Plant protein in the Amazon Basin

HELENA R. SOBRAL

In 1974, large agro-industrial enterprises particularly for extensive cattle ranching in the Amazon Basin, started being promoted by the Ministry of Agriculture of Brazil (Goodland and Irwin). As those two authors pointed out this will be "environmentally disastrous" as many changes taken place with the deflorestation of vast tracts of land will be irreverssible: soil depletion and disappearance of species will make impossible the restauration of the forest.

Studies have shown that cattle consist in the most inefficient form of protein capture. A cow must be fed 21 pounds of protein in order to produce one pound of protein for human consumption. "An acre of cereals can produce five times more protein than an acre devoted to meat production; legumes (peas, beans, lentils) can produce ten times more; and leafy vegetables fifteen times more" in the average (Lappé). Those figures even though being obtained from the United States, bring to light the fact that other alternatives to livestock could be used in the Amazon, preserving larger areas of forest from devastation. Since it is well documented that temperate zone's crops and agricultural tecniques are very harmful to tropical areas and also unsuccessful, it is necessary to turn the eyes to the indigenous flora in order to find species that would provide the protein necessary for the rapidly increassing population of the Amazon.

The Brazilian Region North which roughly coincides with the limits of the Amazon Basin in that country, has had the following increase in population in the last 30 years, according to the census results.

	Urban	Rural
1940	405.792	1.056.600
1950	580.867	1.263.788
1960	983.278	1.618.241
1970	1.626.600	1.977.260

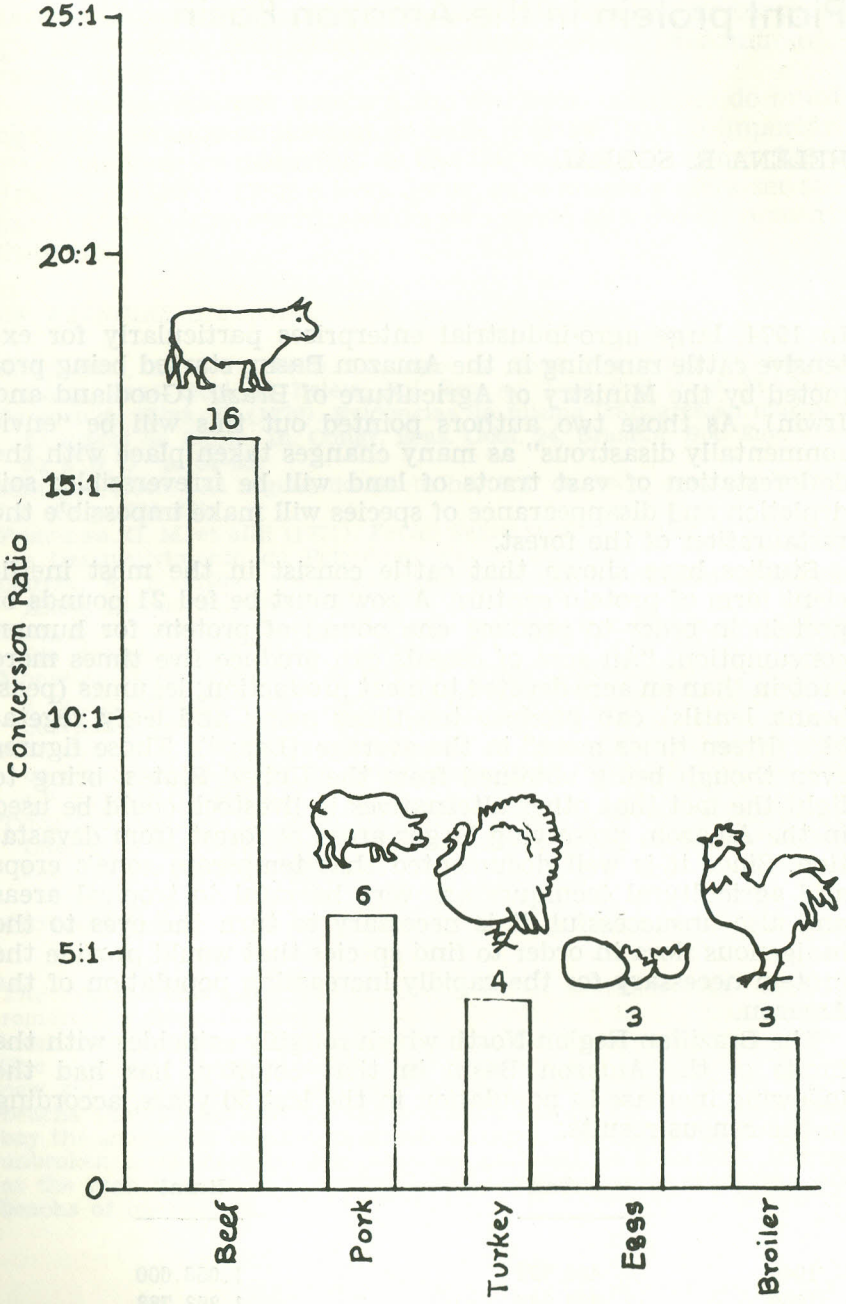

CHART 1 — Pounds of Grain and Soy Fed to Get One Pound of Meat, Poultry, or Eggs. (Source: Lappe, F. M., Diet for a Small Planet, based on U.S.D.A. Economic Research Service.)

Few nutricional studies have been done in the Amazon Region. They do not give an overall assessment of the nutricional status of the populations but suggest that there is a protein defficiency specially in the urban areas and in the rural ones which received immigrants from the NE of the country. This is an increasing trend as it is the urban population that is booming.

I will give a few examples of those studies to show how they suggest the protein deficiency, even though a not strong one.

In 1953 studies of F.A.C. and W.H.O. indicated that kwashiorkor was rare in Belem.

From 1954-56 the "Comissao Nac. de Alimentos" did an "Inquerito sobre consumo de alimentos e nutrimentos, a avaliação do estado nutritivo e situação da popul. da Amazônia" and gave an avaliation of the population: 50% in good physical condition, 5% in bad condition and the rest in fair condition.

In 1957, Garcia Filho and others studied 20 families affiliated to the Liga Paraense contra a tuberculose and concluded that their food was inefficient and inadequate and that the protein consumption was insufficient.

In 1961, Viana C. M. analysed 108 patients with 'Sindrome Anemico Parasitaria" in the Hospital of Santa Casa de Misericórdia do Pará and saw the under-consumption of protein as one of the main causes of the disiase.

In 1965, 160 residents of the town of Raimundo Nonato and in 100 residents of the colônia Agrícola de Sumauma in Pará, 84 in the first and 64 in the second showed signs of protein defficiency.

Even though it is important to metion that those cases of protein defficiency occur in the lower income groups, it seems however that one of the main reasons behind this malnutrition and protein defficiency is the lack of knowledge and the maladaptation of the immigrants to the Amazonian environment. In 1949, Josue de Castro wrote: "le regime alimentaire amazonien... est incomplet, exempt d'elements nutritifs de toutes categories et pauvre en proteines, en sels mineraux et en vitamines". In 1950, Pierre Gourou wrote: "Nas regiões rurais o que nos surpreendeu foi a inadaptação da alimentação ao meio local. Essa inadaptação é de 3 espécies: não utilização dos recursos espontâneos locais, descuido de certas possibilidades agrícolas ou pecuárias, consumo de produtos importados e, por conseguinte, muito caros. É espantoso que os caboclos que vimos não explorem mais ativamente os recursos alimentícios vegetais da floresta...".

Also in 1950 Manuel Bastos described the food of the rubber tappers as consisting of canned goods while the natural foods of the area are either depleated or forgotten.

A survey done in the early 1960's by the Getulio Vargas Fundation showed that in Brazil as a whole protein shortages were more frequent in urban areas and affected one out of ten households. The Amazon region is included in the Northeast.

On the contrare, the primitive inhabitants of the Amazon seemed to have a nutritious diet and were described by the first chroniclers as being healthy and well fed lookind. Even today the indian tribes which have not been severely disrupted by the invading whites show signs of being able to find in the natural environment more than enough to supply, their needs. As example, the Aguaruna group studied by Prof. Berin produce more protein than the minimal allowance for human body established by R.A.O. In fact, all the edible species the white man found in the Amazon were already consumed in greater or lesser degree by the indians. The natives lived and live in a close relationship with the environment and know where and when to find the different sources of food.

Unfortunately at the present time the government policy also ignores the native plant protein resourses to improve the nutricional status of the population. In fact, while some fruits with recognized high protein content as the Brazil nut and the cashew nut are mostly exported, others are neglected. Also as an illustration of this fact, in 1964 and 1968 the nine main fruits cultivated in the state of Para were no only poor in protein but also most of them were allien to the Amazon. Of course one explanation for this fact is that the native species are extrated from wild trees, but also that they are neglected probably because they are not a part of the culture of the immigrating population.

The purpose of this paper then is to put together what was found in the literature available in this University (Berkeley and S. Francisco Campus) about the protein content of the Amazonian edible plant species in order to delineate a viable alternative source of protein.

II. PROTEIN

The word comes from the greek proteios meaning primary or holding first place. "Protein is present in varying amounts in all living cells animal and plant; it is indispensable to growth and development. Children need it especially in their rapidly growing years, but is essencial throughout life for replacement of cells and tissues of the body" (Kraus). Infants require about 1 gram of protein for each pound of body weight. The adult man needs 56 grams and the adult woman 46 grams. Age and weight affect the requirement.

Proteins are formed by amino-acids. The proteins our bodies use are made up of 22 amino-acids in varying combinations. Eight of those amino-acids can't be synthetized by our bodies; they must be obtained from outside sources and for this they are called essential: tryptophan, leucine, isoleucine, lysine, valine, threonine, the sulphur containing amino-acids and the aromatic amino-acids. These essential amino-acids must be taken simultaneous by and in different amounts but in right proportions.

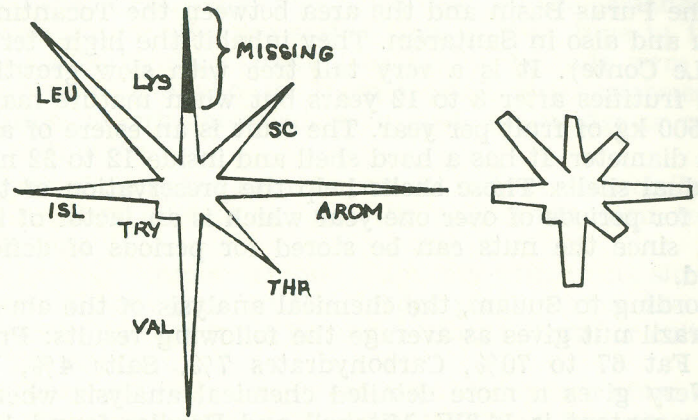

CHART 2 — THE PROBLEM OF A LIMITING AMINO ACID
If even one essential
amino acid is partially missing...
the result is that all amino acids are reduced in the same proportion. (Source: LAPPÉ, F. M., Diet for a Small Planet.)

Plant proteins are not complete, that is they are not present in the right proportions as they are needed, consequently it is necessary to eat a variety of them from different sources in order to have the proteins available for the body. For example if legumes are eaten with cereals the protein of both is made more valuable, increasing the availability of combined protein content. Seeds and nuts are usually deficient in isoleucine and lysine and legumes on the contrary are deficient in thrytophan and sulphur contining amino-acids and rich in the other two. So seeds and nuts make good complements of legumes.

From those facts we can deduct that the diversity of the Amazonian flora is of a great importance for the achievement of a balanced protein diet. Some species even thougghmay have a small protein content can be very important as a complement of others.

III. EDIBLE PLANTS AND FRUITS OF THE AMAZON AND A TENTATIVE ASSESSMENT OF THEIR PROTEIN CONTENT

The best known Amazonian protein rich fruit is the Brazil Nut or castanha do Pará (*Bertholletia Excelsa*). Pio Correa considers the area of the "castanheiro do Pará" that from the states of Maranhão and Mato Grosso until 10° lat. south across the state of Pará until the frontier with Suriname and of the Amazonas until the Orenoco Basin. The richest areas of production are: the Purus Basin and the area between the Tocantins and Xingu and also in Santarém. They inhabit the high "terra firme" Le Conte). It is a very tall tree with slow growth and which frutifies after 8 to 12 years but when mature may produce 500 kg of fruit per year. The fruit is an esfere of around 12 cm diameter. It has a hard shell and inside 12 to 22 nuts in individual shells. Those shells help the preservation of the almond for periods of over one year which is an factor of importance, since the nuts can be stored for periods of deficiency of food.

According to Sudam, the chemical analysis of the almont of the Brazil nut gives as average the following results: Proteins 17%, Fat 67 to 70%, Carbohydrates 7%, Salts 4%, Water 5%. Nery gives a more detailed chemical analysis where the protein content is 14,3W. Mitchell and Beadles found 16,25% of protein with a digestability coeficient of 95,71%. According to Moura Campos it contains 10,72 to 16,40% of protein which is of a high biological value. (Chaves, Nelson) U.S.D.A. gives the values of 2,5 gr of protein for 4 shelled nuts (.6 oz).

The protein of the Bertholletia is called excelsina and according to Manuel Bastos in it we find "glycine, aline, valine, leucine, proline, phenyl-alanine, aspartic and glutamic acids, tyrosine, ccstine, aginine, hcstidine, lysine, triptophan", in sum, "all the amino-acids" and calls it the vegetable meat.

Dante Costa did experiments with young rats for a period of 90 days in order to compare the value of the protein of the Brazil nut with that of powder milk in the growth and the results showed that their value was almost, similar, the one for the Brazil nut being only 6% lower than the one for the milk (0,183 grm. for Brazil nut).

Tobias J. B. Menezes discussed the value of the Brazil nut flour and said than when its oil is extracted it has a protein content of 33,4% and recomends its use in mixtures with wheat flour to enrich the nutricional value of the bread, cakes, puddings and soups.

The Brazil nut was known by the natives at the time of the conquest. Juan Alvare Maldonado in his expedition of 1567 and

1569 talks about those nuts as if they were already known. He asked the "cacique" to bring "gran suma de almendra para que los españoles comiesen". Cobo in 1691 wrote: "y hai en las provincias de los Andes tan grande cantidad de ellas que se hallan montanas de cincuenta leguas y mas de estos almendras". This suggests that the nuts were very abondant exceeding in volume what the indians could consume.

In an article published in 1943 in R. Bras. Geogr. the unidentified author said that as a consequence of the occupation of the plain by the invaders, the aborigenous population found refugee in the interiorlands and relied more on the castanhais for their subsistance. He also stated that at that time in the regions were bertholletias existed naturally the nuts were staple of the poor people who ate them roasted or transformed into oil (banha de seringueiro) or even made a porridge or milk to drink with coffee.

In spite of being the more important ones commercially speaking, the Bertholletias are not the only Amazonian trees to provide nuts.

The *Lecythis Paraensis* or Cast. Sapucaia with fruits similar to the Bertholletia's grow on the flooded plains of the Low Amazon. Ducke said they could be found either natural or cultivated along the Amazon.

The *Gouroupita Guianensis* or castanha de macaco grows on the Igapós do Salgado and of the estuary. It was first observed in 1582 in the Magdalena River among the patangoros indians.

The *Omphalea Diandra* or castanha caiate grows in the waterlogged soils over all the Amazon has fruits with edible nut and pulp.

The *Licania Parinarioides* (Copuda) grows in beaches and sandy soils of the rivers Jamunda, Mapuera, Trombetas, Tapajós, Capim; Cameta, and Marajó Island has edible oily seeds.

The *Coumaronaa Polyphylla* or Cumaru inhabits the terra firme near streams and has oily seeds that taste like cashew nuts.

The *Cunuria Spruceana* found in Upper Rio Negro and R. Solimões has fruits similar to those of the rubber tree. Its almonds when fresh are bitter and poisonous but can be cooked and are eaten by the indians. (Ducke)

The *Bombax Aquaticum* or mamorana also called Provision tree or castanheira das Guianas common all over the Amazon specially near the "igarapés" of the "várzea", and the *Bombax Spruceanum* found in the flooded forests of the Amazon River both have edible nuts.

Other species with edible nuts are: *Parinarium Montanum* (Pajura de Mata) in terra firme all over the Amazon, the *Couerpia Bracteosa* from the Rio Negro and R. Branco, the *Lucuma Speciosa*, the *Licania Parinarioides* from the Tapajós

and *Couerpia Longipendula* (castanha Pêndula ou de Galinha). From this long list only from the last one I could find the results of a chemical analysis done by Maravilhas and others. Its fruits are oval and contain almonds which can be eaten raw or toasted but is usually made into a flour. The protein content of the oil free nut is 32,5%, similar to that of the Brazil nut.

Even though the fruits of the other trees mentioned have not been analysed we can assume that they are mostly protein rich. Since the different species grow in different environments and areas of the Amazon Basin as we saw by Le Cointe's work which I used for this paper, we can assume that all over the region there are protein rich nuts and seeds.

Another species which was reasonably studied and showed a high protein content is *Anacardium Occidentale*, the cashew, which grows in any soil with good permeability. P. Cavalcanti says there are evidences that it is a native plant of the Low Amazon and trat from there it was disseminated to the whole of the Amazon Basin, to the Brazilian coast and also to the tropical areas of the world. Potino mentioned that "De la parte baja del Amazonas debio comunicarse al pie de los Andes, pues para mediados del siglo XVII ya era arbol hortense en varios lugares de esa imensa region"... "Oviedo descrive, as pauxi, una planta oriunda de Venezuela"... "A un pajui se refere un autor como frutal del Esequibo é la region del bajo Orinoco". He also mentioned that in the lhanos of Casanare the indians used to make a drink with the flesh of the cashew. In the 16th and 17th C. it was known as Maranon in Colombia and the word caju in portuguese is tupi-guarani. The cajueiro was considered as the most important natural product that the indians of he coast of Brazil could find and the rippening of its fruits served as a basis for a calendar.

The fruit of the cashew is the nut which has a yellow redish fleshy "pedunculo" attached to it. Both fruit and "pedunculo" are of high nutritional value, the first for its protein and the second for its richnesse in ascorbic acid. Guimarães and Pechnick say that one can get all the needed daily supply of vitamin C with 15-50 gr. of the flesh or of the fresh juice of the cashew.

The protein content of the pedunculo is ensignificant, around 0,15 and 0,25%.

The chemical analysis of the real fruit showed a protein content of 15,7% and fat 37,1% (Almeida). Purseglove gave a protein content of 20% and fat 40%. U.S.D.A. figures ore 4,9 gr. per 1 oz. of nuts. According to Lacerda Madruga it contains the following amino-acids: Leucine, Phenil-alanine, thiptophan, valine, methionine, proline, alanine, treonine, cysteine, serine, glutamic and aspartic acids, aspargine, lysine, hystidine and arginine. From those 16 amino-acids the nut contains 7 of the 8

essential for the maintenance of an adult person and 9 of the 10 necessary for growth. Only isoleucine is missing.

Guimarães and Pechnick carried out preliminary biological tests by feeding rats with cashew flour or caseine. The tests revealed that the protein of cashew nuts has a higher nutritive value than caseine. Improvement was noted when cashew nut protein was supplemented with methinine. Addition of lysine and isoleusine had no appreciable effect. They concluded that their experiment confirmed the studies of Mitchell and Beadles that did comparative tests of the proteins of cashew nut and beef and obtained very similar values. They argue that anacardina is the vegetable protein that is most similar to animal proteins.

The indians made use of the "pedunculo" as well as of the nut. Mauro Mota says that the indians and first explorers already used the nuts. The indians of the NE made a flour with it that they used to take on trips.

Moura Campos recomended the addition of the cashew nut flour to the wheat one to enrich the bread.

Another advantageous factor of the Anacardium Occ. is that the frutification starts when they are still young (3 years) and goes sometimes until are over 50. The productivity of an adult tree (12 to 15 years) in good environmental condition is around 4.000 fruits per year according to Pechnick and Guimarães. In the state of Pará few plantations exist and they show a productivity of 700 fruits/tree/year of 130.000/hec./year.

Other varieties of cashew occur wildly in the Amazon with similar fruits: *Anacardium Giganteum* largely distributed in the whole Hylea; *Anacardium Microcarpum* or cajui in the dry soils of the low Amazon and Marajó; *Anacardium Negrense* or cajutim known only in upper R. Negro and Uapes River and *Anacardium Spruceanum* or cajuacu which grows in the high forest in large part of the Amazon but not near the mouth.

The "cacaueiro" is another indigenous tree of the Amazon which has fruits rich in protein. Theobroma, as it is known scientifically, is ground wild in the Magdalena, Orinoco and Amazon Valleys. The real cacao is *Theobroma Cacao* frequently native in the "várzea" forests. But there are other varieties which are also explored for human use: *Theobroma Spruceanum* (cacau azul), *Theobroma Bicolor* (cacau do Peru) *Theobroma Microcarpum* and *Theobroma Subincanum* (cacau-rana of Tapajós and East Amazon and Obidos), and *Theobroma Speciosum* (cacao-i0) from the terra firme forests all over the Amazon which also gives an excellent chocolat: in addition to *Theobroma Grandiflorum* or cupuacu from the high várzea and terra firme in the south and east of the state of Pará.

The fruit of the cacao is alongated about 10 to 25 cm has a thick skin which contains 15 to 56 seeds surrounded by a white flesh. The flesh is sweet and sour and good for jams, wine and vinegar but can also be eated plain as the indians do. From the toasted seeds one extracts chocolate anda cocoa butter.

Braz and Bruno say the "cacaueiro" had an important role in the ancient civilizations of north south America being even used as a coin. They also say that the spanishes were the first to add sugar to it.

Patino comments on chocolate being used as a benerage saying: "Non se sabe hasta ahora de ninguna tribu suramericana que en la época prehispanica usara una bebida semejante al chocolate... Lo unico realmente comprobado és la absorcion del mucilago que rodea las semillas. Menos documentado, aunque probable, es el uso de la grasa o manteca de los granos, para fines rituales o religiosos y quiza medicinales".

Also Theobroma subincanum is supposedly used only after the spanish conquest and Theobroma grandiflorum was diffused in the upper tributaries of the Amazon by brazilian expansion. Patino)

Braz and Bruno obtained the following figures in a chemical analysis of the chocolate in powder:

Carbohydrates	73,5%
Fat	8,8%
Proteins	10,15%

Purseglove gave the following figures for the protein content of oven dried coroa products:

Fresh Kernel	14,8%
Cocoa Powder	22,2%

The U.S.D.A. standart figures are: 8,3 gr. of protein for 1/2 cup (1.5 oz.) of low fat plain dry cocoa.

Lima Vasconcelos and others did a chemical study of the seed of the *Theobroma Grandiflorum* (cupuacu) which they claim is excellent for the fabrication of white chocolate and found the following values:

Carbohydrates	15%
Protein	15%
Fat	50%

Unfortunately, they say, this part of the fruit is neglected.

The palm trees are an important item in the Amazon Basin and there is a tremendous variet, most of them providing edible fruits or palmitos.

One of the most diffused ones is the açai palm, *Euterpe Oleracea,* which grows on the marshy lands of the Amazon mouth and on the margins of the terra firme streams in the Low Amazon. It gives purple fruits of the size of a cherry used to prepare a beverage known as "vinho de açai" very popular in urban or rural areas of the Amazon. This palm also provides a good palmito which is the hearth of the new growth of the tree, but to obtain it he tree has to be destroyed. There are other varieties of açai: *Euterpe Caatinga* (açai chumbo) that grows in the terra firme near Manaus, *Euterpe Precatoria* (açai mirim) from the upper Amazon, *Euterpe Longispathacea* (açai da terra firme) in the south of Pará, and *Euterpe Edulis*, all with similar characteristics.

The açai was already used by the indians, and the ticunas used the time of the ripening of the fruit as a cycle of their calendar (Patino). It was wild and cultivated.

J. E. Paula published results of analysis made by Campos and Altman of the flesh and of the seed respectively. The values found for the flesh were: Fats 13,4%, Proteins 1,25%; for the seed: 4,34% of protein, 12,26% of hemicelulose and 34,42% of celulose.

In the preparation of the vinho de açai the pulp is used and the seed is rejected.

Chaves and Pechnik also analysed the fruit of the Açai chemically and arrived to an average protein content for the pulp of 3,38% and for the açai drink 1,25%. They concluded that the value of the drink is not in its protein content which is relatively low but in its high energetic value, superior to that of the milk.

Another very widespread palm in the Amazon, but especially through cultivation by the indians is *Guilielma Gasipaes* formely Speciosa. Patino says it can be considered the most important palm domesticated and cultivated by the primitive american. He published a vocabulary of regional names given to the Guilielma with 338 words grouped in 66 divisions. Those names were part of the vocabulary of the follwing tribes: chibcha, zaparo, tucano, tupi-guarani, arawak, pano, caribe, quechaa, macu, witoto bora salivapiaroa cawapana, puinave, cahua-pano, mayna, jivaro and sabela. This gives us an idea of the widespread diffusion and of the importance of this species. The more common names naowadays are: chontaduro, pijibay, pipire, pupuna or pupunha.

Still according to Patino all the mentions of the Guilielma in the Amazon Region refer to the left bank of the river. It seems that it was already abondant in the Andean part of the Amazon and its tributaries in the 16th C., but not in the coast of Brazil. Perez says that in the 19th C. near the rivers Caqueta and Po-

tumayo it was the most important palm used for food and drink. Howewer Rocha says that in the beginning of this century it was cultivated everywhere the indians had migrated to.

Patino dobts that the indians cultivated them to eat the palmitos. He suggests that this was rather an sporadic thing since they tree provides valuable fruits anda would be destroyed by this practice.

Today the pejibaye or peach palm is little known outside Central America and Northern South America.

The palm can carry up to 300 fruits and under ideal conditions two crops are harvested per year. The fruit is a starchy mesocarp surrounding a seed. It is usually prepared by boiling in salted water. If one wishes to preserve it, it is dried afterwards but can be restored to original consistency and flavor even after 6 months or more by a second brief boiling.

Qupunha is as important staple in the America tropics because of its high starch, fat and vitamins A and C content. Its protein content is not very significant. Different analysis arrived at different results:

Percentage of protein in the pulp of the fruit:

		(from Johannessen)
Popenoe and Jimenez	2,8%	
Burgos and de Vargas	3,0%	
Raymond and Squires	6,7%	
Gongora y Lopes	3,3%	
Wu Leung	2,6%	
Johannessen	1,7%	to 2,6% depending on the size of the fruit

For the seeds Johannessen found valunes of 8,8%.

The *Mauritia Flexuosa* (Buriti or Muriti) palm grows abondantly throughout the Amazon Basin, Venezuela and Guianas in the "igapós" of the "terra firme" and in humid "campos". They are always associated with water and for this from areas of human attraction.

The hearth of the palm is made into a sagu, the "ipurana" of the indians. The pulp of the fruit is edible and good to make sweets. This pulp is oily and extremely rich in vit. A.

Altman and Cordeiro analysed it and found that the whole fruit grouded has 5,2% of protein. The same value was found for only the pulp.

As I said before there are any other palm trees with edible fruits or palmito. Since I did not find results of chemical analysis done on them, I will leave open any conclusion as to their protein content.

The *Caryocar* species (around 15) are also abundant in the Amazon Basin, Guianas and Central Brazil. The species Villosum and Nuciferum are more widespread in the Amazonian "terra firme" with the name of piquia. Caryocar kernels are said to be the best edible nuts in the tropics. They are called suari or butternuts and, according to Hauser and Berg they are rich in protein and very rich in fat and carbohydrates.

Arachis Nambyquarae, the indigenous peanuts of Mato Gros- in the Amazon Basin, and *Arachis Hypogaea* or mendubi, usually cultivated, are very rich in incomplete protein.

U.S.D.A. figures for the peanut protein are:

1 lb. of peanuts raw in, shell = 86,1 gr. of protein
1 oz. with skin = 7,4 gr. of protein.

Its protein has two globulins which together provide a fairly good amino-acid contend but its composition is far from perfect.

Chaves published a table comparing the proteins of the peanut with that of the egg, considered the perfect protein.

Percentage of the deficit in relation to egg protein:

Arginine	+ 55
Cystine	—33
Hystidine	0
Isoleucine	—62
Leucine	—24
Lysine	—58
Methionine	—76
Phenyl-alanine	—14
Treonine	—69
Tryptophan	—33
Tyrosine	— 2
Valine	+ 10

Poraqueiba Sericea (Umari roxo) and *Poraqueiba Paraensis* (Umari Amarelo) indigenous or cultivated has a relatively high protein content in the skin and edible pulp: 4,46% for the yellow one and 2,90% for the purple one.

Leaves are additional protein resourse of Amazonian plants. Those of the *Manihot Esculenta* have the most widespread use in Brazil, especially for cattle feed and in some places for human consumption as in the dish hnown as "maniçobada". Patino mentions that "los muosz utilizaban las hojas de la yuca como verdura". "Tambien en el Brasil usaran los indigenas las partes foliares". Purseglove mentions that they are rich in protein. In fact, Pechnik and Guimarães analysed it and obtained the follwing result:s

Leaf air dried 29,2%
Leaf dried in refrigerator 30,0%

They also did some experiments with the amino-acid balance of the sweed cassava leaves and arrived to the conclusion that with 0,3% of methionine the diet containing leaf meal dried in a refrigerator yielded result that compare well with caseine.

Other edible leaves found in the area are: from: *Ipomea Batatas* (sweet potato), *Phytolacca Octandra* (Caiena spinach) and *Hibiscus.*

Nelson Chaves considers the saffron another source of protein and oil. The saffron from the Amazon is *Bixa Orellana* and has not been explored as source of protein.

Bamboo shoots from *Bambusa Vulgaris* and *Guadua Superba* are another possible protein source. Hauser and Berg say bamboo shoots contain a fairly large amount of inferior protein. U.S.D.A. figures for 4 oz. of trimmed bamboo shoots are 2,9 gr. of protein.

This long list does not exaust the vegetable protein sources of the Amazon Basin. Again I will say that other native fruits are not notorious for their protein content but could have a role in the amino-acid balance of the ingested proteins.

IV — CONCLUSIONS

There is a tremendous variety of species that occur in different environments of the Amazon Basin so one could say that there is an widespread distribution of protein rich foods. In the literature I found evidence that they were used sporadically by the pre-colombian populations. Because most of them have harvest periods during the flood and rain season (exception cashew) and that it is the period when agricultural activities were almost stagnated and also fishing was more difficult, I suspect they played an important role in the supply of protein for this period. Also because the nuts have a great storage capacity thay must have played an important role when game was scarce and when the indians were travelling or were in war.

With the invasion of the Amazon by the Iberians the indians were pushed to the interior and passed to rely more on those plants as source of protein since fishing was made more difficult.

The diet to the table of foods consumed by the Xavantes in the boundary forest-savanna reveals that they do rely on nuts of indigenous trees of the area specially in periods when agricultural products are scarse, that is two months after the heavy rains have started and two months after the drought season has

started that is, during the "grande seca", as they are under the savanna type of climate. Under forest type of climate the critical season be that of the heavier rains and floods since the dry season is not very marked.

The diet of the first explorers also relied a lot on those fruits.

With the rubber boom and immigration of norteasterners, it seems they did not learn to take full profit of those resourses, or maybe they were not enough.

Anyway, no effort was made to develop those plant protein resouses in a systhematic way, on the contrary, to what happened in other tropical areas that started to produce commercially some Amazonian fruits.

In 1967 the Economic and Social Council of the United Nations proposed: "Expand the use of oil-seed meals as direct sources of protein in human diets" and comments that "vast amounts of protein are available in the developing countries, but not presently used for human diets, which could be incorporated into simple, nutritious, low cost mixtures with cereals, or used in more sophisticated food products at higher cost. Indeed, no other single source of uncoventional protein could contribute so greatry and promptly towards closing the protein gap. "

Or. Dutra de Oliveira (Recursos Proteicos Am. Latina) comments that the traditional foods of our countries have not been sufficiently considered as possible protein sources. He emphasizes that they should not te baken separately, but as part of a daily diet and that because they are already in the social-economical and cultural context of the population they would be more easily accepted.

Maybe also a lot of forest would be saved from devastation.

BIBLIOGRAFIA

Altman, R., Cordeiro, M. Margarida (1964). A industrialização do fruto do Buriti, *I.N.P.A.*, public. n.º 5, Química.

Altman, R., Oliveira, P. C., Oliveira e Silva (1965). Estudos sobre o fruto do Umari, *I.N.P.A.*, Publ. n.º 8, Química.

Amazônia Bibliografia 1614-1962 (1963) Cons. Nac. de Pesquisa, Instituto Nac. Bibl. e Doc., Rio de Janeiro.

Amazônia Bibliografia 1601-1970 (1972) Inst. Bras. Bibl. Doc., *I.N.P.A.*, Rio de Janeiro.

Bastos, Manuel (1950) Sobre o valor dos alimentos aborígenes da Amazônia, *Revista Médica Brasileira*, vol. 28, n.º 2.

Behar, M. e Bressani, R. (1971). *Recursos Proteicos en America Latina*, Inst. de Nutricion de Centro America y Panama, Guatemala.

Braz, M. e Bruno, O. (1965). O valor alimentício do chocolate, *Arquivo Brasileiro de Nutrição*, vol. 21, n.º 2.

Britto, R. e Viana, C. (1966). Aspectos de Nutrição Humana do Est. do Pará, *Cadernos Paraenses*, n.º 1, I.D.E.S.P.

Buaes, A. (1969). A Castanha do Pará — *Sudam Documenta*, vol. 1, n.º 1, Belém.

(1942) Buritizal — *Revista Brasileira de Geografia*, ano IV (4)
(1943) Castanhais — *Revista Brasil de Geografia*, ano V(3).
Castioli, B. (1968). Proteínas Vegetais, *Bol. Centro Trop. de Pesq. Tec. Alim.*, n.º 15, Campinas.
Castro, Josué de (1949). *Géographie de la Faim*, Les Ed. Ouvrieres, Econ. et Humanisme, Paris.
Cavalcanti, Paulo B. (1972) *Frutas Comestíveis da Amazônia*, Publicações Avulsas do Museu Goeldi, n.º 17, Belém.
Chaves, J. M. e Pechnick, Emilia (1945). O Assaí, um dos alimentos básicos da Amazônia, *Anais da Ass. Quim. Brasil*, vol. IV, n.º 3.
Chaves, Nelson (1963). *Proteínas Vegetais e Trópicos*, Universidade do Recife, Imprensa Universitária.
Costa, Dante (1945). Valor do crescimento da proteína da Castanha do Pará, *O Hospital*, vol. 28, n.º 1.
(1973) Proteins, *Enc. Britânica*, Macropaedia, Knowledge in depth, vol. 15.
(1966) Fruticultura no Pará, *Estudos Paraenses*, 7, I.D.E.S.P.
(1971) Fruticultura no Pará, *Estudos Paraenses*, 35, I.D.E.S.P.
(1970) *Food Consumption in Brazil, Family Budget Surveys in the early 60's*, Getulio Vargas Foundation.
Goodland, R. J. A., Irwin, H. S. (1975). *Amazon Jungle: Green Hell to Red Desert?* Elsevier Scientific Public. Co., Amsterdam.
Gourou, Pierre (1950). Observações Geográficas na Amazônia, *Rev. Bras. de Geografia*, ano 12, n.º 2.
Guimarães, L. R. e Pechnick, E. (1968). Contribuição ao Estudo do valor alimentício da Cast. do Caju, *Arquivo Bras. de Nutrição*, vol. 24, n.º 1 e 2.
Hauser, B. e Berg, R. (1932). *Dictoionary or Foods*, Tempo Inc., N. Y.
Hodge, W. H. (1965). Palm Cabbage, *Princeps*, 9, (4).
Johannessen, C. L. (1966). Pejibaye Palm, *Economic Botany* 20 (3).
Johannessen, C. L. (1967). Physical and Chemical Analysis of the fruit of the Pejibaye, *Economic Botany*, 21 (8).
Kraus, Barbara (1975). *The Barbara Kraus Dictionary of Proteins*, Harper's Magazine Press.
Lappe, Frances M. (1976). *Diet for a Small Planet*, Ballantine Books, New York.
Le Cointe, Paul (1947). *Amazônia Brasileira III, Árvores e Plantas Úteis*, Cia. Editora Nacional.
Lima Vasconcellos, M. N., Leão da Silva, M., Soares Maia, J. G. Gottlieb (1975). Estudo Químico das Sementes do Cupuaçú, *Acta Amazônica*, ano V, n.º 3.
Maravilhas, Rodrigues e Leão da Silva (1965). Castanha Pendula ou Castanha de Galinha (Couepia Longipendula) Valor Econ., Duas Oleaginosas da Amazônia, *I.N.P.A.*, Publ. Quim., n.º 9.
Menezes Tobias, J. B. (1967). A Castanha do Pará na indústria de alimentos. *Boletim do Centro Trop. de Pesq. e Tec. de Alimentos*, n.º 9.
Mors e Rizzini (1966). *Useful Plants of Brazil*. Holden Day Inc.
Mota, Mauro (1956). *O Cajueiro Nordestino*. Min. Educ. e Cultura.
(1975) Murici, *Estudos Paranaenses*, 35, I.D.E.S.P.
(1975) *Underexploited Tropical Plants with Promising Economic Value*, National Academy of Sciences.
Nery, José P. (1969). Castanha do Pará. *Bol. do Inst. Tec. Alim.* n.º 20.
(1968). O Maracujá, *Estudos Paraenses*, 21, I.D.E.S.P.
Patino, Vítor Manuel (1963). *Plantas Cultivadas y Animales Domésticos en America Equinoccial*, tomos 1 e 2. Cali Imp. Departamental.
Paula, J. E. (1975). Anatomia de Euterpe Oleracea, *Acta Amazônica* ano V, n.º 3.

Purseglove, J. M. (1968). *Tropical Crops, Dicotyledons*, vols. 1 e 2, Longmans Green e Co.
Sampaio, A. J. (1942). A flora Amazônica, *Revista Brasil de Geografia*, ano IV (2).
Sauer, Carl O. (1950). Cultivated plants of South and Central America, in *Handbook of South American Indians*, Smithsonien Institution, Bureau of American Ethnology, Bulletin 143, vol. 6, pp. 487-543.
Sinopse Estatística do Brasil (1975). I.B.G.E., Rio de Janeiro.
United Nations Economic and Social Council (1967). Increasing the production and use of edible protein.
Yokomizo, Y. (1972). Comportamento e Importância das Proteínas no Processo Tecnológico de Alimentos, *Boletim do Inst. Tec. de Alimentos*, n.º 29.

RESUMO

Proteínas Vegetais da Amazônia. I. A partir de 1974, o Ministério da Agricultura do Brasil começou a incentivar a instalação de grandes empresas agro-industriais, dedicadas sobretudo a criação extensiva de gado, na Bacia Amazônica. Como Goodland e Irwin tão bem apontaram em sua obra "Green Hell to Red Desert", isto será desastroso para o meio ambiente, uma vez que muitas mudanças ocorridas com a derrubada da floresta e vastas áreas de terra serão irreversíveis: o empobrecimento do solo e o desaparecimento de espécies tornarão impossível a restauração da floresta.

Estudos feitos mostraram que gado consiste na forma mais ineficiente de se obter proteína. Uma vaca precisa ser alimentada de 9,5 quilos de proteína a fim de produzir 440 gramas de proteina para consumo humano (Lappé). "Um acre de cereais pode produzir cinco vezes mais proteina do que um acre dedicado a produção de carne; legumes (ervilhas, feijão e lentilha) podem produzir dez vezes mais; e vegetais em folha quinze vezes mais", em média (Lappé). (Ver ilustração n.º 1.)

Estas observações, apesar de terem sido obtidas nos E.U.A., ilustram o fato de que outras alternativas à criação de gado poderiam ser usadas na Amazônia, preservando maiores áreas de floresta. Uma vez que é sabido que produtos e técnicas agrícolas de zonas temperadas são mal sucedidos, e as vezes danosos para as áreas tropicais, é preciso que se voltem os olhos para a flora indígena a fim de se achar espécies que proveriam proteína necessária à população da Amazônia, que está crescendo rapidamente.

Poucos estudos sobre nutrição na região Amazônica foram feitos, mas sugerem deficiência protéica, sobretudo entre as populações mais baixas das áreas urbanas e nas rurais, que receberam imigrantes da região nordeste do país. Esta tendência deve se acentuar uma vez que é a população urbana que mais está crescendo e que muitas fontes tradicionais de proteínas na região, como a caça e a pesca, estão sendo prejudicadas com o processo de desenvolvimento econômico.

Parece que uma das causas desta deficiência protéica é a falta de conhecimento e a mal adaptação dos imigrantes ao ambiente amazônico. Ao contrário, os primitivos habitantes da região pareciam ter uma dieta nutritiva melhor, e eram descritos pelos primeiros cronistas como sendo saudáveis e bem alimentados. Até hoje as tribos indígenas, que foram severamente afetadas pelos brancos, mostram-se capazes de encontrar proteina suficiente em seu meio natural. Infelizmente, no presente, a política governamental ignora os recursos protéicos vegetais nativos. Enquanto algumas frutas de alto teor protéico, como a castanha de caju e a castanha do pará, são quase que totalmente exportadas, outras são negligenciadas.

II. Proteínas estão presentes em quantidades variadas em todas as células vivas, animais ou vegetais, sendo indispensáveis ao crescimento e desenvolvimento. O "Food and Nutrition Board", da Academia de Ciências dos E.U.A., recomenda um consumo mínimo necessário de 0,47 gramas por quilo de peso.

As proteínas são formadas por amino-ácidos. Aquelas usadas pelo corpo humano são formadas por 22 amino-ácidos em combinações variadas. Oito destes não podem ser sintetizados por nossos corpos, precisando vir de fontes externas e por isso são chamados de essenciais. Os amino-ácidos essenciais precisam ser tomados simultaneamente e em diferentes porções, mas nas proporções certas. (Ver ilustração n.º 2).

As proteínas vegetais não são completas, ou seja, não estão presentes nas proporções certas conforme requeridas; consequentemente, é necessário comer uma variedade delas, de diferentes fontes, a fim de se ter os amino-ácidos necessários ao corpo.

III. *Frutas e plantas comestíveis da Amazônia e uma tentativa de avaliação de seu conteúdo protéico. Bertholletia Excelsa* — a castanha do Pará com um conteúdo protéico ao redor de 17 e 14% sobre o peso da noz. Sua proteína, a excelsina, é de alto valor pois nela estão presentes todos os amino-ácidos, sendo por isso chamada de "carne vegetal".

Outras árvores amazônicas dão frutos oleaginosos semelhantes que, se bem que não tenham sido todos estudados, supostamente tem um alto teor protéico. São elas: Castanha sapucaia (*Lecythis Paraensis*), Castanha de Macaco (*Gouroupita Guianensis*), Castanha caiate (*Omphalea Diandra*), Copuda (*Licania Parinarioides*), Cumaru (*Coumarona Polyphylla*), *Cunuria Spruceana*, Mamorana (*Bombax Aquaticum*), Pajura da mata (*Parinarium Montanum*), *Couerpia Bracteosa, Lucuma Speciosa, Licania Parinarioides* e Castanha Pendula ou de Galinha (*Couerpia Longipendula*).

Outra fruta razoavelmente estudada e que apresenta alto teor protéico de excelente qualidade é a castanha de caju (*Anacardium Occidentale*). Sua proteína varia entre 20 e 15% de seu peso e possui 13 amino-ácidos, sendo 7 dos essenciais.

Existem na Amazônia outra variedades de caju: *Anacardium Giganteum, Anacardium Microcarpum. Negrense, Anacardium Spruceanum.* Outra espécie com frutos ricos em proteína é o cacaueiro (*Theobroma Cacao*) e suas outras variedades (*Theobroma Spruceanum, Bicolor, Microcarpum. Subincanum, Speciosum* e *Grandiflorum*). O conteúdo protéico do chocolate em pó varia de 10 a 22% de seu peso.

As palmeiras tem importante lugar na floresta amazônica e seus frutos ou palmito, se bem que não tão ricos em proteínas, podem ser importantes no balanceamento dos amino-ácidos. O mesmo pode se dizer para as 15 espécies de *Caryocar* e para o Umari roxo e amarelo (*Poraqueiba Sericea e Paraensis*).

O amendoim (*Arachis Nambuguarae* e *Hypogaea*) geralmente são cultivados e são muito ricos em proteína incompleta.

Folhas também constituem um importante recurso protéico da Amazônia. Dentre elas destacam-se as da mandioca (*Manihot Esculenta*), com 30% de proteína sobre o peso da folha seca, da batata doce (*Ipomea Batas*), espinafre de Caiena (*Phytolacac Octandra*). Outros recursos seriam o acafrão (*Bixa Orellana*) e brotos de bambu.

IV *Conclusões.* Há grande variedade de espécies que se distribuem em diferentes meios e áreas da Amazônia, de modo que pode se dizer que há recursos protéicos vegetais em toda a região. Estes recursos eram mais ou menos usados pelos primitivos habitantes e primeiros colonizadores, dependendo da estação do ano, mas, com o tempo, seu uso tem sido negligenciado.