

**AMINO ACID SCORE OF THE MOST CONSUMED FOODS AND RELATIONSHIP
OF THE DIFFERENT MEAL TIMES WITH THE NUTRITIONAL STATUS OF
ESPOCH STUDENTS 2020**

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Abstract

Introduction: The quality of food must be diverse, balanced, healthy, which provides energy and nutrients necessary for the perfect functioning of the organism. **Objective:** To describe the relationship of the main meal times with the nutritional status of university students and to calculate the amino acid score in foods most consumed in the restaurants of the Higher Polytechnic School of Chimborazo-Riobamba-Ecuador. **Methodology:** Descriptive cross-sectional study with the application of a semi-structured survey on the frequency of eating times for breakfast, lunch, snack and types of preparations with the highest consumption applied to 483 university students who used ESPOCH bars, with voluntary participation. The statistical analysis was carried out with the free version InfoStat/L 2020 program, where it was found that more than 50% are within normal parameters. **Results:** Regarding the frequency of consumption of the different meal times according to nutritional status, 48.2% had breakfast daily, 59.8% had lunch and 56.3% had a snack. Of the foods with the highest consumption, two limiting amino acids, threonine and tryptophan, are evident due to the consumption of unhealthy foods with a lower biological value of proteins. It is recommended to make suitable combinations to achieve the balance of essential amino acids.

Keywords: Food quality, Nutritional status, Amino acid score.

1. Introduction.

According to the World Health Organization "Food is the set of activities and processes by which we eat food from abroad that provide us with energy and nutritional substances, necessary for the maintenance of life." (1) Food is currently one of the main concerns worldwide, due to the increase in problems related to poor diet that affect several countries of the world. (2) The quality of the diet refers to maintaining a diverse, balanced, healthy diet that provides the energy and nutrients necessary for the perfect functioning of the organism. In addition, it describes the content of nutrients as their absorption because they contribute to the maintenance, growth, physiological state and prevention of infections that can occur in the body (3) and even more so in young university students where poor diet can affect brain functioning and cognitive functions. (4)

In addition, food consumption is considered as an indicator to measure the quality of a diet and also a determinant in nutrition and health and when talking about food services think of those places where people attend, voluntarily or compulsorily, with the intention of eating as restaurants that meet the proper sanitary standards. (5) It is considered that the set of foods consumed in the course of the day is known as diet, which must be balanced, adequate and healthy if it meets the criteria that the food ingested is varied, in moderate quantities and that it provides the necessary nutrients, sufficient and appropriate to meet the needs of each individual. (6)

Currently young people have a very marked tendency towards bad eating habits, do not eat at adequate times, skip meal times, eat a lot of unhealthy food instead of being properly nourished, also prefer fast food due to relatively cheap costs and its availability at any time and place. (7) But this is the least healthy food they can consume, since in many cases they have large amounts of fats, (8) in addition to the quality of the ingredients with which they are prepared does not provide nutrients and could lead to non-communicable diseases. (9) On the other hand, some

epidemiological studies show that although sometimes the population is informed and knows the basics of a healthy diet, this knowledge does not translate into actual consumption of foods that are part of a balanced diet. (10)

Diets consumed in developed countries usually contain various sources of dietary protein such as cereals, legume seeds, meat, among others and the composition of individual dietary components has little real importance in relation to nutritional requirements. However, this is not the case in some less developed countries where a single cereal may account for a significant portion of total protein intake. (11) In this case, the nutritional quality with regard to the type and quantity of essential amino acids in the protein are important. (12) Dietary proteins differ in their ability to meet the metabolic needs demand for the nine indispensable dietary amino acids and nitrogen. (13) The protein digestibility corrected amino acid score (PDCAAS) has been used for more than 20 years to assess the quality of protein in human foods, the biological value of a protein depends fundamentally on its composition in indispensable amino acids. Once this is known, it is possible to predict, within certain limitations, its behavior in the organism; For this it is only necessary to have an adequate comparison pattern. (13) (14)

The objective of the research was to describe the relationship of the main meal times with the nutritional status of university students and to calculate the amino acid score in foods of higher consumption in the establishments of the ESPOCH.

2. Methodology

The methodology applied for the study was cross-sectional and descriptive, with direct observation technique. To collect the information, the semi-structured survey Measurement of dietary pattern and characteristics of the diet of ESPOCH students was applied within the research project: "Bromatological and Microbiological characteristics of the preparations sold in the bars of the ESPOCH", it was validated by the CEPIAD research group, which was constituted by categories with anthropometric information, questions of eating times of breakfast, lunch and types of preparations of greater consumption within the facilities of vending of food of the ESPOCH.

The survey was applied with the voluntary participation and informed consent of 483 university students of the Polytechnic School of Chimborazo (ESPOCH) – Ecuador.

The analysis of the response variables was descriptive with respect to anthropometric characteristics according to sex and meal times were expressed in terms of frequencies with respect to the nutritional status of the students.

The amino acid score was obtained by calculating the limiting amino acids in the preparations of greater consumption in breakfast, main dishes and fast food, taking as reference the standard protein in amino acids for adults proposed by FAO. (15) An analysis of variance was applied comparing the amino acid computation values of lysine, threonine, tryptophan and sulphur. The statistical analysis of the data was performed in the statistical package InfoStat/L 2020 of free version.

3. Results.

3.1 Anthropometric characteristics of students by sex

Table 1 Description of the anthropometric characteristics of ESPOCH students.

Variables	Men n=235 X ± SD	Female n=248	p
		X ± OF	
Age (years)	22,02 ± 2,75	21,01 ± 2,48	0.004
Weight (Kg)	67,45 ± 10,42	57,23 ± 8.36	0.001
Size (m)	1,69 ± 0.07	1.57 ± 0.06	0.001
IMC (Kg/m ²)	23,53 ± 3,44	23.20 ± 3.45	0.006
Nutritional status	%	%	p
Normal	66.8	76.2	
Low weight	4.3	4.8	
Overweight	23.4	15.3	0.085
Obesity	5.5	3.6	

Means with a common letter are not significantly different ($p > 0.05$)

Table 1 shows the result of the descriptive statistical analysis of the anthropometric characteristics of the study group, which consisted of 483 students distributed as follows: 235 men and 248 women. (16) These were young adults aged between 18 and 42 years, with a mean of 22.02 ± 2.75 for men; in addition, the average of 21.01 ± 2.48 . for women is evident. When analyzing the anthropometric characteristics of the study population, it was observed that men have a higher mean and standard deviation with respect to women; In terms of weight, men have values of (67.45 ± 10.42) while women have (57.23 ± 8.36); with respect to height, it is evident (1.69 ± 0.07) for men and for women (1.57 ± 0.06); and the BMI has a mean close to the upper limit of normal, especially in men with (23.53 ± 3.44) and in women the value is (23.20 ± 3.45). Most of the study population presented a normal nutritional status, although there is already 15.3% in overweight women with a significantly higher proportion in men with 23.4%. (17)

3.2 Relationship of meal times with nutritional status

Table 2 Frequency of consumption of three meal times, according to nutritional status of ESPOCH students.

MEAL TIMES	NUTRITIONAL STATUS				p- value
	Low weight %	Normal %	Overwei ght %	Obesity %	

Breakfast					
Daily	17 (3,5)	233	70 (14,5)	16 (3,3)	
Two or three times a week	3 (0,6)	(48,2)	11 (2,3)	3 (0,6)	
Weekends only	0 (0,0)	53 (11,0)	3 (0,6)	0 (0,0)	0.949
Occasionally	2 (0,4)	15 (3,1)	7 (1,4)	2 (0,4)	
No breakfast	0 (0,0)	32 (6,6)	2 (0,4)	1 (0,2)	
		13 (2,7)			
Lunch					
Daily	20 (4,1)	289	76 (15,7)	16 (3,3)	
Two or three times a week	2 (0,4)	(59,8)	14 (2,9)	6 (1,2)	
Weekends only	0 (0,0)	39 (8,1)	1 (0,2)	0 (0,0)	0.304
Occasionally	0 (0,0)	3 (0,6)	1 (0,2)	0 (0,0)	
No lunch	0 (0,0)	15 (3,1)	1 (0,2)	0 (0,0)	
		0 (0,0)			
Snack					
Daily	19 (3,9)	272(56.3)	66 (13,7)	18 (3,7)	
Two or three times a week	1 (0,2)	26 (5,4)	11 (2,3)	1 (0,2)	
Weekends only	1 (0,2)	10 (2,1)	2 (0,4)	0 (0,0)	0.349
Occasionally	0 (0,0)	34 (7,0)	9 (1,9)	2 (0,4)	
No snack	1 (0,2)	4 (0,8)	5 (1,0)	1 (0,2)	

Means with a common letter are not significantly different ($p > 0.05$)

In relation to the frequency of consumption of the three main meal times related to nutritional status, a statistical analysis was applied with the Chi square test, for this the 483 students were surveyed as a result it was obtained that according to the meal time the people who ate breakfast daily have low weight only the 3.5% (n=17, 0.6% (n=3) do it two to three times a week and 0.4% occasionally; with respect to normal nutritional status, 48.5% (n=233) eat breakfast daily, 11% (n=53) do so two to three times a week, 3.1% (n=15) only on weekends, 6.6% (n=32) occasionally and 2.7% did not eat breakfast; People who are overweight in their nutritional status show the following results: 4.5% (n = 70) eat breakfast daily, 2.3% (n = 11) do it two to three times a week, 0.6% (n = 3) only on weekends, 1.4% (n = 7) occasionally and 0.4% (n = 2) do not eat breakfast and finally people who are obese in their nutritional status it is obtained that 3.3% (n = 16) eat breakfast daily, 0.6% (n=3) two to three times a week, 0.4% (n=2) occasionally and 0.2% (n=1) definitely do not eat breakfast. The result of $p = 0.949$ induces that the consumption of breakfast does not influence the nutritional status of the student population investigated.

In reference to lunch and nutritional status, low weight is obtained that only 4.1% (n = 20) and 0.4% (n = 2) consume it daily two to three times a week; People who are normal weight consume 59.8% daily (n=289), 8.1% (n=39) consume it two to three times a week, 0.6% (n=3) do it only on weekends, 3.1% (n=15) occasionally; those who are overweight daily consume it only 15.7% (n =

76), 2.9% (n = 14) do it two to three times a week, and 0.2% (n = 1) only on weekends, 0.2% (n = 1) occasionally and the other 0.2% (n = 1) do not eat lunch and people who are obese only 3.3% (n = 16) consume it daily, 1.2% (n=6) only on weekends. When obtaining the result of the value of $p = 0.304$ indicates that in the population investigated the consumption of lunch does not influence its nutritional status.

The correlation between snack meal time and people who have low weight nutritional status only 3.9% (n = 19) consume it daily, 0.2% (n = 1) two to three times a week, the other 0.2% (n = 1) does it only on weekends and do not snack also 0.2% (n = 1); People who are normal weight consume 56.3% (n=272), 5.4% (n=26) two to three times a week, 2.1% (n=10) only on weekends, 17% (n=34) occasionally and 0.8% (n=4) definitely do not snack. Overweight individuals consume 13.7 (n=66) daily, 2.3% (n=11) two to three times a week, 0.4% (n=2) only on weekends and 1% (n=5) no snack. And people who are obese eat 3.7% (n=18) daily, 0.2% (n=1) two to three times a week, 0.4% (n=2) occasionally, and 0.2% (n=1) no snack. When analyzing the result of the value of $p = 0.349$ refers that in the population investigated the consumption of the snack does not influence its nutritional status.

3.3 Amino acid score of higher consumption preparations

Table 3. Analysis of Variance (SC type III) of the amino acid score of foodsmost consumed by university students of ESPOCH.

Foods	AMINO ACIDS		p-value
	Lysine (mg)	X ± D.E	
CONTINENTAL BREAKFAST	^a 1.2	± 0.01	0.0024
FULL BREAKFAST	^c 1.32	± 0.07	
RICE WITH CHICKEN	^a 1.2	± 0.02	
CHICKEN SOUP	from 1.28	± 0.05	
STUFFED RICE	from 1.19	± 0.08	
HAMBURGER	from 1.27	± 0.02	
SALCHIPAPA	^{abc} 1.29	± 0.06	
PAPICARNE	^c 1.38	± 0.02	
Foods	AAS	(mg)	
CONTINENTAL BREAKFAST	^b 1.23	± 0.02	0.0237
FULL BREAKFAST	^b 1.17	± 0.15	
RICE WITH CHICKEN	^a 0.98	± 0.01	
CHICKEN SOUP	^a 0.97	± 0.02	
STUFFED RICE	^a 0.95	± 0.03	

HAMBURGER	^a 0.96	± 0.02	
SALCHIPAPA	^a 0.91	± 0.05	
PAPICARNE	^a 0.95	± 0.02	
Threonine (mg)			
	X ± D.E		p-value
CONTINENTAL BREAKFAST	^D 1.14	± 0.05	
FULL BREAKFAST	^D 1.08	± 0.06	
RICE WITH CHICKEN	^c 0.97	± 0.01	
CHICKEN SOUP	^c 0.98	± 0.01	0.0035
STUFFED RICE	^{bc} 0.94	± 0.03	
HAMBURGER	^D 1.07	± 0.08	
SALCHIPAPA	^a 0.68	± 0.06	
PAPICARNE	^b 0.86	± 0.07	
Tryptophan (mg)			
	X ± D.E		p-value
CONTINENTAL BREAKFAST	^a 0.45	± 0.04	
FULL BREAKFAST	^b 0.67	± 0.05	
RICE WITH CHICKEN	^{cd} 1.22	± 0.1	
CHICKEN SOUP	^{cd} 1.16	± 0.07	0.0147
STUFFED RICE	^D 1.3	± 0.07	
HAMBURGER	^c 1.12	± 0.05	
SALCHIPAPA	^{cd} 1.14	± 0.18	
PAPICARNE	^c 1.11	± 0.05	

Means with a common letter are not significantly different ($p > 0.05$)

(X= mean; D.E= standard deviation; gl= degrees of freedom; CV= coefficient of variation; mg= milligrams; AAS= sulfur amino acids)

Table 3 reports the analysis of variance of essential amino acids when comparing seven preparations of higher consumption that are sold in the establishments of foods of the ESPOCH, where the coefficient of variation present values of lower dispersion, it is evident that the score of the four types of amino acids present statistically significant differences for a value of $p < 0.05$ in all preparations of greater consumption by ESPOCH students.

With regard to lysine with a value of $p = 0.024160$ exhibit four ranges of differentiation, where the preparation that has greater value of amino acid computation is the combination of potatoes with meat with an average of 1.38 ± 0.02 followed by the full breakfast that corresponds to milk, egg and rice with chicken with an average of 1.32 ± 0.07 , On the other hand, all preparations

indicate ranges that exceed one's score scores, which means that there is a greater source of animal proteins such as meat, milk, polwhich are richer in lysine.

In the group of essential amino acids is methionine (a sulfur amino acid), while cysteine is a non-essential amino acid, since it can be formed from the previous one and are considered sulfur amino acids, and significant differences are reported for a value of $p = 0.0237$, with a range of higher AAS content for Breakfasts containing animal foods such as chicken, eggs, milk, and plant-based foods such as whole grains.

For threonine, the analysis of variance obtained with a value of $p = 0.003560$ indicates that there are significant differences with the amino acid score with four classification ranges, where the food that presents the highest contribution of threonine is the continental breakfast with average value of amino acid score of 1.14 ± 0.05 and the preparation with the lowest amino acid score in threonine is salchipapa with an average of 0.68 ± 0.06 Foods rich in threonine are meats, dairy products, cereals and legumes, little amount in potatoes and sausages.

Finally, in the case of tryptophan, the amino acid score presents statistically significant differences with five classification ranges and a value of $p = 0.0147$, where the continental breakfast (water, coffee, bread, seasonal fruit juice and an egg) has the lowest amino acid computation value with an average of 0.45 ± 0.04 , on the contrary the preparation that presents the greatest contribution of this amino acid is the dry chicken (rice, potatoes with chicken and vegetables) with an average of 1.16 ± 0.07 . Foods rich in tryptophan are usually chicken, dairy, fish, eggs.

4. Discussion.

With respect to the frequency of consuming food in the respective meal times, it is evident that students who present a normal nutritional status have a minimum consumption of the 3 main meals on a regular basis, this shows that when there is greater food intake, in adequate portions and schedules favorable results were observed in BMI and health, being evident that the lower the intake either due to lack of time due to academic loads or money, the greater the tendency to get sick or suffer repercussions on nutritional status.

According to a study conducted by Ibáñez et al. (2015) entitled Changes in eating habits of dental students of the San Martín University Foundation in Bogotá, Colombia, it was shown that students presented irregular eating habits in the number of meals per day and in feeding schedules and this was related to the entrance to the university environment causing their lifestyle to deteriorate, The significant differences between 3 to 4 meals per day (t-test, $p=0.03$) before and after entering university were currently 42% ($n=134$) and before 52.7% ($n=168$). (18)

Also, in a study of university population of the Faculty of Higher Studies Zaragoza, as well as different campuses of Ciudad Universitaria carried out to 100 women and 100 men between 17 and 30 years of age, to whom they applied a unique survey to obtain data related to eating habits and lifestyle, 65.5 % of the population ate three meals a day, these meals were not considered

within a balanced diet because they did not integrate different food groups,(8) compared to this study, most students eat at least the three main meals of the day daily, which include varied foods but the consumption of unhealthy food such as fried foods stands out.

With regard to amino acid computation calculations; the limiting amino acids (AA) provide us with values that lead us to identify deficiencies in essential AA contents in mixtures of two or more food components, in preparations of ready meals or formulas, when analyzing the contents of foods, we find cases that contain proteins with limiting amino acids such as preparations with wheat and derivatives, Such foods may possess methionine, low lysine protein content from wheat rice, but when successfully combined with lysine legumes, they complement each other, then the amino acid of one protein can compensate for the deficiency of the other, resulting in a protein of high biological value (19).

Breakfast cereals contain low-quality protein and are often consumed with milk. The digestible indispensable amino acid score (DIAAS) has been used to assess protein quality, but it is not known whether DIAAS obtained in individual foods is additive in combination meals. (6)(20)

On the other hand, combinations of foods with each other and with dairy produce adequate mixtures and with better quality protein contents. In corn, lysine and tryptophan are essential amino acids contained in small portions. (21)

Sulfur is a component of sulfur amino acids. It is a mineral necessary for the formation of collagen and other protein components that are part of connective tissue, such as keratin that is part of the skin, and other mucopolysaccharides that make up bones, cartilage, tendons and ligaments. Therefore, an adequate supply of sulfur through sulfur amino acids is essential for the good maintenance of the skin, hair, as well as ligaments and tendons. (22)

Threonine is the amino acid in the highest concentration in mucin (intestinal mucosa) and antibodies. It is necessary to take into account that its deficiency can compromise the functioning of the digestive and immune system and reduce its availability for muscle protein synthesis.

The PDCAAS procedure has limitations because the values are calculated from the total digestibility of the crude protein (CP) tract. and PDCAAS calculations are based on the assumption that all amino acids (AAs) have the same digestibility as PC. However, it is recognized that AA digestibility is most correctly determined at the end of the small intestine (the ileum), because AAs are absorbed only in the small intestine, and because fermentation of the hindgut can affect fecal excretion of AA. (20)

Conclusion.

A proper diet is an important factor in maintaining a good nutritional status; Therefore, the frequency of consumption by meal times and food groups according to anthropometric characteristics resulted in the three main meal times being eaten more frequently, that is, 48.2% of the population ate breakfast, 59.8% had lunch and 56.3% snacked.

The limiting amino acids that were evidenced in the preparations of greater consumption of the restaurants of the ESPOCH is threonine by the consumption of unhealthy foods such as salchichas

with chips and tryptophan which indicates that some foods that are used have lower biological value of proteins and some preparations should be changed to achieve a better nitrogen balance.

Conflict of interest.

The authors indicate that there is no conflict of interest

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