



Use of SAIN and LIM System for Determination of Nutritional Profile of Foods Consumed by Under-five Children in the District of Abidjan, Ivory Coast

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Abstract

The aim of this study is to use the SAIN and LIM system to determine the nutritional profile of foods consumed by children in the district of Abidjan, Ivory Coast. After the selection of some foods consumed by children, we determined their SAIN and LIM score. Some foods such as industrial flour porridge with a score SAIN of $8.2 \pm 0.3 > 5$ and a LIM score of $3.1 \pm 0.5 < 7.5$ have a good nutritional profile and can be recommended for health. Foods such as millet flour porridge with SAIN score of $4.08 \pm 0.22 < 5$ and LIM score of $3.47 \pm 0.13 < 7.5$ are classified in neutral food group. Bissap juice with a SAIN score > 5 and LIM score > 7.5 are among the foods group that must be eaten occasionally in small quantities. Foods such as palm seed soup is among the foods group whose consumption should be limited.

Keywords: SAIN LIM system, nutritional profile, under-five children, Abidjan.

1. Introduction

Nutritional profiling consists of a classification of foods based on their nutritional composition. The best nutritional profiling system at present is the SAIN, LIM system. This system has been described for the first time by Darmon (2004). This method is based on two indicators previously developed for studying the relationship between the nutritional quality and the cost of foods (Maillot, 2007). The SAIN and the LIM respectively synthesize the healthy and unhealthy aspects of each food and the system allows the allocation of each food into one of four different classes: 1. recommended for health; 2. neutral; 3. recommended in small quantities or occasionally; 4. consumption should be limited.

Malnutrition affects 8 million children in sub-Saharan Africa. Child malnutrition is in this part of the world a major public health problem (Manzan and Toure, 2007). In Africa, malnutrition among children appears frequently after weaning. In this context the nutritional profile of foods consumed by children after weaning is a very important parameter to explain malnutrition (Youssef and Kaboré, 2006). In Ivory Coast, like in the most of sub-saharan Africa country malnutrition affects several children (Aké-Tanoh *et al.*, 2010).

The use of SAIN and LIM system can help to choose the best food for the children and thus contribute to reduce malnutrition. The aim of this study is to use the LIM and SAIN system to determine the nutritional profile of foods consumed by children after weaning in six municipalities in the district of Abidjan, Ivory Coast.

2. Material and Methods

Food selection

Foods were selected in six municipalities of Abidjan: Abobo, Koumassi, Yopougon, Treichville, Marcory, Cocody. The foods consumed by children after weaning are numerous and vary according to the age of the children. Thus in this study we classified food into 9 categories:

- ✓ Porridges (millet flour, maize flour, industrial flour)
- ✓ Soups (tomato, okra, eggplant, pistachio, peanut, palm seed)
- ✓ Starchy foods (yam fufu, banana fufu, placali, attieke, bread, rice, paste)
- ✓ Vegetable proteins (Peas, bean)
- ✓ Animal Proteins (Fish, meat, egg)
- ✓ Sweetened beverage (Bissap, gnamakou)
- ✓ Fat foods (butter, margarine)
- ✓ Fruits and vegetables (Orange, avocado, banana)
- ✓ Dairy products (yogourt, cheese)

Determination of nutritional profile of food by the SAIN, LIM System

In order to establish nutritional profiling of different food groups, a number of successive steps were performed. First, it was necessary to establish the nutritional value of each food based on the nutrients that are needed to calculate the SAIN and LIM. For this purpose, it was necessary first to establish for each of the nine groups of foods, a composition table detailing the contents of these nutrients. The nutrient content is expressed on the basis of 100g of raw material (MB). These data were collected from the French table Ciqual (2013) and the FAO table. Based on these composition tables, it was then established an excel table describing the nutritional value of each food group. It expresses the nutritional value per 100 g of Food. The nutrients needed for calculation of SAIN are Vitamin C, Iron, Calcium, Protein and fiber. The nutrients needed for calculation of LIM are Saturated fatty acid, Sodium and added sugar. A food has a good profile when its SAIN are high and its LIM is low.

SAIN calculation formula is as follows:

$$\text{SAIN} = \frac{\left(\frac{\text{Vitamin C} + \text{Iron} + \text{Calcium} + \text{Protein} + \text{Fiber}}{\text{RNI Vitamin C} + \text{RNI Iron} + \text{RNI Calcium} + \text{RNI Protein} + \text{RNI Fiber}} \right) \times 100}{\text{Energy} \times 100}$$

RNI (Recommended nutritional intake)

The LIM calculation formula is as follows:

$$\text{LIM} = \frac{\left(\frac{\text{Na} + \text{SFA} + \text{Added sugar}}{3153 + 22 + 50} \right) \times 100}{3}$$

These two values plotted on a graph used to classify foods into four groups. It considers two acceptability thresholds (SAIN > 5 and LIM < 7.5):

1. foods recommended for health (SAIN > 5 and LIM < 7.5)
2. neutral foods (SAIN < 5 and LIM < 7.5)
3. foods recommended in small quantities or occasionally (SAIN > 5 and LIM > 7.5)
4. Foods to limit (SAIN < 5 and LIM > 7.5).

Statistical analyses

All of the statistical analysis and all other data processing were done by using SPSS 16.0 windows program. A p-value < 0.05 was considered as statistically significant. For graphical representation Microsoft Word and Microsoft Excel were used.

3. Results and Discussion

SAIN and LIM score of three porridges

Figure 1 shows the SAIN and LIM scores of three porridges (industrial flour porridge, traditional millet flour porridge, traditional maize flour porridge). The score SAIN for industrial flour porridge is $8,2 \pm 0,3$ and its LIM score is $3,1 \pm 0,5$. This porridge has a good nutritional profile because its SAIN > 5 and LIM < 7.5. This porridge is good for children's health. These results corroborate those of Darmon, (2007). The SAIN score of millet flour porridge is $4,08 \pm 0,22$ and its LIM score is $3,47 \pm 0,13$. The SAIN score of maize flour porridge is $3,34 \pm 0,41$ and its LIM score is $3,89 \pm 0,32$. These porridges belong to neutral food group because their SAIN < 5 and their LIM < 7.5. These porridges must be associated with food with a high SAIN.

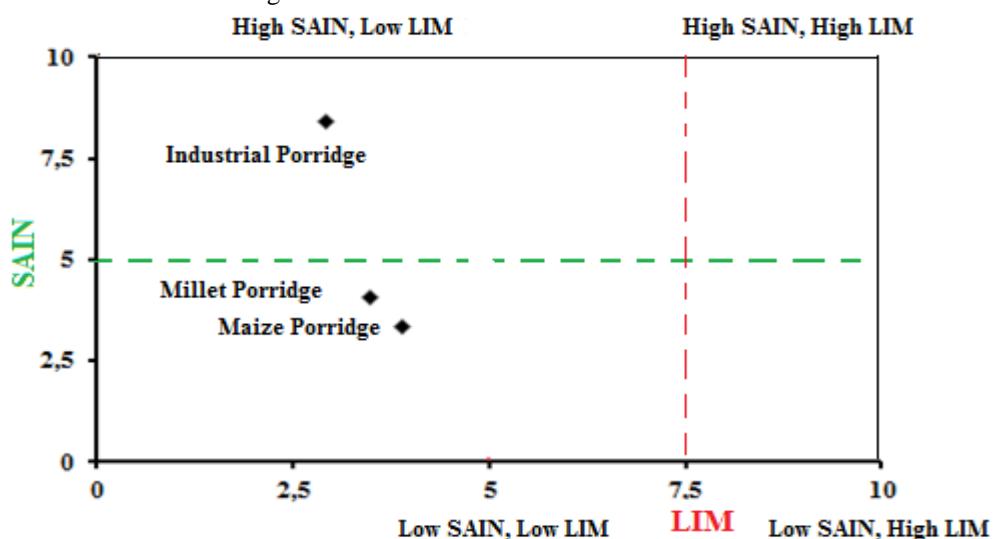


Figure 1: SAIN and LIM score of three porridges

SAIN and LIM score of some starchy foods

Figure 2 shows the SAIN and LIM scores of different starches (yam fufu, banana fufu, placali, attieke, bread, rice, paste). These starchy foods belong to neutral food group because their SAIN < 5 and their LIM < 7.5. Similar results were obtained by Lambertini, (2009). For a balanced diet starchy foods should be associated with high SAIN foods such as protein-rich foods, fruits and vegetables.

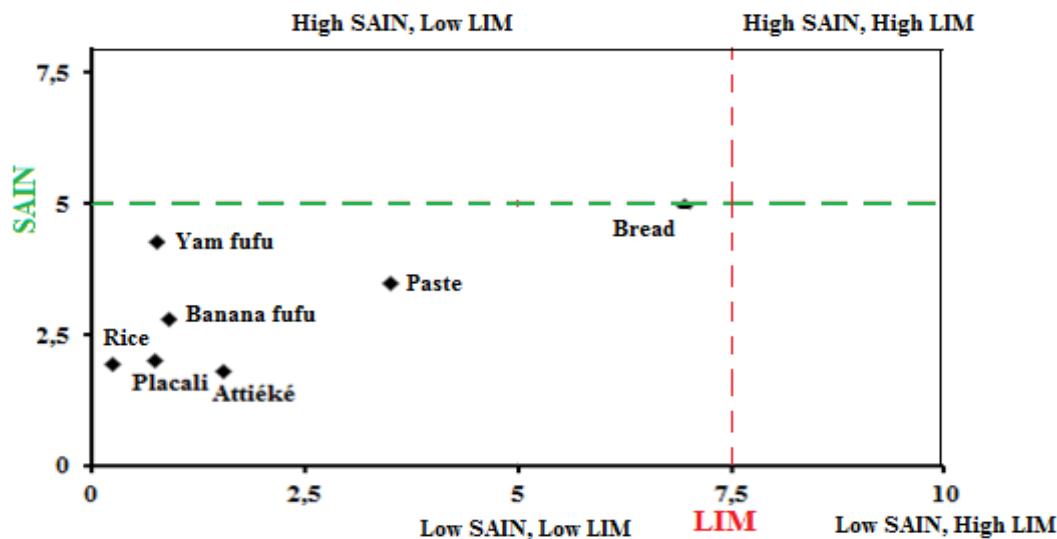


Figure 2: SAIN and LIM score of some starchy food

SAIN and LIM score of vegetable proteins

Figure 3 shows the LIM and SAIN scores of two sources of plant protein (beans and peas). Beans and peas have LIM scores below 7.5 and SAIN scores above 5. They belong to the group of foods recommended for health. These results corroborate those of Taylor and Francis, (2004) which showed that beans and peas are low in calories, rich in minerals and protein.

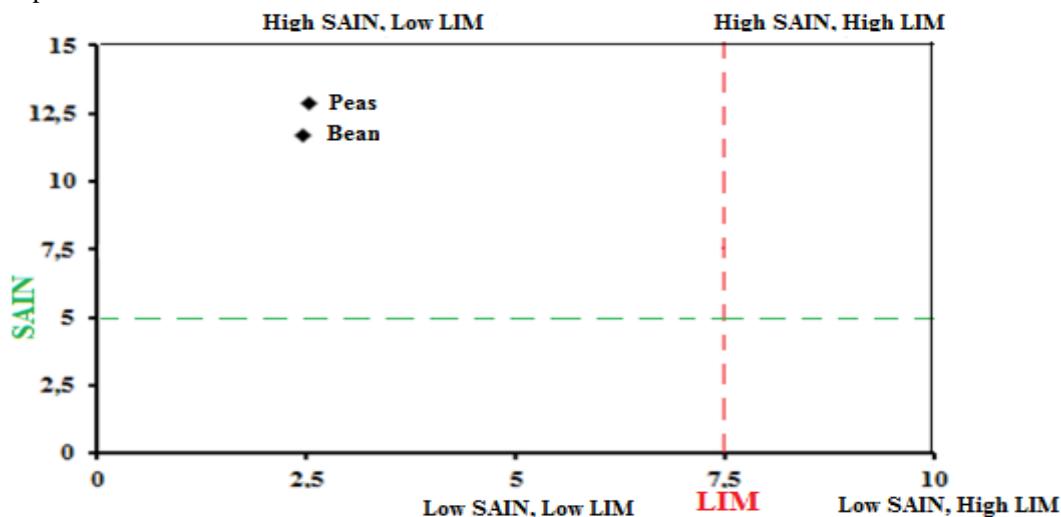


Figure 3: SAIN and LIM score of peas and bean

SAIN and LIM score of some soups

Figure 4 shows the scores SAIN and LIM different soups (tomato, okra, eggplant, pistachio, peanut, palm seed). Tomato soup, okra soup and eggplant soup have a good nutritional because their SAIN > 5 and LIM < 7.5. Thus, these 3 soups are good for health. By contrast, pistachio soup, peanut soup and palm seed soup belong to the food group that consumption should be limited because their SAIN < 5 and LIM > 7.5. According to Black (2008) these foods are associated with nutritional disorders (overweight, obesity, hyperlipidemia etc.)

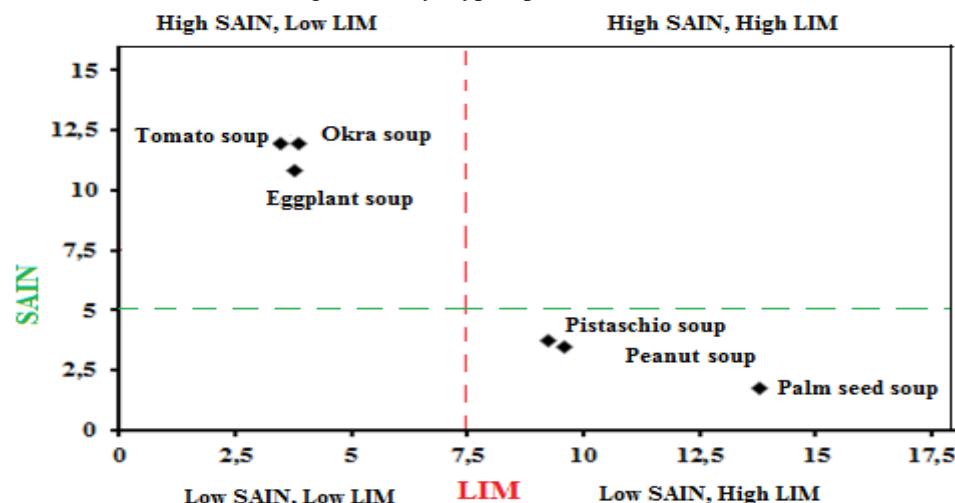


Figure 4: SAIN and LIM score of some soups

SAIN and LIM score of some sweetened beverage

Figure 5 shows the SAIN and LIM score of bissap juice and gnamakou (ginger juice). The results indicate that they have a LIM above 7.5 and a SAIN above 5. They belong to group foods which can be consumed occasionally but in small quantities. These results do not match those of James and Farrell, (2004) which showed that sweetened beverage are among the foods whose consumption should be limited.

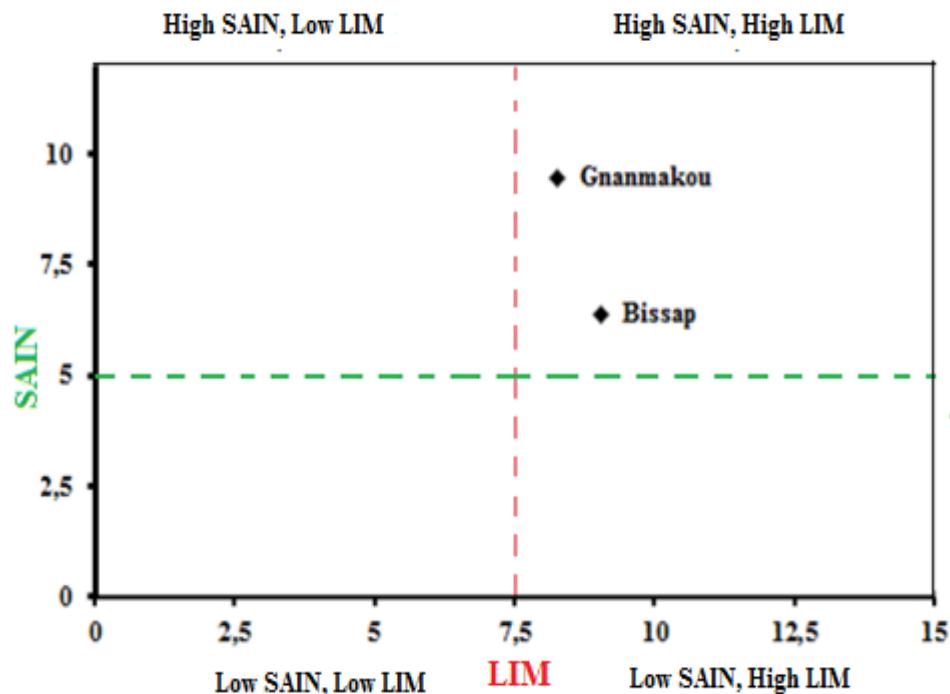


Figure 5: SAIN and LIM score of some sweetened beverage

SAIN and LIM score of some animal proteins

Figure 6 shows the score SAIN and LIM of meat, fish and egg. These three sources of animal protein have a good nutritional because their SAIN > 5 and LIM < 7.5. Thus they are good for health and growth of children. These results agree with those of Maxwell *et al.*, (2007).

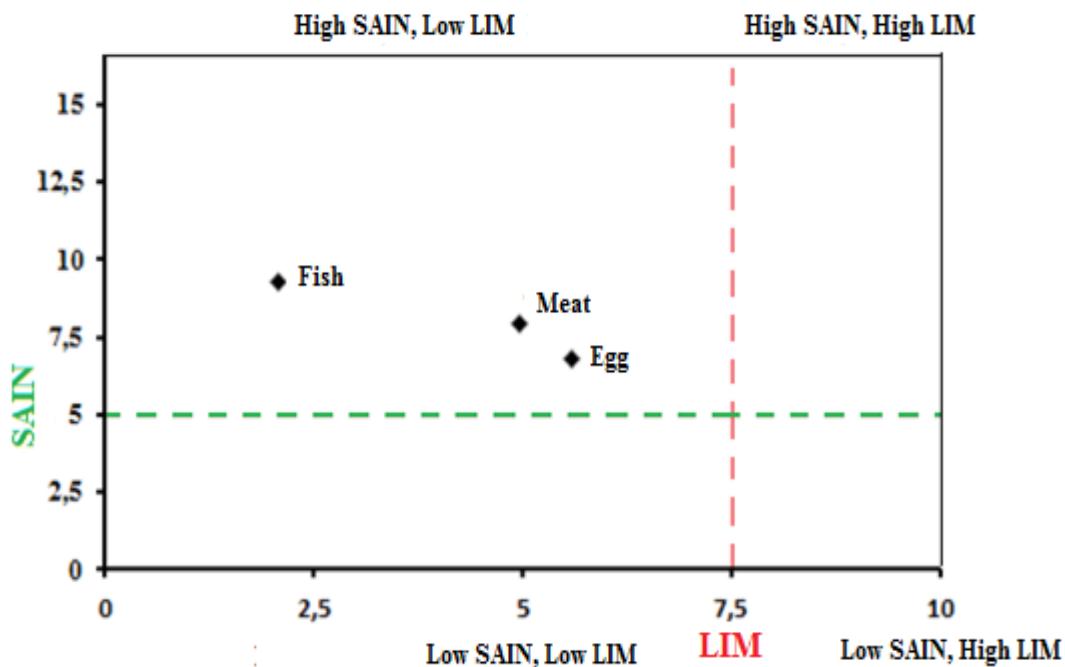


Figure 6: SAIN and LIM score of some animal protein

SAIN and LIM score of some fruits and vegetables

The SAIN and LIM scores of orange, banana, avocado are presented in Figure 7. These foods have a high SAIN (SAIN > 5) and low LIM (LIM < 7.5). These foods belong to the group of foods recommended for health. These results corroborate those of Roman *et al.*, (2005), Darmon, (2007) and Masset, (2009) who showed that these foods are low in calories, rich in minerals and vitamins. Newman *et al.*, (2005) have shown that the consumption of fruit and vegetables is associated with the prevention of cancer and cardiovascular diseases.

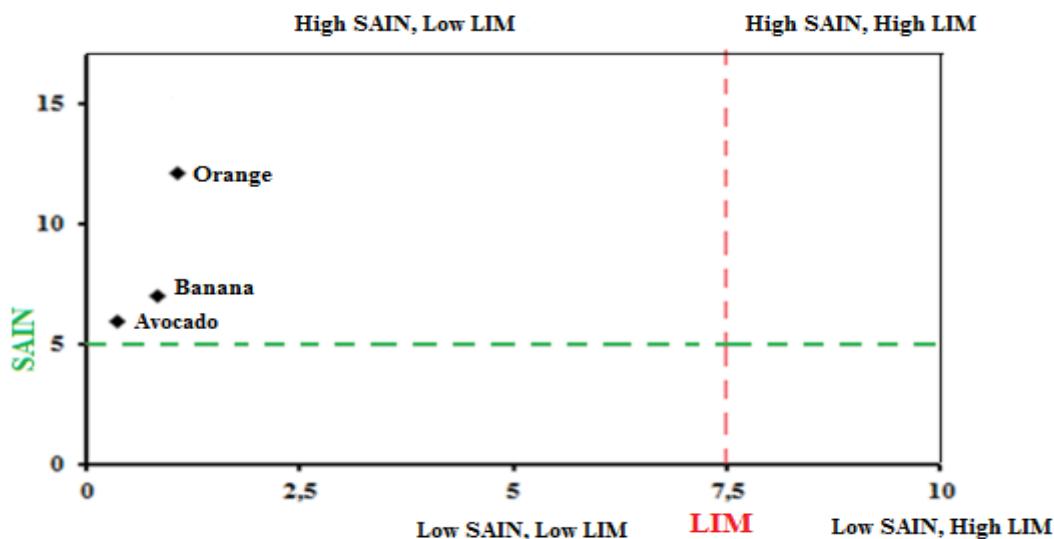


Figure 7: SAIN and LIM score of some fruits and vegetables

SAIN and LIM score of yoghurt and cheese

Figure 8 shows the SAIN and LIM score of the yoghurt and cheese. Yoghurt has a LIM $5.4 \pm 0.45 < 7.5$ and 6.9 ± 0.23 SAIN > 5 and the cheese has a LIM $7.1 \pm 0.32 < 7.5$ and 7.6 ± 0.17 SAIN > 5 . Thus, both dairy products belong to group of foods recommended for health. These results corroborate those of Salvador *et al.*, (2004) which showed that these foods are rich in calcium and protein and can contribute to the growth and density of the bone structure of children.

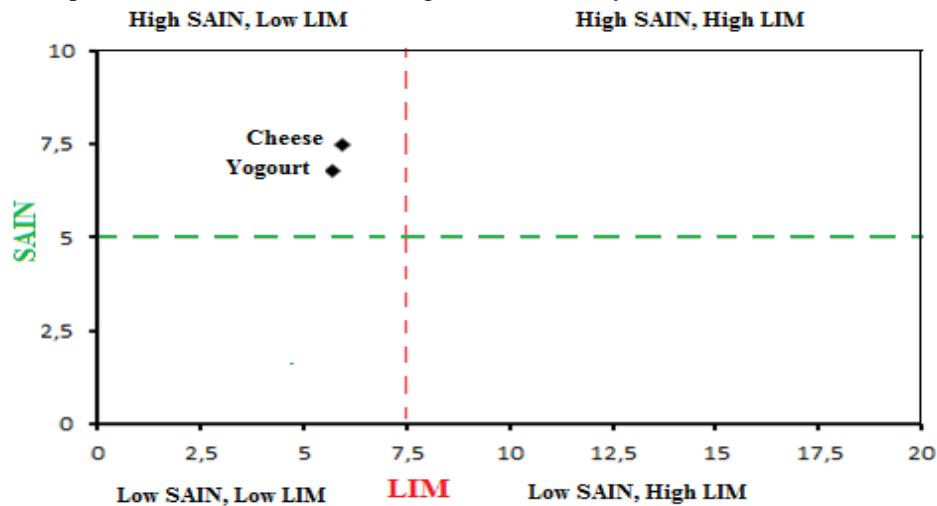


Figure 8: SAIN and LIM score of yoghurt and cheese

SAIN and LIM score of butter and margarine

Figure 9 shows the SAIN and LIM scores of butter and margarine. Butter and margarine have a low SAIN (< 5) and a strong LIM ($7.5 >$). They thus belong to the group of foods whose consumption should be limited. Thus, these foods are adverse to health. According to Black, (2008) these foods are associated with nutritional disorders (overweight, obesity, hyperlipidemia etc.)

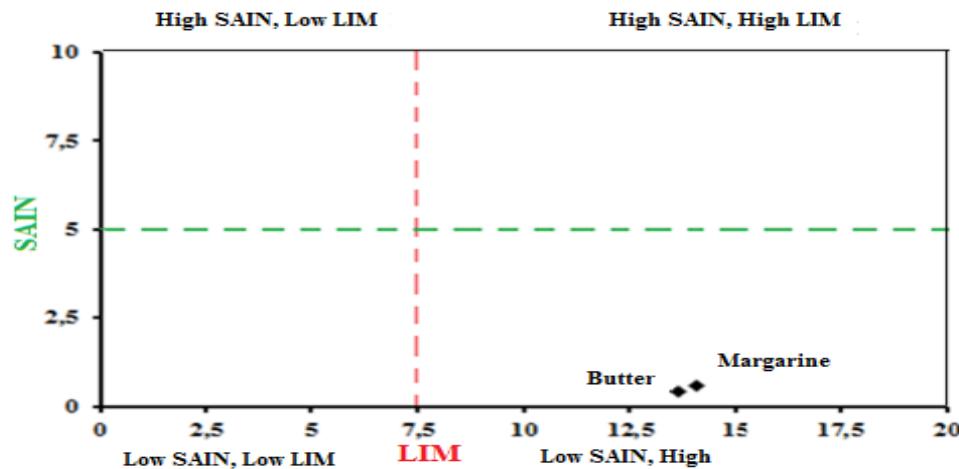


Figure 9 : SAIN and LIM score of butter and margarine

4. Conclusion

The aim of this study was to use the LIM and SAIN system to determine the nutritional profile of foods consumed by children after weaning in six municipalities in the district of Abidjan, Ivory Coast. Some foods concerned by this study can be recommended for the health and growth of children. Thus, foods with good nutritional profile are industrial flour porridge, okra soup, tomato soup, eggplant soup, yogurt, cheese, peas, beans, meat, fish, eggs, fruits and vegetable. Some foods consumed by children are classified in the group of neutral foods (porridge made from millet flour, porridge made of corn flour, attiéké, placali, rice, pasta, yams fufu, banana fufu, bread). Sweet beverages such as bissap juice and ginger juice should be consumed occasionally and in small quantities. Foods whose consumption should be limited are butter, margarine, pistachio soup, palm seed soup, peanut soup. The combination of certain foods and changing the recipe of certain soups can help to improve the quality of children's diets in the district of Abidjan.

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