets and pharmacies. Study by Hassan-ghomi *et al.* (2017) reported *Ensure*, *Entramil*, *Milatech*, *Notricamp* and *Fresubin* as the common types of commercial enteral formulas used in Iran. Some commercial enteral formulas listed by the Royal Pharmaceutical Society (2017) in England were *Ensure*, *Fresubin*, *Nutrison*, *Jevity* and *Osmolite* .

### 5.2.3 Existence of a Documented Standardized Recipe

None of the hospitals interviewed presented a documented standardized recipe however, diet cooks described how the enteral feeds were made. They further reported that they had prepared the foods over and over again. However, the absence of documented standardized recipes is likely to produce inconsistencies in the nutrient values of the prepared feeds. According to Egan (2015), a standardized recipe is a set of instructions that is written and used in preparation of food in order to produce a known and consistent quantity and quality even when a different person prepares the meal. The absence of a standardized recipe therefore may make it difficult to produce consistent results. This finding confirms a systematic review and meta-analysis on “an evaluation of the nutritional value and physical properties of blenderized enteral nutrition formula" by Ojo *et al.* (2020) which revealed that the absence of a standardized recipe led to irregularities in the nutrient values of blenderized feeds produced.

### 5.2.4 Food Ingredients Used in Preparing Hospital-Prepared Enteral Feeds (fortified soup)

"Fortified porridges and soups" were the types of hospital-prepared enteral feeds used in the two hospitals however, "fortified soups" were the type commonly used. Generally, food ingredients used in preparing "fortified soups" in Hospital A were fresh tomatoes, onions, garden eggs, fish, chicken, garlic, ginger, carrot, cabbage, rice flour, soya bean flour, fish powder. In Hospital B, the food ingredients used in the preparation of hospital-prepared enteral feeds were yam, fresh tomatoes, onions, garden eggs, turkey berries, fish (tuna, salmon), vegetable oil, rice, *kaffa*, potatoes, *kenkey*, *banku*. However, in this study, food ingredients used in the preparation of "fortified soup" in the two hospitals as shown in Table 4.3 were fresh tomatoes, onions, fish powder, soya bean flour, rice flour in Hospital A and fresh tomatoes, onions, rice and fish (tuna) in Hospital B and this was because at the time of data collection these were the food ingredients available from the hospital stores to be used for feed preparation. These food ingredients are readily available on the markets and can be accessed all year round. This finding is similar to a number of investigations conducted that observed that food ingredients such as vegetables, milk, meat, chicken, beef, eggs, fruits, legumes, grains, maltodextrin and vegetable oil were used in the preparation of blenderized feeds (Mokhalalati *et al*., 2004 ; Araujo *et al.*, 2013; Ezz El-Regal *et al.*, 2016 ; Paula *et al*., 2017; Vieira *et al.*, 2018 ; Shabanpur *et al*., 2018).

### 5.3 Energy and Nutrient Values for Hospital-Prepared Enteral Feeds (fortified soup) Obtained by Chemical Analyses for Hospitals A and B.

Table 4.5 presented the energy and nutrient values of hospital-prepared enteral feeds obtained from chemical analyses of the two hospitals. From the results obtained, the energy and nutrient values of hospital-prepared enteral feeds were lower compared to other reported studies. The energy values in this study were 23.19kcal in Hospital A and 21.63kcal in Hospital B. Vieira *et al.* (2018) recorded energy value to be 40.5kcal which even though were low were slightly higher than the values obtained in the study. Carbohydrate values in the study were 4.66g and 4.29g in Hospitals A and B respectively. Mokhalalati *et al.* (2004) recorded 6.01-11.15g as the mean ranges for carbohydrates and these values were slightly higher than the values obtained in the study. However, values for Vieira *et al.* (2018) reported lower value of carbohydrates (3.40g). Protein values obtained in this study were 0.498g and 0.002g in Hospital A and B respectively. Vieira *et al.* (2018) reported 2.10g as the protein value of non-commercial enteral diets. Fats and fibre values obtained in this study were 0.28g; 0.49g and 0.50g; 0.12g in Hospitals A and B respectively and these values were lower than other investigations conducted in the area. Fats and fibre recorded in other studies were 1.90g; 0.80g (Vieira *et al*., 2018) and fat-1.77g (Sullivan et al., 2004); fibre-1.86g (Felicio *et al.*, 2012). Sodium values in this study were 71.95mg in Hospital A and 175.55mg in Hospital B. These values when compared to a study by Sullivan *et al.* (2004) recorded lower values. The sodium values reported in their study were 679mg, 672mg, 405mg and 280mg in four hospitals. The study conducted by Mokhalalati *et al.* (2004) reported the values of potassium and calcium as 112.40mg, 274.20mg and 41.10mg, 80.50mg respectively. These values were higher than the values of potassium and calcium obtained in this study. In Hospital A, potassium and calcium recorded 72.38mg and 24.74mg and in Hospital B, 28.75mg and 4.75mg respectively. The values of phosphorus in this study were 159.92mg and 20.12mg in Hospitals A and B respectively but was lower than 293mg and 499mg in the study conducted by Sullivan *et al.* (2004). The value for iron for Hospital A, 1.68mg was higher than the values recorded by Mokhalalati *et al.* (2004) which were 0.15mg to 0.65mg in four hospitals whiles Hospital B reported less values (0.20mg). Again, this study recorded higher vitamin c values (24.44mg and 30.24mg) in Hospitals A and B as compared to 0.89mg and 2.09mg in the study by Mokhalalati *et al.* (2004).

The energy and nutrient values obtained from the chemical analyses of the hospital-prepared enteral feeds samples investigated in the two hospitals in this study were low. These lesser values may imply that the nutrients in the feeds may have been lost during feed preparation. After the feed was prepared, it may have had a high viscosity and therefore may be impossible to pass through feeding tubes and may clog feeding tubes thus after preparation of the feed, sieving was done to make it easier to pass through the tubes. This sieving may lead to loss of nutrients and cause less nutrients to be retained in the feeds. Again, lots of water may be added to make it slightly thin for easy passage through tubes. This finding is consistent with the study by Vieira *et al.* (2018). Their study recorded high addition of liquids to blended feeds to reduce the viscosity and continuous sieving in order to remove greater particles to enable easier passage of feeds. The addition of water to blenderized feeds is likely to allow free flow of feeds to prevent clogging of tubes; however this further decreases the nutritional value of the feeds (Carter *et al.*, 2018).

Furthermore, the lesser values recorded may be attributed to the choice of foods used in feed preparation. The food ingredients used for feed preparations may be low-dense foods and therefore may not retain enough nutrients after preparation. This may be due to the fact that the food ingredients used for the sample feeds investigated in the two hospitals were the food ingredients available in the hospital stores and as a result, the diet cooks may be obliged to use such ingredients for feed preparation even when the food ingredients are low-dense foods. This, therefore may influence the values obtained from chemical analyses.

Significant differences observed in all nutrients with the exception of energy, carbohydrate, vitamin c and sodium between the two hospitals may be closely linked to the fact that different food ingredients were used in preparing the feeds in the two hospitals. These different food ingredients may have different nutrient compositions which is likely to cause differences in the nutrients analysed. This finding is consistent with the study conducted by Mokhalalati *et al.* (2004) in three hospitals in Saudi Arabia which discovered that differences in nutrient composition of blenderized feeds among three hospitals were due to different food ingredients used.

Again, the significant differences observed between the two hospitals may be attributed to the quantities of food ingredients used to prepare hospital-prepared enteral feeds. The food ingredients used for feed preparation may be low in quantity and therefore, feeds produced may record less nutrients. This confirms a study by Davidson *et al.* (2017) in South-Eastern Nigeria that revealed that the greater the quantities of food ingredients used in preparing soups the higher the nutrient contents of the soups. Furthermore, in this study, the two hospitals had no documented standardized recipes to follow in order to produce consistent nutrient values. A standardized recipe will show the actual quantities of food ingredients to be used to prepare feeds. This finding confirms a study by Ojo *et al*. (2020) that revealed that the absence of a standardized recipe led to irregularities in the nutrient values of blenderized feeds produced.

When such feeds are provided to critically ill patients, there is the possibility that they may receive lesser nutrients than they actually should receive. During critical illness, the body undergoes metabolic stress and there is hypermetabolism, and therefore nutrients are provided to help reverse the situation in order to lead to speedy recovery, reduced length of stay, low hospital costs as well as mortality. These hypermetabolic patients require increased nutrients and therefore when nutrients are under supplied to the patient, there is the danger of causing malnutrition in the hospital which can be detrimental. Studies have shown that 40% of patients become malnourished in hospitals (Pearce & Duncan, 2002). The lesser energy and nutrient values of the feeds analyzed from the two hospitals are therefore of great concern. Nutrients such as carbohydrates, fats and proteins are needed by the critically ill but from the study they are in small quantities that may impact on the nutritional status of the critically ill. Protein for instance, is a vital macronutrient in enteral feeding (McClave *et al*., 2016) and it is important that it is provided in the right amounts to aid rapid healing and in overcoming metabolic stress that occurs during injury or trauma.

**5.4 Comparison of Energy and Nutrient Values of Hospital-Prepared Enteral Feeds Obtained from Chemical Analyses to Commercial Enteral Formulas.**

Evident from Tables 4.7 and 4.8, there were differences detected in energy, fat, protein, carbohydrates when the hospital-prepared enteral feeds were compared to two commercial enteral formulas. The differences observed may be due to the fact that nutrient contents of commercial enteral formulas are designed specifically to cater for the needs of a healthy population (Malone 2005). Unlike hospital-prepared feeds that are made from local food ingredients that had to undergo sieving and inaccurate measurements of food ingredients, commercial enteral formulas are made of nutrients that have undergone processing and manufacturing standards in order to cater for the nutrient needs of the population intended for. These commercial enteral formulas therefore can be used to accurately prepare feeds for patients and obtain the estimated nutrients required. A number of studies have stated similar views when blenderized feeds were compared to commercial formulas. One of such studies revealed that commercial formulas were precise in supplying nutrients the body needed compared to blenderized feeds (Mokhalalati *et al*., 2004). They attributed this to irregularities in measurement of food ingredients which notwithstanding may influence the results obtained. Another study by Jolfaie *et al*. (2017) demonstrated that commercial enteral formulas provided the needed values for carbohydrates, energy and fat when compared to non-commercial enteral formulas. Contrary to finding of this study was a study by Hron *et al*. (2019) who recorded similarities in the concentrations of macro and micronutrient contents between blenderized feeds and commercial enteral formulas.

Again, in this study, the two hospitals had a method for preparing enteral feeds (fortified soup) but did not have a documented standardized recipe that could be used in feed preparation in order to minimize errors and inconsistencies that may arise in human measurement of food ingredients. This is consistent with the study by Ojo *et al*. (2020) that identified the lack of standard formulation to be a contributory factor to the differences between hospital-prepared enteral feeds and commercial enteral formulas.

### 5.5 Conclusions

The study showed that fortified porridges and soups were the types of hospital-prepared enteral feeds used in the two hospitals with fortified soup being commonly used. The commercial enteral formulas frequently used in the two hospitals were *Ensure*, *Complan* and *Casilan*. There were no documented standardized recipes in the two selected hospitals. Significant differences were observed in all nutrient values with the exception of energy, carbohydrate, vitamin c and sodium of hospital-prepared enteral feed samples investigated by chemical analyses between the two hospitals. Again, vitamin c, iron, sodium and phosphorus values of *Ensure* commercial formula and the hospital-prepared enteral feeds as well as fibre, sodium and phosphorus values of *Complan* and hospital-prepared enteral feeds were similar nevertheless energy, fat, protein, carbohydrate, calcium and potassium were higher in the commercial enteral formulas compared to the hospital-prepared enteral feeds. This implied that the energy and nutrient values of hospital-prepared enteral feeds samples differed from the commercial enteral formulas.

### 5.6 Limitations of the study

Due to the corona virus pandemic, it was not possible to collect data from the third hospital as decided earlier and therefore researcher only had two hospitals for the study. It will be greater to see data from other hospitals for a broader view.

Diet cooks estimated the quantities of food ingredients used in feed preparation and this could lead to information bias. This is because diet cooks may have under or over-estimated quantities of food ingredients used by recall and is likely to influence the results obtained.

## 5.7 Recommendations

- A documented standardized recipe should be developed in hospitals to guide cooking that will help improve nutrition and prevent inconsistencies in nutrient values.
- Based on the developed standardized recipes, nutrients in hospital-prepared enteral feeds should be calculated by dietitians to enable modifications to be done to cater for nutrients which are low.
- Further research should be conducted in other hospitals around the country in order to reflect the general population.
- Extensive research could be conducted to identify the viscosity and microbial state of the feeds prepared in hospitals.
- Research should be conducted on patients who are fed hospital-prepared enteral feeds to find out the nutritional adequacy to the patients.

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# APPENDICES

## APPENDIX 1: Information Sheet

Dear Respondent,

I am Rosa Adom, a Masters student at the School of Biomedical and Allied Health Sciences, University of Ghana and Principal Investigator of this study.

I am carrying out a research on **“NUTRIENT PROFILES OF ENTERAL FEEDS IN SELECTED HOSPITALS IN ACCRA, GHANA”**.

This study seeks to investigate the nutrient profiles of enteral feeds provided to patients in hospitals in Accra, Ghana.

As part of this study, you would be required to complete a questionnaire about yourself, on your roles as dietitians or diet cooks involved in enteral nutrition support in your facility. Additionally, information on the types of enteral feeds available to you and recipes for the preparation of hospital-prepared enteral feeds will be obtained. An observation on feed preparation as well as collection of hospital-prepared enteral feeds will be made for chemical analyses.

Please respond carefully and sincerely to the best of your knowledge. All information given will be kept confidential and used for the research purpose only.

Participation in this survey is completely voluntary and you are free to withdraw your participation at any stage of this study without giving any reason. There would be no compensation.

Thank you.

For further enquiries about this research, kindly contact Rosa Adom of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana on +233(0) 267295311.

**APPENDIX II: Consent Form**

I, ROSA ADOM have fully explained the nature and purpose of the research, risks and benefits. I have permitted the respondent to ask questions relating to the study and have fully answered to the best of my ability.

I have been invited to take part in this study for the research titled above.

My role is to complete some attached questionnaires. I acknowledge that the research procedures have been explained to me and all questions have been answered to my satisfaction. I have been informed that the confidentiality of the information I will provide will be safeguarded and that the privacy and anonymity will be ensured in the collection, storage and publication of the research material.

I………………………………………… have fully understood the aims, methods and collections of participation in this study, I therefore consent to my participation.

| | |
|---|---|
| ………………………… | ………………………… |
| Participant's signature | Date |
| ……………………… | ………………………… |
| Researcher's signature | Date |

**APPENDIX III: Questionnaire**

**<u>SECTION A</u>: INFORMATION ON ENTERAL FEEDING (<u>FOR DIETITIANS ONLY)</u>**

1. Name of hospital?

   …………………………………

2. How long have you been practicing as a dietitian?

   ………………………………………………………………………………………..

3. How often do you administer enteral feeds?

a. [ ] Never
b. [ ] Daily
c. [ ] ___ times in a Weekly
d. [ ] ___ times in a Monthly
e. [ ] Other (please specify)…………………………………………………..………

4. What products are used for enteral tube feeding in your facility?

a. [ ] Commercial products ONLY
b. [ ] Locally prepared enteral feeds ONLY
c. [ ] Commercial products and locally prepared enteral feeds
d. [ ] Other (please specify)…………………………………………………

4b. If you chose **'c'**, which one do you use more often

a. [ ] Commercial products
b. [ ] Locally prepared enteral feeds

5. If you chose **'a'** or **'c'** in **4** above, please tick the brands of commercial enteral feeding products are used in your facility?

a. [ ] Complan
b. [ ] Ensure
c. [ ] Caslan
d. [ ] Other (please specify)……………………………………………………….

6. Is there a standardized recipe for use in your facility, if you use locally prepared enteral feeds?

a. [ ] Yes
b. [ ] No
c. [ ] Don't know

7. If yes, kindly provide a copy of the recipe

8. Who prepares the local enteral feeds in your facility?

a. [ ] Diet cooks
b. [ ] Kitchen staff
c. [ ] Other (please specify)…………………………………………………………

9. Has the nutrient content of the local enteral feeds been determined? (e.g. what is the macronutrient content – carbohydrates, fats, protein, in 100ml of the enteral feed)

a. [ ] Yes
b. [ ] No

9b. If yes, please provide a copy

10. Have the diet cooks received any form of training in preparing local enteral feeds?

a. [ ] Yes
b. [ ] No
c. [ ] Don't know

11. Which types of locally prepared enteral feeds are commonly used in your facility?

a. [ ] Fortified porridge
b. [ ] Fortified soup

c. [ ] Other (please specify)…………………………………………………………….

12. Who supervises the preparation of local enteral feeds?

a. [ ] Dietitian
b. [ ] Diet Cook Supervisors
c. [ ] Kitchen colleagues
d. [ ] Other (please specify)………………………………………………………..

13. How often is the preparation of local enteral feeds supervised?

a. [ ] Daily
b. [ ] ___ times in a Weekly
c. [ ] ___ times in a Monthly
d. [ ] Other (please specify)……………………………………………..………

**<u>SECTION B</u>: INFORMATION ON HOSPITAL ENTERAL FEEDING PREPARATION (<u>FOR DIET COOKS ONLY)</u>**

1. How long have you been working in the hospital kitchen?

…………………………………………………………………………………………

2. What is your educational level?

a. [ ] Primary school
b. [ ] Junior secondary
c. [ ] Senior secondary
d. [ ] Vocational school
e. [ ] Tertiary

3. Have you received any form of training in preparing local enteral feeds?

a. [ ] Yes
b. [ ] No

4. If yes, where did you receive this form of training?

a. [ ] Your current workplace
b. [ ] Your previous workplace
c. [ ] At your training institution.
d. [ ] Other (please specify)…………………………………………………………………

5. Who provided the training you received in the preparation of local enteral feeds?

a. [ ] Dietitian
b. [ ] Diet Cook Supervisors
c. [ ] Kitchen colleagues
d. [ ] Other (please specify)……………………………………………………..

6. Does the kitchen have a standardized recipe for preparing local enteral feeds?

a. [ ] Yes

b. [ ] No
c. [ ] Don't know

7. If yes, please provide a copy of the recipe.

8. If no, please complete **Sheet 1**?

9. Is there a supervision for preparation of local enteral feeds?

a. [ ] Yes
b. [ ] No

10. If yes, who supervises enteral feeds preparation?

a. [ ] Dietitian
b. [ ] Diet Cook Supervisors
c. [ ] Kitchen colleagues
d. [ ] Other (please specify)…………………………………………………..

**SHEET 1: MEAL PREPARATION PROCEDURE**

| **Name of Meal** | **Patient Condition** | **Ingredient** | **Measurement (in cups/grams)** | **Preparation procedure** |
|---|---|---|---|---|
| | | | | |

**APPENDIX IV: Orally described recipes for hospital-prepared enteral feeds**

**Orally described recipes for Hospital A**

Recipe name: Fortified soup

**A. Ingredients (fish-based fortified soup) for one patient**

| | |
|---|---|
| Rice flour | 2 soup ladles |
| Soya bean flour | 2 stew ladles |
| Fresh tomato | 3-4 medium sized |
| Onion | 1 medium sized |
| Fish powder | 1 stew ladle |
| Garden eggs | 2 small size |
| Salt | 1 teaspoon |

**Method of preparation**

Soak soya bean flour and rice flour in water for 30 minutes

Sieve the mixture in a saucepan and bring to boil

Wash and blend vegetables into a smooth consistency

Add blended vegetables to the boiling stock

Remove from fire after 30-45 minutes and add fish powder

Add salt to taste

Allow to simmer

Sieve soup into another saucepan

Serve fortified soup

**B. Ingredients (chicken-based fortified soup) for one patient**

| | |
|---|---|
| Rice flour | 2 soup ladles |
| Soya bean flour | 2 stew ladles |
| Fresh tomato | 3-4 medium sized |
| Onion | 1 medium sized |
| Chicken | 2 drumsticks |
| Garden eggs | 2 small size |
| Garlic and ginger | 1 dessertspoon |
| Salt | 1 teaspoon |

**Method of preparation**

Soak soya bean flour and rice flour in water for 30 minutes

Sieve the mixture in a saucepan and bring to boil

Season chicken with onion, garlic and ginger

Blend chicken

Wash and blend vegetables into a smooth consistency

Add blended vegetables and blended chicken stock to soya bean flour and rice flour mixture

Allow to simmer

Add salt to taste

Remove from fire after 30-45 minutes

Allow to simmer

Sieve soup into another saucepan

Serve fortified soup

**Orally described recipes for Hospital B**

I. Recipe name: Fortified porridges (with corn, rice, oats, millet or "*ekuegbemi*")

**A. Ingredients (corn-based fortified porridge) for one patient**

| | |
|---|---|
| Corn dough | 1 stew ladle |
| Salt | ½ teaspoon |
| Water | 750ml |
| Egg | 1 or 2 (whole or yolk depending on dietitian's prescription) |
| Milk | quantity dependent on dietitian's prescription |

**Method of preparation**

Boil water about 500ml and add a pinch of salt to the boiling water

Mix corn dough with water to form a paste

Add the paste to the boiling water and gradually stir

Take porridge from fire

***Fortification is done with eggs or milk***

*in fortifying with egg (see below)

Boil water about 150ml

Break egg(s) and add to boiling water

Stir till an off-white colour is noticed

Add mixture to the porridge and gently sieve fortified porridge

Put the fortified porridge on fire for five minutes and remove from fire.

Serve fortified porridge

**B. Ingredients (rice/ oats/ millet/ "*ekuegbemi*" based fortified porridge) for one patient**

| | |
|---|---|
| Rice/ oats/ millets/ "*ekuegbemi*" | 1 stew ladle |
| Salt | ½ teaspoon |
| Water | 750ml |

Egg 1 or 2 (whole or yolk depending on dietitian's prescription)

Milk quantity dependent on dietitian's prescription

**Method of preparation**

Boil water about 500ml and add a pinch of salt to the boiling water

Rice/ oats/ millet or ekuegbemi is blended into powder form

Mix the powder with water to form a paste

Add the paste to the boiling water and gradually stir

Take porridge from fire

***Fortification is done with eggs or milk***

*in fortifying with egg (see below)

Boil water about 150ml

Break egg(s) and add to boiling water

Stir till an off-white colour is noticed

Add mixture to the porridge and gently sieve fortified

Put the fortified porridge on fire for five minutes and remove from fire.

Serve fortified porridge

2. Recipe name: Fortified soup (yam, rice, potato, *kaffa*, *banku*, *kenkey*)

**A. Ingredients (yam/potato-based fortified soup) for one patient**

| | |
|---|---|
| Yam/potato | 3 sardine tin |
| Fresh tomato | 4 medium sized |
| Onion | 1 medium sized |
| Fish (tuna, salmon, dry fish, fish powder) | 4 matchbox size |
| Turkey berries | 1 stew ladle |
| Vegetable oil | 1-2 dessertspoons |
| Salt | ½ teaspoon |

**Method of preparation**

Wash and cut yam or potatoes into suitable sizes and bring to boil

Wash vegetables and fish and add to boiling yam

Gently remove yam or potato from stock and blend into a smooth consistency

Add blended yam to the boiling stock

Remove vegetables and fish from stock and blend separately

Gradually add the blended vegetables and fish to the boiling stock

Add vegetable oil and salt to taste

Allow to simmer

Sieve soup into another saucepan and bring to boil

Allow to simmer for few minutes

Serve fortified soup

**B. Ingredients (rice-based fortified soup) for one patient**

| | |
|---|---|
| Rice | 2 stew ladles |
| Fresh tomato | 4 medium sized |
| Onion | 1 medium sized |
| Fish (tuna, salmon, dry fish, fish powder) | 4 matchbox size |
| Turkey berries | 1 stew ladle |

| | |
|---|---|
| Vegetable oil | 1-2 dessertspoons |
| Salt | ½ teaspoon |

**Method of preparation**

Wash rice, add water and bring to boil

Blend the rice and bring to boil

Wash vegetables and fish and steam in a saucepan

Remove vegetables and fish from stock and blend separately

Gradually add the blended vegetables and fish to the blended rice stock

Add vegetable oil and salt to taste

Allow to simmer

Sieve soup into another saucepan and bring to boil

Allow to simmer for few minutes

Serve fortified soup

**C. Ingredients (*kenkey, banku or kaffa*-based fortified soup) for one patient**

| | |
|---|---|
| *Kenkey/banku/kaffa* | 1 small orange-sized |
| Fresh tomato | 4 medium sized |
| Onion | 1 medium sized |
| Fish (tuna, salmon, dry fish, fish powder) | 4 matchbox size |
| Turkey berries | 1 stew ladle |
| Vegetable oil | 1-2 dessertspoons |
| Salt | ½ teaspoon |

**Method of preparation**

Wash vegetables and fish and steam in a saucepan

Remove vegetables and fish from stock and blend separately

Gradually add the blended vegetables and fish to the stock

Gently break *kenkey*, *banku* or *kaffa* into suitable sizes and add to boiling stock

Bring to boil

Blend stock into a smooth consistency

Add vegetable oil and salt to taste

Allow to simmer

Sieve soup into another saucepan and bring to boil

Allow to simmer for few minutes

Serve fortified soup

**APPENDIX V: Official raw data for analytical test**


**UNIVERSITY OF GHANA**
**DEPARTMENT OF NUTRITION AND FOOD SCIENCE**
SCHOOL OF BIOLOGICAL SCIENCES


**Ref. No.:**...........................................

July 15, 2020

Dr. Laureen Boateng
Nutrition and Dietetics department
College of Health Sciences
Korle Bu.
July 14, 2020

Dear Madam,

**Analytical Test Report**

I refer to your request for analysis of fortified soup samples submitted to us on 2020-02-20 by Rosa Adom, MSc. Dietetics student with index number 10251553.

Please find attached the test report on fortified soup sample(s) collected for Nutritional analysis.

Yours faithfully

Dr. Frederick Vuvor
**(Head of Department)**

INTEGRI PROCEDAMUS


COLLEGE OF BASIC AND APPLIED SCIENCES
P. O. Box LG 134, Legon, Accra, Ghana.
• **Telephone:** +233 (0) 303 965 361 • **Email:** nfs@ug.edu.gh • **Website:** www.ug.edu.gh

| Sample Identity | %Moisture | % Ash | % Fibre | % Fat | %Protein | %Carbohydrate | Vitamin C mg/100g | %Ca | %Fe | % K | % Na | %P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CRS001 | 93.51756 | 0.133954 | 0.4227 | 0.186 | 0.791188 | 4.948602258 | 37.92 | 34.66 | 2.38 | 73.74 | 66.67 | 238 |
| CRS001 | 93.40066 | 0.072983 | 0.5946 | 0.185 | 0.80275 | 4.944006852 | 31.60 | 34.76 | 2.61 | 74.04 | 65.97 | 235 |
| CRS002 | 93.65822 | 0.14293 | 0.5484 | 0.308 | 0.458625 | 4.883825413 | 13.904 | 17.96 | 1.11 | 66.67 | 73.74 | 110 |
| CRS002 | 93.63808 | 0.17798 | 0.454 | 0.317 | 0.54175 | 4.871188052 | 12.64 | 18.04 | 1.13 | 66.67 | 73.24 | 111 |
| CRS003 | 94.69964 | 0.131879 | 0.4441 | 0.325 | 0.286563 | 4.112815718 | 25.28 | 21.14 | 1.33 | 76.06 | 76.05 | 132.5 |
| CRS003 | 94.67769 | 0.141972 | 0.4883 | 0.383 | 0.105625 | 4.203411494 | 25.28 | 21.88 | 1.5 | 77.12 | 76.05 | 133 |
| DRS001 | 94.68791 | 0.162338 | 0.102381 | 0.571857 | 0.00125 | 4.4742616 | 33.00 | 4.31 | 0.04 | 23.49 | 1.14 | 4.10 |
| DRS001 | 94.64387 | 0.140626 | 0.092568 | 0.581857 | 0.000625 | 4.540452818 | 32.90 | 3.99 | 0.045 | 24.01 | 1.09 | 4.00 |
| DRS002 | 94.86626 | 0.242177 | 0.069771 | 0.56612 | 0.00625 | 4.249424269 | 33.05 | 4.55 | 0.54 | 27.33 | 202.6 | 54.2 |
| DRS002 | 94.90082 | 0.246923 | 0.080576 | 0.56612 | 0.001875 | 4.20368317 | 33.00 | 5.02 | 0.56 | 26.98 | 202.83 | 54.00 |
| DRS003 | 94.94529 | 0.406046 | 0.145212 | 0.337588 | 0.000625 | 4.165239557 | 24.27 | 5.30 | 0.02 | 35.3 | 325.4 | 2.09 |
| DRS003 | 94.91852 | 0.397583 | 0.227247 | 0.347588 | 0.000625 | 4.108438642 | 25.23 | 5.30 | 0.024 | 35.39 | 320.25 | 2.30 |

**Signature:** ...................... **Date:** 16/7/2020 **Signature:** ...................... **Date:** 15-07-2020

**Reported By:** Joyce Duah
**(Analyst)**

**Approved By:** Dr. Frederick Vuvor
**(Head of Department)**

## APPENDIX VI: Ethical Approval

**UNIVERSITY OF GHANA**
**COLLEGE OF HEALTH SCIENCES**

ETHICAL AND PROTOCOL REVIEW COMMITTEE

**Ref. No.:** EPRC/MAR/2019 March 19, 2019

Dr. Laurene Boateng
Department of
Nutrition and Dietetics
SBAHS
Korle-Bu

**ETHICAL CLEARANCE**

*Protocol Identification Number:* ***CHS-Et/M.7 – 4.8/2018-2019***

**FWA: 000185779** **IORG: 0005170** **IRB: 00006220**

The College of Health Sciences Ethical and Protocol Review Committee (EPRC) at its February 28, 2019 full board meeting reviewed and approved your re-submitted research protocol.

Title of Protocol: "Nutrition support practices in Ghanaian hospitals"

Principal Investigator: Dr. Laurene Boateng

This approval requires that you submit six-monthly review report(s) of the study to the Committee and a final full review report to the EPRC at the completion of the study. The Committee may observe, or cause to be observed, procedures and records of the study before, during and after implementation.

Please note that any significant modification(s) to this project/study must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this study to the EPRC within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this study. You will therefore be required to furnish the Committee with any manuscript for publication.

**This ethical clearance is valid till March 20, 2020.**

Please always quote the protocol identification number in all future correspondence in relation to this protocol.

Signed: ..............................

**Professor Andrew Anthony Adjei**
Chair, Ethical and Protocol Review Committee

cc: Provost, CHS
Dean, SBAHS
Head, Nutrition and Dietetics

• P. O. Box KB 52, Korle Bu, Accra, Ghana. **Telephone:** +233 (0) 302 665103/4 • **Fax:** +233 (0) 302 660762
• **Email:** admin.chs@ug.edu.gh /provost.chs@ug.edu.gh • **Website:** www.chs.ug.edu.gh

**Institutional Review Board**
37 Military Hospital
Neghelli Barracks
ACCRA

Tel: 0302 769667
Email:irbmilhosp@gmail.com

18 September 2019

**ETHICAL CLEARANCE**

**37MH-IRB IPN/321/2019**

On 12 September 2019, the 37 Military Hospital (37MH) Institutional Review Board (IRB) at a Board Meeting reviewed and approved your protocol.

**TITLE OF PROTOCOL : Nutrition Support Practices in Ghanaian Hospitals**

**INVESTIGATOR : Prince Abban**

Please note that a final review report must be submitted to the Board at the completion of the study.

Please report all serious adverse events related to this study to 37MH-IRB within seven (7) days verbally and fourteen (14) days in writing.

This certificate is valid until 10 September 2020.

**DR EDWARD ASUMANU**
(37MH-IRB, Vice Chairman)

37 MILITARY HOSPITAL
INSTITUTIONAL REVIEW BOARD
DATE 18 - 09 - 19

Cc: Brig Gen (Dr) NA Obodai
Commander, 37 Military Hospital

In case of reply the number
And the date of this
Letter should be quoted

*My Ref. No.* KBTH/MD/G3/19
*Your Ref. No.*..........................

KORLE BU TEACHING HOSPITAL
P. O. BOX KB 77,
KORLE BU, ACCRA.

Tel: +233 302 667759/673034-6
Fax: +233 302 667759
Email: info@kbth.gov.gh
pr@kbth.gov.gh
Website: www.kbth.gov.gh

15th August 2019

DR. LAURENE BOATENG
DEPT. OF NUTRITION & DIETETICS
UNIVERSITY OF GHANA
LEGON

**NUTRITION SUPPORT PRACTICES IN GHANAIAN HOSPITALS**

**KBTH-IRB /000101/2019**

**Investigator: DR. LAURENE BOATENG**

The Korle Bu Teaching Hospital Institutional Review Board (KBTH IRB) reviewed and granted approval to the study entitled: "Nutrition support practices in Ghanaian Hospitals

Please note that the Board requires you to submit a final review report on completion of this study to the KBTH-IRB.

Kindly, note that, any modification/amendment to the approved study protocol without approval from KBTH-IRB renders this certificate invalid.

Please report all serious adverse events related to this study to KBTH-IRB within seven days verbally and fourteen days in writing.

This IRB approval is valid till 30th July, 2020. You are to submit annual report for continuing review.

Sincere regards,

DR. DANIEL ANKRAH
VICE CHAIR (KBTH-IRB)
FOR: CHAIR (KBTH-IRB)

Cc: The Chief Executive Officer
Korle Bu Teaching Hospital

In case of reply the number
And the date of this
Letter should be quoted

My Ref. No. KBTH/MS/G8/19
Your Ref. No. .......................

KORLE BU TEACHING HOSPITAL
P. O. BOX KB 77,
KORLE BU, ACCRA.

Tel: +233 302 667759/673034-6
Fax: +233 302 667759
Email: info@kbth.gov.gh
pr@kbth.gov.gh
Website: www.kbth.gov.gh

25th July, 2019

DR. LAURENE BOATENG
DEPT. OF NUTRITION AND DIETETICS
UNIVERSITY OF GHANA
LEGON

**SCIENTIFIC AND TECHNICAL COMMITTEE APPROVAL**
**PROTOCOL IDENTIFICATION NUMBER: KBTH-STC 000101/2019**

The Korle Bu Teaching Hospital Scientific and Technical Committee (KBTH-STC), on 25th July, 2019 approved your submitted study protocol.

TITLE OF PROTOCOL: "Nutrition support practices in Ghanaian hospitals"

PRINCIPAL INVESTIGATOR: Dr. Lawrene Boateng

This approval requires that you **forward your approved document to Korle Bu Teaching Hospital – Institutional Review Board (KBTH-IRB) for the ethical aspect of the proposal to be assessed before the project can be initiated.**

This STC approval is valid till 30th November, 2019
You may, however, request extension of the approval period, or renewal as the case may be, should the study extend beyond the stated period.

Upon completion, you are required to submit a final report on the study to the STC. This is to enable the STC ensure among others that, the project has been implemented as per the approved protocol. You are also required to inform the KBTH-STC and Research Directorate of any publications that may emanate from the research findings.

Kindly note that, should the need arise, the KBTH-STC or IRB may institute appropriate measures to satisfy itself that study is being conducted according to the highest scientific and ethical standards.

Please note that any modification to the study protocol without Scientific Technical Committee (STC) approval renders this approval invalid.

Sincere regards,

Prof. G. Obeng Adjei
Chairman, KBTH-STC

Cc: The Chairman, KBTH-IRB

**APPENDIX VII: Plagiarism Checker Report**

10251553:Adom_Rosa_final_thesis_copy.docx

ORIGINALITY REPORT

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