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Why is the Ratio Between Food Nutritional Value and Price Not Constant?



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ABSTRACT

Eating is the act of consuming food orally. Food intake is essential for human health because nutrients in food are essential for sustaining human life, growth, and reproduction. If the purpose of eating was only to ingest nutrients, there would be no need for many types of food, and it would be sufficient if nutrients could be ingested as efficiently and cheaply as possible. However, given a choice, people like to consume a variety of foods daily, some of which are high in calories and inexpensive, whereas others are low in calories and expensive. The ratio of calories to price often differs depending on the food. This paper examined the diversity in types of foods and why they are not expensive because they are high in calories.



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INTRODUCTION

Eating involves nutrient intake. Nutrients are essential for the support, growth, and reproduction of humans^{1),2)}. Food contains nutrients, and eating refers to the intake of nutrients by the body by processing or ingesting food. The main food sources are animals, plants, and processed products. In other words, people use substances possessed by living organisms, other than humans, to survive. In recent years, some foods have been biosynthesized by microorganisms or completely chemically synthesized, and the concentration of nutrients has been adjusted so that only one or a small number of nutrients can satisfy the intake amount required by humans³⁾. Foods that contain sufficient nutrients on their own are called complete nutritional foods. However, such foods may not be suitable for everyone because the requirement of a number of calories and types of nutrients differ from person to person. A calorie is a unit that indicates the amount of energy, and energy serves as fuel for dynamic actions such as regulating body temperature, various metabolic reactions in the body, and maintaining the heartbeat.

If the purpose of eating is only to ingest nutrients, and if nutrients can be ingested as cheaply and efficiently as possible which will serve the purpose—diversity in types of food would not be necessary, and people would not have to eat different types of food daily. However, given a choice, people often like to change the type of food they consume daily. Some foods are high in calories but inexpensive and foods that are low in calories but expensive. In other words, the number of calories and food price often are not commensurate. Moreover, many people can tolerate such an imbalance. This may be because each food has various characteristics and people place importance on these characteristics, in addition to calories. In this article, we examine why there are several types of foods and why they are not expensive despite being high in calories.

Type and amount of nutrients required

Nutrients include sugars (carbohydrates), lipids, proteins, minerals (inorganic substances), and vitamins, collectively known as the five major nutrients^{4),5)}. While sugars, lipids, and proteins are the three major nutrients mainly used for energy production, vitamins and minerals are mainly involved in the regulation of metabolism in the body. There are large differences in the amount of nutrients contained in different foods. This is natural considering that food itself is mainly made up of living things, such as animals and plants, and that even in humans, the structure and

composition of food differ depending on the organ.

The required nutrient intake also differs depending on age, gender, and amount of exercise⁵⁾. Therefore, people usually ingest the nutrients they require from a combination of various foods⁴⁾. Approximately 60% of the energy required comes from basal metabolism (the amount required even without exercise), 10% comes from meal-induced thermogenesis (the amount that increases body temperature when eating), and 30% comes from physical activity (the amount required during exercise)⁵⁾. The basal metabolic rate accounts for a large proportion of this rate⁶⁾, but it varies not only by gender and age but also by body size. Individual differences in the amount of physical activity also exist.

Because the human body is composed of many muscles, it is usually assumed that the protein content is the highest overall. However, in adults, the proportion of water is the highest, at over 60%. The main component, other than water, is protein, which accounts for less than 20% in adults. Next, are lipids (approximately 16%), minerals (approximately 6%), and carbohydrates (less than 0.04%)⁴⁾. In contrast, the composition of an average meal is high in carbohydrates, with 18% protein, 13% fat, 69% carbohydrates, and less than 0.1% minerals, excluding water. The reason for this difference in the composition ratio between food and the human body is related to how it is used in the body; while proteins and lipids make up a large proportion of the body's skeletal materials, carbohydrates are used and consumed for energy production at a high rate and are difficult to retain in the body.

Why is there no correlation between food price and nutritional value?

The price of food varies. Despite the same amount of protein in food products, the price is rarely the same, even if the amount of energy produced is the same (Table 1). This price difference is because there is additional value to food²⁾. Table 2 provides an overview of the reasons for these price differences. The cost of production, transportation, and processing results in an increase or decrease in the purchase price of different ingredients. If food has added value other than acquiring nutrients, its price will rise. Even for the same type of food, its visual appeal, taste, smell, and freshness can increase the price. Alternatively, the price may be high if the food is related to disease prevention or has clear health benefits. Some consumers prefer foods without artificial substances, such as additives, which makes such foods more expensive. Animal meat

and vegetables which are rare and difficult to obtain are often traded at high prices. Such foods often have a short shelf life and do not last long; therefore, their price may increase if they can be stored for a long time as frozen or refrigerated foods. If food can be stored for a long time, its value and price may increase, even if it contains additives. Furthermore, waste rates may be related to the price. Perishable foods do not last long; consequently, the rate of waste tends to increase the price. Moreover, disposal costs and the price of the discarded food can be added to this price. The more popular a food is, the more it is consumed, and the less likely it is to be thrown away.

CONCLUSION

In this paper, we presented the results of our research and our analysis of why the balance between nutritional content and the price of food varies. Eating the same type of food leads to boredom and disinterest in that food. Even muscle-building protein drinks have flavors such as chocolate or strawberry, for variety. A variety of colors such as red and yellow ingredients in a plate stimulates appetite. Cooking also changes taste, and processing, such as heating, can produce a pleasant aroma⁷). Changes in the five senses (sight, hearing, smell, taste, and touch) lead to improved appetite. To ingest the necessary nutrients continuously, it seems necessary to make changes to one's diet and add a wide variety of ingredients and seasonings which results in differences in food prices.

Fundamentally, prices also change depending on whether the ingredients are in season (whether they are available in large quantities at low prices, production costs are low, nutritional content is high, etc.). The ease of availability (rarity of food, transportation costs), degree of processing, storage costs (chilling, etc.) before reaching consumers, added value (e.g., recognition as a healthy food), and waste rate (effort for disposal) also affect food price.

Food price fluctuations occur for several reasons. Such situations can be revealed and impacted if many foods are available both financially and logistically. In reality, such regions exist only in a few countries, including Japan. This may not necessarily be a good thing as there is considerable choice and opportunities to make comparisons. When people enjoy meals in this manner, they can make several dishes using different ingredients because a wide variety of ingredients is always available; hence their prices also vary.

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Table 1 Food nutritional value and standard price

Food Name	Plain bread	Cabbage	Carrot	Pork (loin, raw)	Chicken/ eggs (whole, raw)	Milk	
Water (g)	38.8	92.7	89.1	65.7	76.1	87.4	
Protein (g)	9.0	1.3	0.7	21.1	12.3	3.3	
Fat (g)	4.2	0.2	0.2	11.9	10.3	3.8	
Carbohydrates (g)	46.6	5.2	9.3	0.3	0.3	4.8	
Inorganic substances	Sodium (mg)	470	5	28	45	140	41
	Potassium (mg)	88	200	300	340	130	150
	Calcium (mg)	23	43	28	5	51	110
	Phosphorus (mg)	68	27	26	200	180	93
	Iron (mg)	0.5	0.3	0.2	0.3	1.8	0.02
Vitamins	Retinol (µg)	0	0	0	5	140	38
	β -carotene (µg)	2	49	6900	-	3	6
	Thiamine (mg)	0.07	0.04	0.07	0.75	0.06	0.04
	Riboflavin (mg)	0.04	0.03	0.06	0.16	0.43	0.15
	Niacin (mg)	1.2	0.2	0.8	8.0	0.1	0.1
	Ascorbic acid (mg)	0	41	6	1	0	1
Energy (kcal)	260	23	39	202	151	67	
Price (US dollars)	0.37	.011	0.31	0.19	0.21	0.20	
Waste rate	0	15	3	0	15	0	
Price per unit energy amount (kcal/US \$)	0.033	0.010	0.006	0.051	0.034	0.016	

The values in the table are per 100 g of food.

Prices are average values surveyed in August 2023.

Numerical values other than prices were reproduced from the 2015 Japanese Food Standard Composition Table (7th edition), Supplementary Edition, 2017.

Based on data from references 5) and 8).

Table 2 Reasons why food prices are high per nutritional value

The major classification of reasons	Minor classification
High costs	<p>High material cost</p> <ul style="list-style-type: none"> → Scarcity, low production amount → some foods can be produced in large quantities and cheaply but have high nutritional value. <p>High processing cost</p> <ul style="list-style-type: none"> → Ready-to-eat prepared foods (pre-processed such as heating and cutting) are expensive. → Items that require cooking by themselves are slightly cheaper <p>High transportation cost</p> <ul style="list-style-type: none"> → If the animals and plants are not grown nearby, the transportation cost will increase. → Items are not produced domestically or are produced in low quantities, and are mainly imported.
Added value exists	<p>Expensive if there is added value</p> <ul style="list-style-type: none"> → Good taste, good appearance, etc. → Freshness → Good for health, etc. (≠ healthy food) → (For those who care) Contains no extra additives etc. <p>Expensive if long-term storage is possible (frozen foods, emergency food, etc.)</p> <ul style="list-style-type: none"> → Additional labor and material costs (packaging film, etc.) are required.
Disposal rate	<p>Fresh food tends to spoil more easily, leading to greater wastage.</p> <ul style="list-style-type: none"> → Shipping volume tends to increase or decrease for seasonal items.

Based on the contents of reference 2).