



Commercial Powder and Ready-to-use Enteral Nutrition had better Accuracy in Energy and Macronutrients Content Compared to Homebrew.

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Abstract

Introduction: In Indonesia, homebrew, commercial powder and ready-to-use enteral formula have been used in hospital and at home. However, the decision to choose enteral formula is influenced by various things and often does not based on evidence-based practice. This study aims to compare macronutrient accuracy and microbial contamination status of homebrew, commercial powder and ready-to-use enteral formula. Furthermore, this result was expected to become a reference in deciding the enteral formula to use.

Methods: The design was a cross sectional comparative study. We collected 63 enteral nutrition samples from 7 different ICUs, wards and homes, in Jakarta from April to June 2012. Macronutrient accuracy was assessed by comparing energy, carbohydrate, protein and fat to their nutritional fact labels. The macronutrient accuracy was considered to be good if the deviation was <10% and bad if >10%. Microbial contamination was considered to be acceptable if the contamination in enteral formula by coliform was <3 MPN/mL, total plate count (TPC) <10 CFU/mL, and *Staphylococcus aureus* < 10 CFU/mL.

Results: Homebrew had bad accuracy in calorie, carbohydrate and fat; commercial powder enteral formula had slightly bad accuracy in fat; ready-to-use enteral formula had bad accuracy in carbohydrate and fat. There was no sample contaminated by *Staphylococcus aureus*. Contamination by coliform and TPC was most acceptable in ready-to-use enteral formula than others, and the least in homebrew.

Conclusion: Commercial and ready-to-use enteral nutrition are more acceptable than homebrew in macronutrients accuracy and microbial contamination status.

Keywords enteral formula, macronutrients accuracy, microbial contamination

Introduction

Hospital malnutrition in Indonesia is becoming a serious problem, however, there is no data

regarding this issue. In industrialized countries, several studies have identified this condition in 25–50% of the hospitalized population.¹ Malnourished patients will certainly have higher rate of morbidity and mortality as well as longer hospital stay and higher cost.²

There are several factors related to the etiology of hospital malnutrition, among others are the underlying illness for which the patient is hospitalized, and quality of hospital medical care which includes nutrition support care.¹

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Insufficiency in energy and macronutrient composition is a critical problem which, among others, is related to diet portioning and distribution, to fulfill the nutritional needs of the patients.² Although there are few studies comparing the energy and macronutrient content of diet formulation however, different from micronutrients, it is assumed that food preparation does not lead to significant changes in macronutrients amount.²

Aside from the quality of nutrient content, the safety of enteral formula given to the hospital patients is also very important and can pose a significant risk to the patients. In general, the contamination of the formula with microorganism can occur at any point starting from the production, to preparation, storage, or administration process.³ During the preparation in the hospital or healthcare setting, the process of mixing, reconstitution, or dilution of modular products and formula with water, and/or pouring the formula into an administration container are critical points for contamination. The contaminated feeding increases the risk for nosocomial infections such as diarrhea, pneumonia and septicemia. A study in the Philippines found that 75–96% of blenderized tube feeding samples were contaminated, while in Saudi Arabia the percentage was reported higher.⁴

Sterile ready-to-use (RTU) and commercial powders are available in Indonesia, however homebrew is still used. This preliminary study aims to compare the use of different enteral nutrition formula i.e. ready to use enteral formula, commercial powder and homebrew, in terms of energy and macronutrient composition accuracy, as well as the contamination.

Methods

Sample inclusion criteria including: 1) Homebrew, commercial powder and ready to use enteral nutrition sample which were taken from ICU, wards and homes in Jakarta; 2) Sample was kept in the standard collection cups, and 3) Sample was brought to the laboratory by using the cold box. The samples were excluded if the transportation of the samples to the laboratory were more than four hours.

Data collected were analyzed to get accuracy of the energy and macronutrition content of each product, and the microbial contamination status based on the coliform, total plate count (TPC) and *Staphylococcus aureus* counts. The energy and macronutrient content value was considered to be good, if it has less than 10% deviation of energy, carbohydrate, protein and fat between the laboratory findings compared to its nutritional fact label. On the other hand, the nutritional content value was considered to be poor, if it has 10% and more deviation of energy, carbohydrate, protein and fat in the laboratory findings compared to its nutritional fact label. For microbial contamination status, it was considered acceptable if the coliform counts was less than 3 MPN/mL, the TPC was less than 10 CFU/mL, and the *Staphylococcus aureus* was less than 10 CFU/mL.⁵

Data were then managed by using the Statistical Program for Social Sciences (SPSS) version 11.5. To compare the energy and macronutrient content accuracy of each of the product, paired-t and/or Wilcoxon test was used. McNemar-test was used to compare the energy and macronutrient accuracy status and the microbial contamination status between the products. The p-value of less than 0.05 was used as the significance level.

Results

This study collected 21 samples from each of three different preparation locations, i.e. ICU and wards of the selected seven hospitals and home care patients in Jakarta per-product tested. The energy and macronutrient content level accuracy of different enteral preparation, as shown in Table 1, revealed that in average the homebrew product has poor accuracy (having more than 10% deviation) except for protein content. On the other hand, the commercial powder formula, in average, only has poor accuracy for the fat content, and ready-to-use formula has poor accuracy for carbohydrate and fat contents. Furthermore, Table 2 shows the proportion of energy and macronutrient accuracy between the three different enteral formulas.

Table 1 Macronutrient level accuracy of different enteral preparation formula

Macronutrients	Homebrew (1)			Commercial (2)			Ready-to-use (3)			p-value
	Fact label	Laboratory	Deviation	Fact label	Laboratory	Deviation	Fact label	Laboratory	Deviation	
Calorie	Kcal*	Kcal*	%*	Kcal^	Kcal^	%^	Kcal*	Kcal*	%*	
	100 (87-155.3)	60.2 (41.3-154.1)	-46.2 (-59.6-53.1)	103 (10.1)	95.6 (10.3)	-7.4 (11)	150 (118.5-150)	135.8 (96.5-148.5)	-2.6 (-10.7-10.2)	1) 0.003a 2) 0.006b 3) 0.001a
Carbohydrate	g^	g*	%*	g^	g^	%^	g*	g*	%*	
	15.2 (2.8)	6.9 (3.6-21.2)	-26.1 (-43.6-33.6)	14.5 (3.4)	15.5 (3.4)	3.8 (9.7)	17.3 (13.8-18.8)	21.1 (14.3-24.3)	14.9 (2.1-27.9)	1) 0.001a 2) 0.092b 3) <0.001a
Protein	g*	g^	%*	g^	g^	%*	g*	g*	%*	
	3.6 (2.3-6.7)	2.9 (0.9)	-2.6 (-10-72.2)	3.7 (0.8)	3.5 (0.8)	-1.1 (-4.4-7.8)	3.1 (3.1-3.8)	3.0 (2.9-3.5)	-0.6 (-1.6- -0.2)	1) 0.016a 2) 0.112b 3) <0.001a
Fats	g^	g^	%^	g^	g^	%^	g*	g*	%*	
	3.0 (1.1)	1.6 (0.9)	-12 (10.2)	3.3 (1.3)	2.2 (1.2)	-10.2 (7.1)	6.3 (3.4-6.8)	4.4 (2.8-4.5)	-16.8 (-52- -5.2)	1) <0.001b 2) <0.001b 3) <0.001a

* , median (minimum-maximum); ^, mean (sd); a), Wilcoxon; b, paired-t

Table 2 Proportion of macronutrients accuracy of different enteral preparation formula for calorie-content accuracy

For Calorie-content accuracy

Type of formula:		Ready-to-Use		p-value (McNemar)
		Good	Bad	
Homebrew	Good	0	0	na
	Bad	21	0	
Commercial	Good	13	0	na
	Bad	8	0	
For Carbohydrate-content Accuracy:				
Homebrew	Good	0	0	na
	Bad	1	20	
Commercial	Good	1	6	0.031
	Bad	0	14	

Table 2 (continued)

For Protein-content Accuracy:

Type of formula:		Ready-to-Use		p-value (McNemar)
		Good	Bad	
Homebrew	Good	3	0	<0.001
	Bad	17	1	
Commercial	Good	9	1	0.006
	Bad	11	0	

For Fats-content Accuracy:

Homebrew	Good	0	0	na
	Bad	0	21	
Commercial	Good	0	2	na
	Bad	0	19	

By using ready-to-use (RTU) formula as “gold standard”, the proportion of poor energy accuracy is found in all of the homebrew samples, as compared to only 4 to 21 in RTU samples. On the other hand, there is no significant difference in the proportion of poor energy accuracy between RTU and commercial powder formula ($p=0.344$). Furthermore, almost all RTU and all homebrew samples had poor carbohydrate accuracy, and there is a significant lower proportion of poor carbohydrate accuracy in the commercial powder compared to the RTU formula ($p=0.031$). This evidence is similar with the proportion of poor protein accuracy, no significant difference between homebrew and RTU formula, but there is a significant lower proportion of poor protein

accuracy in the commercial powder compared to the RTU formula ($p=0.039$). Finally, there is no significant difference in the proportion of poor fat accuracy in all samples.

Further analysis on the micro-organisms contamination, as shown in Table 3, revealed that there is no single sample contaminated by *Staphylococcus aureus*, however, there are significant lower proportion of coliform and TPC contamination in the RTU compared to both homebrew and commercial powder formula ($P<0.05$).

Table 3 Proportion of microbial contamination of different enteral preparation

Coliform	Ready-to-Use		p-value (McNemar)
	Not contaminated	Contaminated	
Homebrew			
Not contaminated	6	0	<0.001
Contaminated	13	2	
Commercial			
Not contaminated	10	1	0.021
Contaminated	9	1	
TPC	Ready-to-Use		p-value
	Not contaminated	Contaminated	
Homebrew			
Not contaminated	2	0	<0.001
Contaminated	17	2	
Commercial			
Not contaminated	2	0	<0.001
Contaminated	17	2	

Discussion

Energy and macronutrient level accuracy of all preparations showed high degree in variation. In terms of macronutrient, homebrew formula has the highest deviation among all macronutrients. Compared to the study done by Mokhalalati,⁶ this study showed that homebrew had the highest degree of variability in nutrient content and physical properties compared to commercial enteral formula. The average of variability ranged from 16–50%, while the commercial enteral formula was 4–7%.

The microbial contamination analysis showed that there was no formula contaminated by *Staphylococcus aureus*. However, this was not the case for TPC and coliform contamination. Among all the formula, ready-to-use had the least proportion of microbial contamination. Contamination through equipments and utensils of homebrew enteral formula were already reported by several publications.^{4,6,7} This shows that the closed-system in preparation will limit microbial contamination.

Furthermore, the deviation of macronutrient value accuracy and microbial status found in this study has clinical and nutritional implication for malnourished patients and patients at risk of malnutrition. Although we used limited numbers of sample size in this study, it could be concluded that homebrew is inferior compared to commercial and RTU products, especially in energy and macronutrients accuracy, and microbial contamination status. Thus, it is recommended to use the ready-to-use or commercial formula for tube feeding in order to get accurate nutritional foods with low contaminant.

Conflict of Interest

Authors declared no conflict of interest regarding this study.

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