



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org



D00030

TELETYPE
UNITED NATIONS
GENEVA

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.28/12
11 March 1969

ORIGINAL: ENGLISH

Expert Group Meeting on Scientific Approaches to
the Problems of Preservation and Refrigeration of
Food in Developing Countries

Vienna, 24 - 27 February 1969

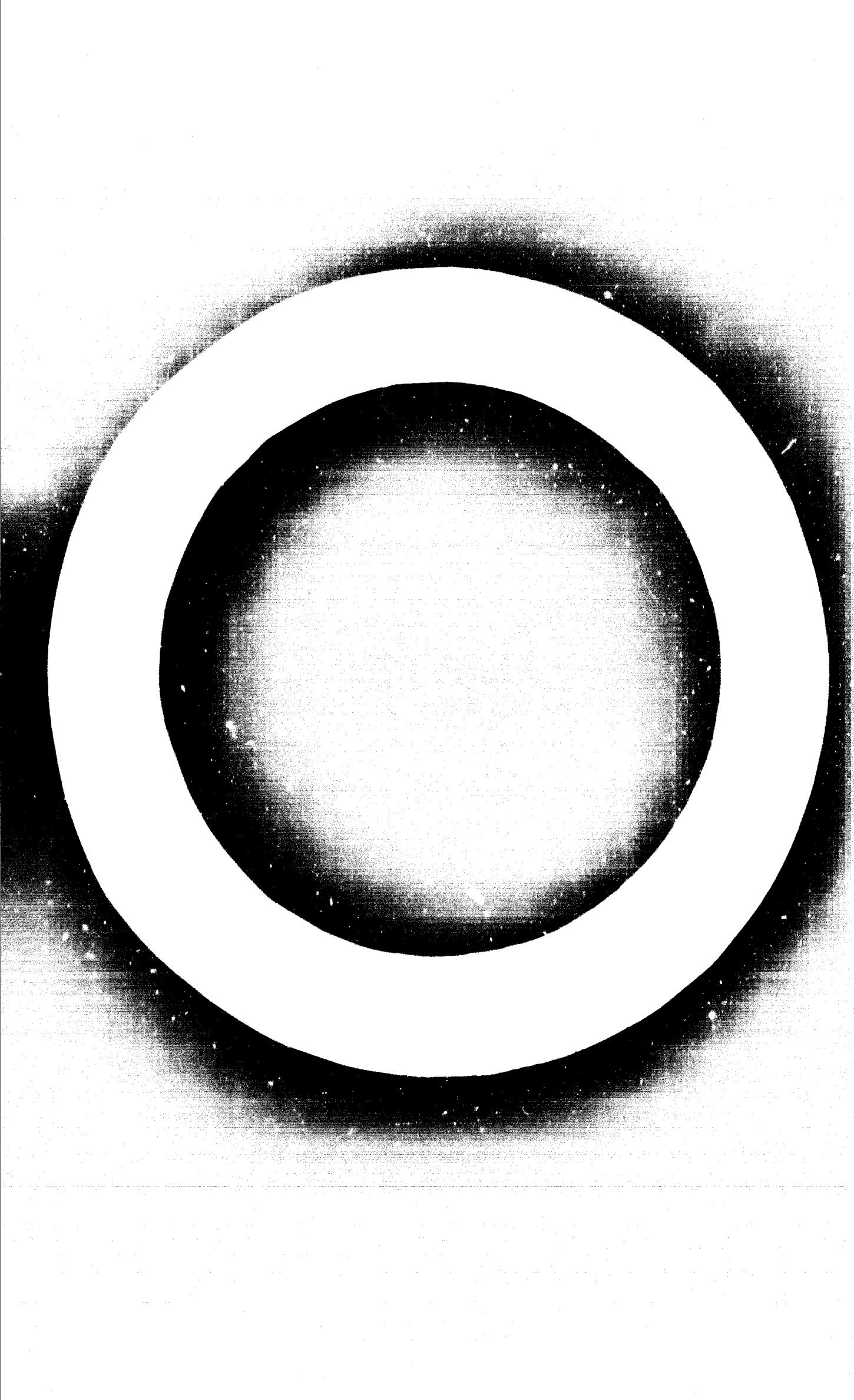
PROTEIN ENRICHMENT OF FOOD IN DEVELOPING COUNTRIES 1/

by

W. Heimann

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDC. This document has been reproduced without formal editing.

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.



Those who look at the world's food imbalance of today and tomorrow, generally agree that the most important aspect of the world's food shortage is the lack of protein in the diets of the poor and developing countries.

The malnutrition in protein or the deficiency in protein of high biological value concerns mainly some countries in Asia, Africa, as well as the regions in South- and Central America. A discussion of protein nutrition is outside the scope and space of this paper but some short references may be given.

The minimum protein requirement is estimated to be approximately 1.0 gms per kg of body weight of an adult human, this will say 60 - 70 gms daily; in the growing child the minimum requirement for optimum growth may be more than 2 gms per kg of body weight. At least a third of the total protein should be of animal source.

TABLE 1
Staple Foods and Nutritive Value 1/

	Calories		Consumption of			Protein	
	Requirement/day	Actual Supply	Cereals kg/year	Tubers and Roots kg/year	Carbo-hydrate Calories	Total Protein gms/day	Amino Acid Protein
North Africa	2260	97	148	18	75	66	16
West- and Central Africa	2360	103	93	320	74	50	13
East- and South Africa	2330	101	149	36	73	69	17
South Asia	1270	66	139	10	70	50	7
Central America	2130	90	112	11	71	58	14
Australia and New Zealand	3250	125	89	53	48	94	62
U.S.A.	3110	120	67	40	40	92	60
West Europe	2910	113	111	101	55	83	39

In Table 1, one can recognize the basic diet (staple food) of the different areas in respect of the protein uptake. It can be seen from this table that especially in the regions of West and Central Africa the main diet of the people consists of roots and tubers (e.g. Cassava and Yams), therefore, the protein uptake is insufficient. In South Asia too a deplorable situation of protein deficiency has existed for a long time.

The consequences are mostly found among the poorer population, because foods richer in protein, like meat, eggs, milk, are too expensive, or not at all available. They are compelled to cover their food requirements almost, if not only, by their native starch-containing cereals, legumes, roots and tubers, which are much cheaper.

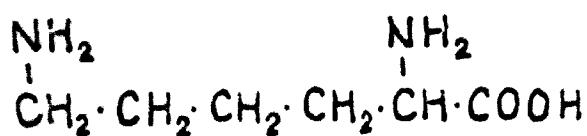
But very often the economical situation is not the only reason for protein deficiency, for it is found also where protein is available in sufficient amounts. The cause of this malnutrition is to be sought in ignorance.

Now allow me to reduce the protein problem to the simplest origins. This introduction and consideration may also help to study more easily the local protein situation and give a better ability to improve protein deficiency.

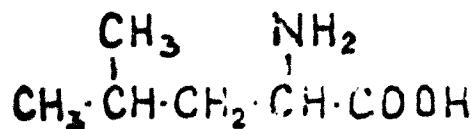
Human beings are in contrary to plants and many micro-organisms dependent on the supply of protein or certain fragments of proteins in the food. These fragments are the amino acids. Today we know about 25 amino acids as basic units of food protein. A certain number of it can be synthesised and converted by our organism. But food must absolutely contain the so-called essential amino acids in a certain minimum amount - 8 for adults, 10 for children.

Table 2 see next page

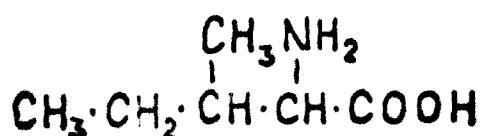
TABLE 2
Essential Amino Acids



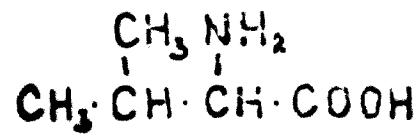
L-Lysine



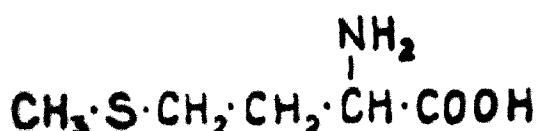
L-Leucine



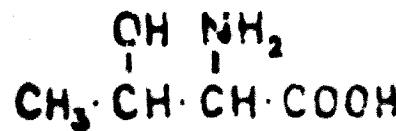
L-Isoleucine



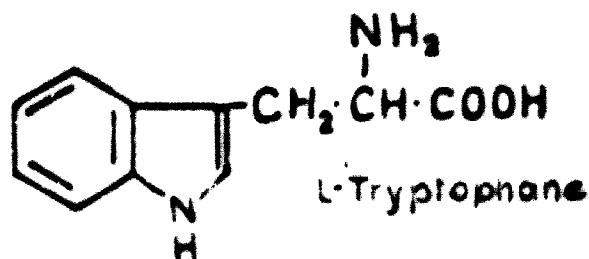
L-Valine



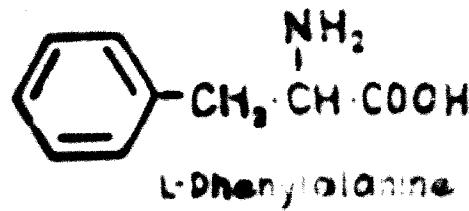
L-Methionine



L-Threonine



L-Tryptophane



L-Phenylalanine

The biological value of the different kinds of protein
is determined by the contents of these essential amino acids.

Table 3 see next page

TABLE 3
Variations in Chemical Scores of Selected
Proteins Using Three Different Reference Standards

Food	Based on FAO provisional pattern (a)	Based on human milk essential amino acid pattern (b)	Based on egg essential amino acid pattern (c)	NPU
Milk (cow's)	80	75	60	75
Egg	100	90	100	100
Casein	80	75	60	72
Egg albumin	100	80	90	83
Beef muscle	80	30	80	80
Beef heart	80	80	70	67
Beef liver	85	85	70	65
Beef kidney	80	85	70	77
Pork tenderloin	85	90	80	84
Fish	70	70	75	83
Oats	80	70	70	-
Rye	80	90	90	-
Rice	70	75	75	57
Corn meal	40	40	45	55
Millet	70	60	60	56
Kaollang	70	50	50	56
White flour	50	50	50	52
Wheat germ	60	70	65	67
Wheat gluten	40	40	40	37
Groundnut flour	60	80	70	48
Soy flour	70	85	70	56
Sesame seed	60	50	50	56
Sunflower seed	70	70	70	65
Cottonseed meal	70	95	80	66
Potato	60	85	70	71
Navy bean	50	50	42	47
Peas	60	70	60	44
Sweet potato	80	85	75	72
Spinach	70	100	90	-
Cassava	20	50	40	-

- (a) Calculated by comparing the quantity of each essential amino acid per g of total nitrogen with that of the same amino acid in the 1957 FAO reference pattern.
- (b) Calculated by comparing the quantity of each essential amino acid per g of total essential amino acids, including tyrosine and cystine, with that of the same amino acid in whole egg.
- (c) Calculated by comparing the quantity of each essential amino acid per g of total essential amino acid, including tyrosine and cystine, with that of the same amino acid in human milk.
- (d) Sulphur-containing essential amino acids (methionine plus cystine).

Table 3 shows that animal protein is dietetically more valuable than plant protein, e.g. cereal and legume protein. Striking appears the low protein content of Cassava (~ 1.8 per cent). In countries like West and Central Africa the tubers of Cassava, Yams, as well as roots serve as basic diet; there is no deficiency in calories per se. But the low protein content of the tubers and the poor quality of these proteins effect a quantitative and qualitative protein deficiency. For this reason a quantitative protein enrichment of this basic diet is indispensable.

What is the reason that protein of cereals and legumes is not highly valuable (see Table 4)? Today one knows, that these proteins lack certain essential amino acids. Table 4 shows a composition of the limiting essential amino acids in the most important varieties of cereals.

TABLE 4
Limiting Amino Acids in Cereals

Cereal Variety	Limiting Amino Acid No. 1	Limiting Amino Acid No. 2
Wheat (10 - 12 per cent protein)	lysine	threonine
Rice (8 per cent)	lysine	threonine
Maize (9 per cent)	lysine	tryptophane
Millet (10 per cent)	lysine	threonine
Sorghum (10 per cent)	lysine	threonine
Barley (10 per cent)	lysine	threonine

Protein of legumes is characterized by a small contents of methionine. Since in many technical developing countries sufficient amounts of cereals and legumes are available - 70 per cent of the cultivated ground of the earth is used for cereals - the quantitative protein supply is covered there.^{1/} This is valid even in case of nutrition with rice, which shows the lowest protein content. The protein supply respectively protein intake

covers in case of the above mentioned consumption of rice the daily intake of 1 gm protein per 1 kg of body weight, recommended by FAO. The most acute deficiency in those countries is that in high quality protein! In many regions, there are sufficient quantities of cereal protein, but because of its lack of essential amino acids, it is insufficient in quality. This means, its biological value is low. To be of high quality, this protein requires supplementation with the missing essential amino acids which means to enrich the actual protein. It would be unrealistic to produce more animal protein in the developing countries in order to cover the protein deficiency: The production of satisfactory animal protein in developing countries is an uneconomical process which does not pay because of high loss of transformation by animal feeding.

Other means have to be found to raise protein quality in those countries. Nowadays in principle there are just two possibilities:

1. Enrichment of basic diet as cereals or legumes with pure amino acids,
2. Enrichment of staple foods containing proteins with special supplementary value,
 - (a) with animal foods,
 - (b) with plant foods.

I. ENRICHMENT WITH AMINO ACIDS 4/

As pointed out, the nutritive value of a dietary protein depends on the pattern or proportions and quantity of essential amino acids which are furnished together with the above protein to the body after absorption by the intestine.

The term "enrichment of protein" will say: protein containing food of lower quality should be revalued, which means to bring it in condition of better "biological protein value". This method has been used in the U.S.A. for many years to enrich feeding-protein with amino acids for poultry nutrition. In order to improve the protein value, methionine is added to legumes which serve as the protein source.

In any case, the way, the know-how, the method and the money for reaching this aim for human nutrition should be adapted to the nutrition and nutrition habits of the concerning developing country.

This means for the practical use: the only success promising method at present, which can guarantee a quick and safe possibility to improve the situation of nutrition with protein containing food of high value is: enriching specifically the staple foods (mostly rich in carbohydrates) with the lacking essential foodstuffs, in this case with protein units.

The staple foods of the concerning country are to be chosen as the basis. The means we must add depend on it. The way of adding, that means the technology of enrichment, can differ and depends on several factors.

In many countries the cereals - as corn, rice, wheat, sorghum - are still the main staple foods. As you know, the protein is not complete in biological nutritive sense. The limiting amino acids are lysine and threonine. Corn has still a second limiting amino acids: Tryptophane. These amino acids should be added to cereals in order to improve their protein value.

Theoretical calculations have shown that it would be possible to double the biological value of wheat protein by adding 0.4 gms lysine and 0.3 gms threonine to 100 gms wheat. Within a wheat production of 200 million tons per year, 25 millions of tons of protein could be saved. This is as much as the total world production of animal protein.

In countries where legumes are the staple food, the amino acid methionine has to be added to the legumes as to peas, soya, peanuts.

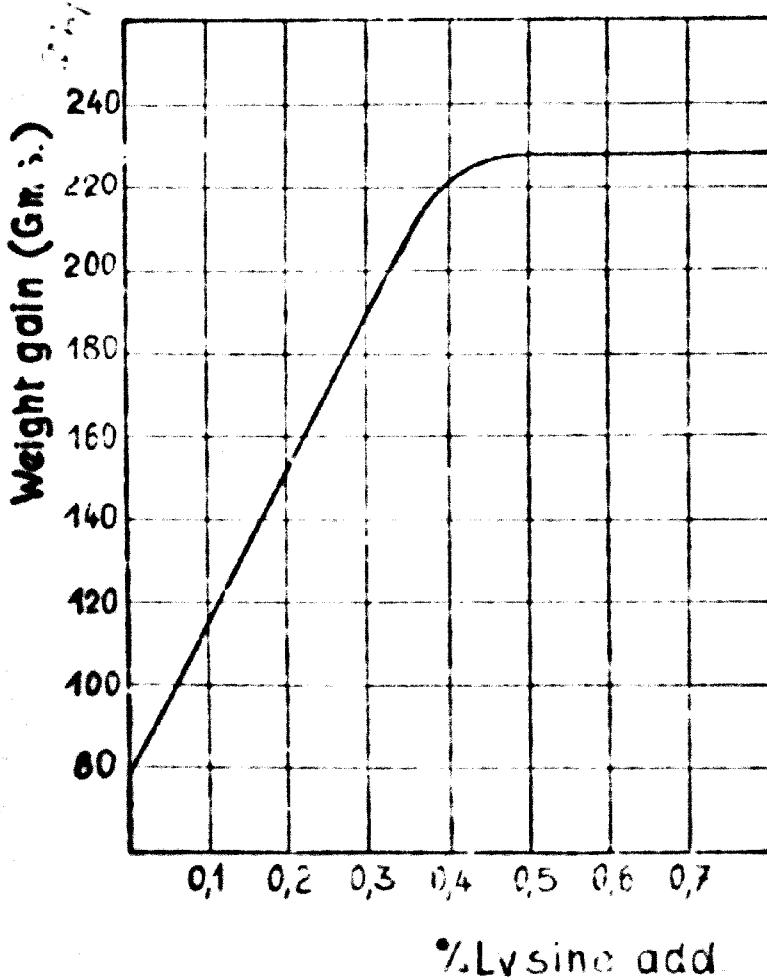
It is important to point out that an addition of amino acids as enriching agents only is nutritively effective if the quantitative protein content of the food is sufficient.

There exists the danger of a destruction of the whole protein metabolism in adding pure amino acids in high quantities; which means that also within an optimal protein supply the utilization of the other amino acids is diminished. This situation or this phenomenon is well known as amino acid imbalance.

The chemical analysis gives the first view in determining the optimal amounts of the enriching amino acids in order to avoid amino acid imbalance. The real relations can only be found by biological tests (growth test), alone by this analytical methods the physiological factors - such as digestion and resorption - can be involved.

Here, two examples of this problem: The supplementation of bread protein by the amino acid lysine shows Table 5.

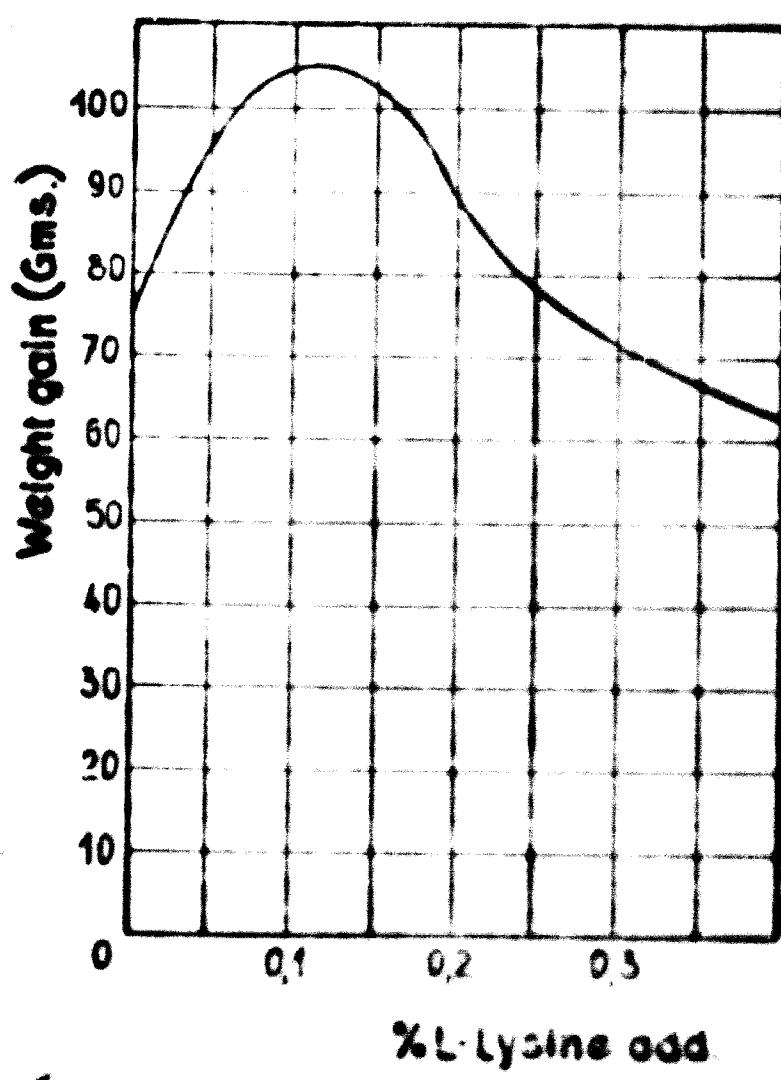
TABLE 5
Growth of Weanling Male Rats on 90 % Bread Diet Supplemented with Graded Levels of Lysine
(five-week growth data) by ROSENBERG



At first the biological value is growing with increasing quantities of the added lysine; but from a definite additive amount no further increase of the biological value can be achieved.

Table 6 gives the results of feeding tests with lysine enriched rice.

TABLE 6
Growth of Weanling Male Rats on Processed
Rice Diet Supplemented with Crated Levels
of Lysine (No Threonine added!)



Here with higher levels of the supplementary lysine a lowering in growth occurs: amino acid imbalance.

Also in the next table (Fig. 7) you can see the improving protein proteins, that the addition of lysine and threonine gives a lower protein efficiency ratio (PER) than without these amino acids. Both of these amino acids are in optimal amounts in the natural protein proteins.

TABLE 7
(Effect of Amino Acids)

Protein source	Protein %	Lysine %	Threonine %	PER %	PER
+	+	+	+	10	1.00
+	6.0	+	+	10	1.00
+	+	6.0	+	10	1.00
+	6.0	6.0	+	10	1.00
6.0	6.0	6.0	+	10	1.00

Effect of Lysine and Threonine

a) PER = Protein Efficiency Ratio = Calories consumed / Calories absorbed

Therefore, an addition of these amino acids in an excess amount will increase the PER = protein efficiency ratio. If we add the lysine and threonine, the PER will increase = Calories consumed / Calories absorbed.

Table 8 (page 11) gives values by PER and as % of protein content of casein and whey. Casein contains more lysine and threonine, which will increase the PER.

I want to show you in Table 9 that the addition of casein whey and casein results in a higher improvement in PER than the only addition of the first lactating casein whey lysine and threonine, the lysine is the excess and these amino acid content is all normal.

NAME

Number	Size	Color
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1
9	1	1
10	1	1
11	1	1
12	1	1
13	1	1
14	1	1
15	1	1
16	1	1
17	1	1
18	1	1
19	1	1
20	1	1
21	1	1
22	1	1
23	1	1
24	1	1
25	1	1
26	1	1
27	1	1
28	1	1
29	1	1
30	1	1
31	1	1
32	1	1
33	1	1
34	1	1
35	1	1
36	1	1
37	1	1
38	1	1
39	1	1
40	1	1
41	1	1
42	1	1
43	1	1
44	1	1
45	1	1
46	1	1
47	1	1
48	1	1
49	1	1
50	1	1
51	1	1
52	1	1
53	1	1
54	1	1
55	1	1
56	1	1
57	1	1
58	1	1
59	1	1
60	1	1
61	1	1
62	1	1
63	1	1
64	1	1
65	1	1
66	1	1
67	1	1
68	1	1
69	1	1
70	1	1
71	1	1
72	1	1
73	1	1
74	1	1
75	1	1
76	1	1
77	1	1
78	1	1
79	1	1
80	1	1
81	1	1
82	1	1
83	1	1
84	1	1
85	1	1
86	1	1
87	1	1
88	1	1
89	1	1
90	1	1
91	1	1
92	1	1
93	1	1
94	1	1
95	1	1
96	1	1
97	1	1
98	1	1
99	1	1
100	1	1
101	1	1
102	1	1
103	1	1
104	1	1
105	1	1
106	1	1
107	1	1
108	1	1
109	1	1
110	1	1
111	1	1
112	1	1
113	1	1
114	1	1
115	1	1
116	1	1
117	1	1
118	1	1
119	1	1
120	1	1
121	1	1
122	1	1
123	1	1
124	1	1
125	1	1
126	1	1
127	1	1
128	1	1
129	1	1
130	1	1
131	1	1
132	1	1
133	1	1
134	1	1
135	1	1
136	1	1
137	1	1
138	1	1
139	1	1
140	1	1
141	1	1
142	1	1
143	1	1
144	1	1
145	1	1
146	1	1
147	1	1
148	1	1
149	1	1
150	1	1
151	1	1
152	1	1
153	1	1
154	1	1
155	1	1
156	1	1
157	1	1
158	1	1
159	1	1
160	1	1
161	1	1
162	1	1
163	1	1
164	1	1
165	1	1
166	1	1
167	1	1
168	1	1
169	1	1
170	1	1
171	1	1
172	1	1
173	1	1
174	1	1
175	1	1
176	1	1
177	1	1
178	1	1
179	1	1
180	1	1
181	1	1
182	1	1
183	1	1
184	1	1
185	1	1
186	1	1
187	1	1
188	1	1
189	1	1
190	1	1
191	1	1
192	1	1
193	1	1
194	1	1
195	1	1
196	1	1
197	1	1
198	1	1
199	1	1
200	1	1
201	1	1
202	1	1
203	1	1
204	1	1
205	1	1
206	1	1
207	1	1
208	1	1
209	1	1
210	1	1
211	1	1
212	1	1
213	1	1
214	1	1
215	1	1
216	1	1
217	1	1
218	1	1
219	1	1
220	1	1
221	1	1
222	1	1
223	1	1
224	1	1
225	1	1
226	1	1
227	1	1
228	1	1
229	1	1
230	1	1
231	1	1
232	1	1
233	1	1
234	1	1
235	1	1
236	1	1
237	1	1
238	1	1
239	1	1
240	1	1
241	1	1
242	1	1
243	1	1
244	1	1
245	1	1
246	1	1
247	1	1
248	1	1
249	1	1
250	1	1
251	1	1
252	1	1
253	1	1
254	1	1
255	1	1
256	1	1
257	1	1
258	1	1
259	1	1
260	1	1
261	1	1
262	1	1
263	1	1
264	1	1
265	1	1
266	1	1
267	1	1
268	1	1
269	1	1
270	1	1
271	1	1
272	1	1
273	1	1
274	1	1
275	1	1
276	1	1
277	1	1
278	1	1
279	1	1
280	1	1
281	1	1
282	1	1
283	1	1
284	1	1
285	1	1
286	1	1
287	1	1
288	1	1
289	1	1
290	1	1
291	1	1
292	1	1
293	1	1
294	1	1
295	1	1
296	1	1
297	1	1
298	1	1
299	1	1
300	1	1
301	1	1
302	1	1
303	1	1
304	1	1
305	1	1
306	1	1
307	1	1
308	1	1
309	1	1
310	1	1
311	1	1
312	1	1
313	1	1
314	1	1
315	1	1
316	1	1
317	1	1
318	1	1
319	1	1
320	1	1
321	1	1
322	1	1
323	1	1
324	1	1
325	1	1
326	1	1
327	1	1
328	1	1
329	1	1
330	1	1
331	1	1
332	1	1
333	1	1
334	1	1
335	1	1
336	1	1
337	1	1
338	1	1
339	1	1
340	1	1
341	1	1
342	1	1
343	1	1
344	1	1
345	1	1
346	1	1
347	1	1
348	1	1
349	1	1
350	1	1
351	1	1
352	1	1
353	1	1
354	1	1
355	1	1
356	1	1
357	1	1
358	1	1
359	1	1
360	1	1
361	1	1
362	1	1
363	1	1
364	1	1
365	1	1
366	1	1
367	1	1
368	1	1
369	1	1
370	1	1
371	1	1
372	1	1
373	1	1
374	1	1
375	1	1
376	1	1
377	1	1
378	1	1
379	1	1
380	1	1
381	1	1
382	1	1
383	1	1
384	1	1
385	1	1
386	1	1
387	1	1
388	1	1
389	1	1
390	1	1
391	1	1
392	1	1
393	1	1
394	1	1
395	1	1
396	1	1
397	1	1
398	1	1
399	1	1
400	1	1
401	1	1
402	1	1
403	1	1
404	1	1
405	1	1
406	1	1
407	1	1
408	1	1
409	1	1
410	1	1
411	1	1
412	1	1
413	1	1
414	1	1
415	1	1
416	1	1
417	1	1
418	1	1
419	1	1
420	1	1
421	1	1
422	1	1
423	1	1
424	1	1
425	1	1
426	1	1
427	1	1
428	1	1
429	1	1
430	1	1
431	1	1
432	1	1
433	1	1
434	1	1
435	1	1

Production of Amino Acids

Now some notes on the production of the amino acids we need for the fortification of cereals and legumes.

Tables 9 and 10 show two ways to win L-lysine by chemical synthesis ^{1/2}. In Japan, lysine as well as methionine are synthesised by fermentation ^{1/2}.

Principles of Fortifying with Amino Acids

As a matter of fact in developing countries, cereals and other foods rich in carbohydrates, represent the main staple food. From the point of view of nutrition and with a view to a certain kind of technique of the protein enrichment, they are considered to be the basis of the protein carriers. The techniques of protein enrichment of cereal products can be made by different methods. The method of enrichment has to be adapted to the respective kind of cereal and its state. Whether wheat or rice grains, its milling products (fleur) or protein concentrates have to be improved.

Methods of Fortification Using either Cereal Grains or Processed Cereal Products

The pure nutrients like amino acids are added at very low levels and have therefore no effect on any organoleptic (sensory) properties of the processed cereal product.

When cereals are milled into flour or flakes or processed to protein concentrates, the enrichment can be carried out by adding on a batch basis or on a continuous basis using suitable feeders and mixers. There are in general very simple ways of processing, using the same simple methods exercised for a long time for ordinary enrichment ^{1/2}.

But enrichment techniques become more difficult when the cereal is used in its whole grain. This concerns particularly the legumes where rice represents the main staple food (basic diet), because of the almost universal custom of washing the

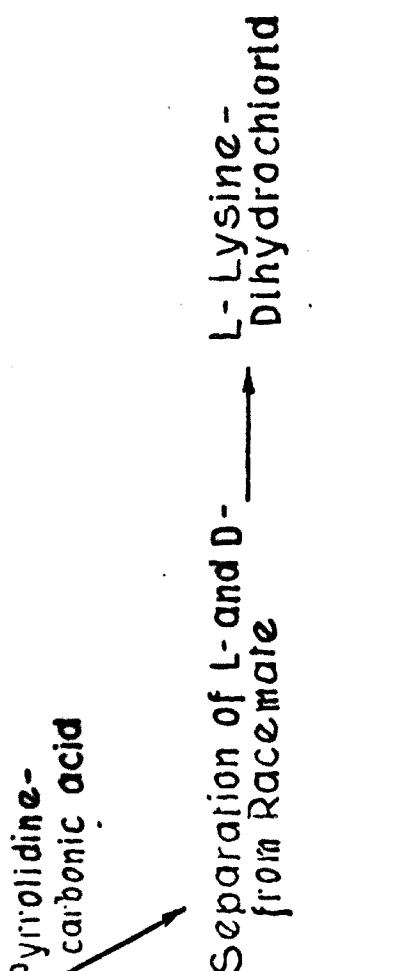
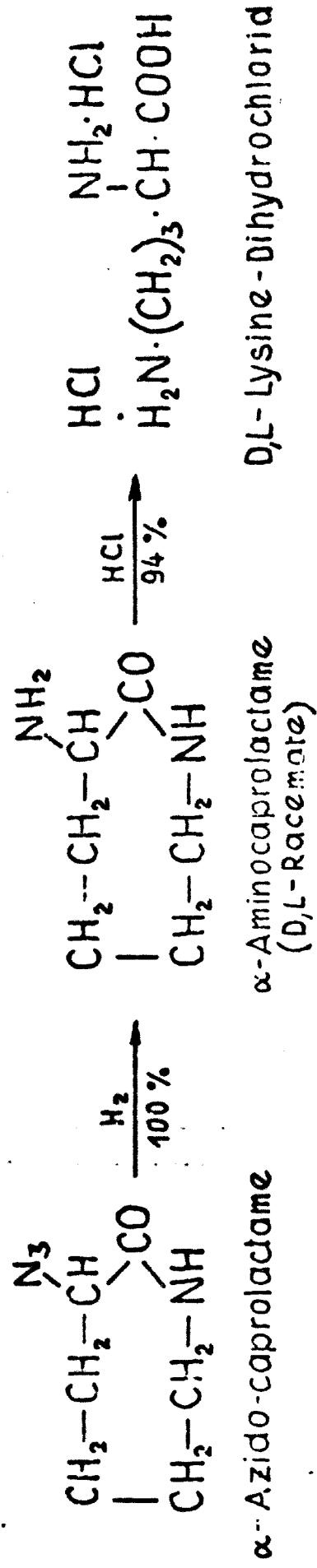
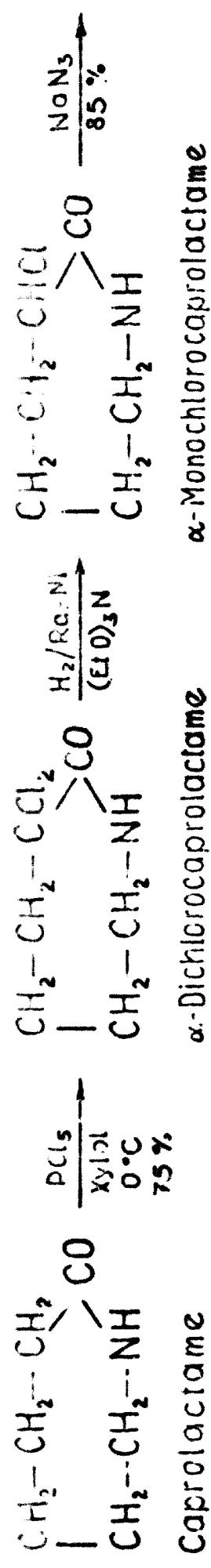
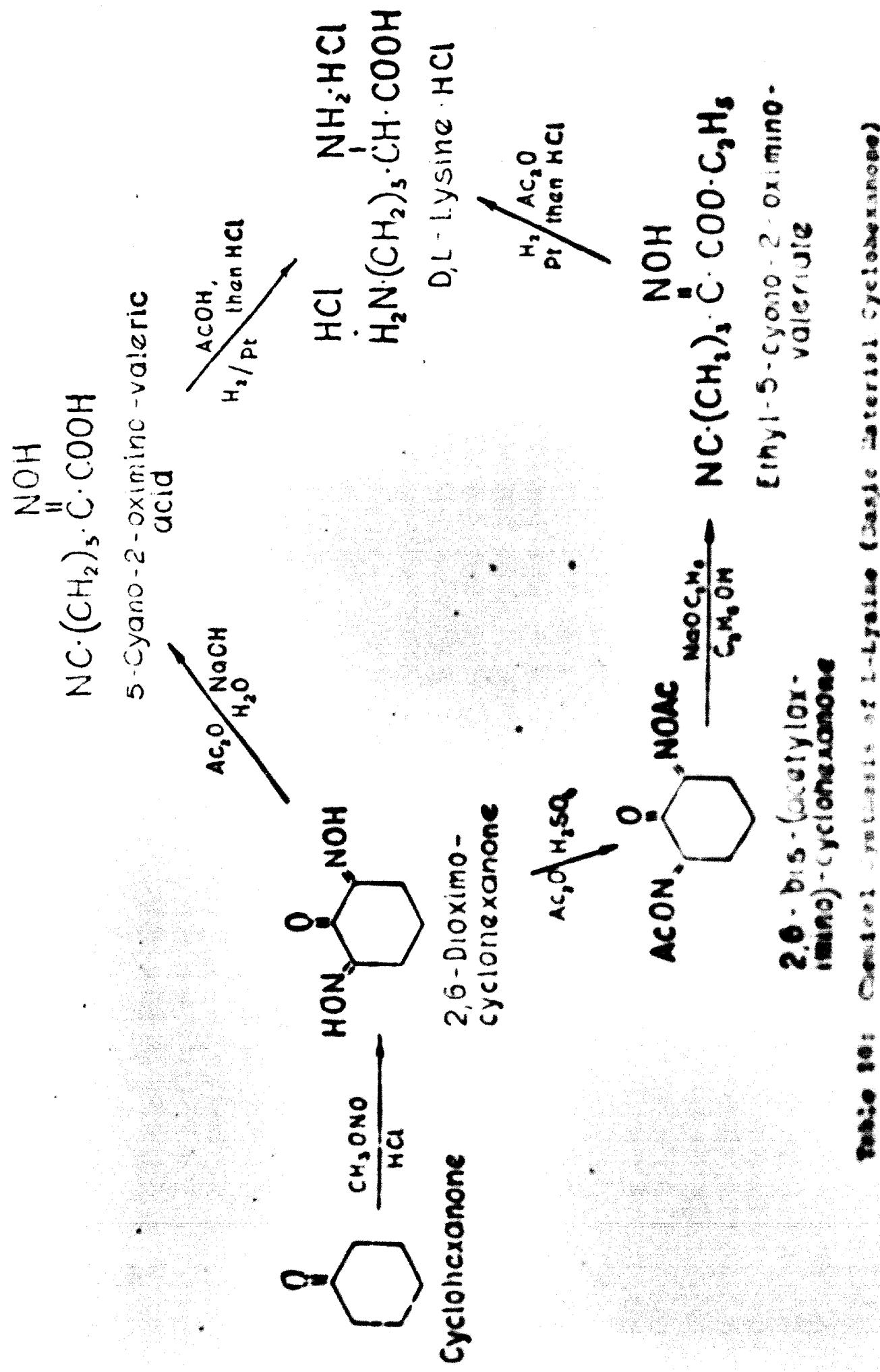


Table 9: Chemical Synthesis of L-Lysine (Basic Material: Caprolactam)



More general border security or by making the process of ~~the~~ ~~border~~ ~~crossing~~ ~~of~~ ~~other~~ ~~types~~ ~~to~~ ~~various~~ ~~countries~~ ~~as~~ ~~legal~~ ~~is~~ ~~done~~ ~~now~~ ~~and~~ ~~especially~~ ~~considering~~ ~~that~~ ~~most~~ ~~of~~ ~~the~~ ~~other~~ ~~types~~ ~~(like~~ ~~truck~~ ~~or~~ ~~aircraft)~~ ~~are~~ ~~illegal~~¹, ~~and~~ ~~the~~ ~~more~~ ~~legitimate~~ ~~(like~~ ~~boat)~~ ~~are~~ ~~prohibited~~ ~~as~~ ~~immigration~~ ~~ships~~ ~~are~~ ~~large~~ ~~in~~ ~~front~~ ~~of~~ ~~the~~ ~~border~~ ~~countries~~ ~~they~~ ~~can~~ ~~be~~ ~~seen~~ ~~as~~ ~~the~~ ~~best~~ ~~solution~~ ~~with~~ ~~problems~~ ~~immigration~~.

There are obviously some limitations of this approach. It is limited to the ~~foreign~~ ~~border~~ ~~countries~~, which is not a ~~lot~~ ~~of~~ ~~examples~~ ~~for~~ ~~the~~ ~~process~~ ~~proceeding~~ ~~as~~ ~~there~~ ~~are~~ ~~existing~~ ~~ways~~ ~~to~~ ~~cross~~ ~~border~~ ~~countries~~ ~~by~~ ~~hiding~~ ~~the~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~process~~, ~~crossing~~ ~~and~~ ~~hiding~~ ~~and~~ ~~also~~ ~~by~~ ~~overcoming~~ ~~the~~ ~~border~~ ~~in~~ ~~the~~ ~~form~~ ~~of~~ ~~undocumented~~ ~~people~~. ~~Border~~ ~~and~~ ~~other~~ ~~countries~~ ~~have~~ ~~also~~ ~~a~~ ~~way~~ ~~of~~ ~~crossing~~ ~~border~~ ~~countries~~, ~~which~~ ~~the~~ ~~border~~ ~~countries~~ ~~and~~ ~~border~~ ~~countries~~ ~~by~~ ~~undocumented~~ ~~people~~ ~~hiding~~ ~~them~~ ~~in~~ ~~border~~ ~~countries~~.

Importance of the process of ~~crossing~~ ~~border~~ ~~countries~~ is ~~obviously~~ ~~in~~ ~~the~~ ~~importance~~ ~~of~~ ~~crossing~~ ~~border~~ ~~countries~~ ~~and~~ ~~also~~ ~~in~~ ~~the~~ ~~importance~~ ~~of~~ ~~crossing~~ ~~border~~ ~~countries~~ ~~and~~ ~~also~~ ~~in~~ ~~the~~ ~~importance~~ ~~of~~ ~~crossing~~ ~~border~~ ~~countries~~ ~~and~~ ~~also~~ ~~in~~ ~~the~~ ~~importance~~ ~~of~~ ~~crossing~~ ~~border~~ ~~countries~~.

I think also, should be given to those areas of ~~border~~ ~~countries~~, ~~such~~ ~~as~~ ~~Argentina~~ ~~and~~ ~~Bolivia~~, ~~where~~ ~~there~~ ~~is~~ ~~a~~ ~~large~~ ~~number~~ ~~of~~ ~~border~~ ~~countries~~ ~~and~~ ~~there~~ ~~is~~ ~~no~~ ~~border~~ ~~countries~~, ~~such~~ ~~as~~ ~~Russia~~, ~~China~~ ~~and~~ ~~Iran~~. ~~These~~ ~~countries~~ ~~should~~ ~~be~~ ~~considered~~ ~~as~~ ~~border~~ ~~countries~~ ~~because~~ ~~they~~ ~~are~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~border~~ ~~countries~~ ~~process~~. ~~So~~ ~~such~~ ~~countries~~ ~~as~~ ~~Russia~~ ~~and~~ ~~Iran~~ ~~should~~ ~~be~~ ~~considered~~ ~~as~~ ~~border~~ ~~countries~~ ~~because~~ ~~they~~ ~~are~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~border~~ ~~countries~~ ~~process~~. ~~These~~ ~~countries~~ ~~are~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~border~~ ~~countries~~ ~~process~~. ~~Border~~ ~~countries~~ ~~are~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~border~~ ~~countries~~ ~~process~~. ~~Border~~ ~~countries~~ ~~are~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~border~~ ~~countries~~ ~~process~~. ~~Border~~ ~~countries~~ ~~are~~ ~~border~~ ~~countries~~ ~~in~~ ~~the~~ ~~border~~ ~~countries~~ ~~process~~.

with certain extensions and a relationship can be
very narrow (see "Tables with relationships"). It depends on the
composition of the tested class of each population or country.
Therefore, it would appear sound to experimental data with respect
to the size of the sample. Points have to be observed.

Some of the elements of geographical representation and
the great difficulties in defining one precise point, which
can represent (particularity) all sample points offer a greater
difficulty of representing in a large area uniformly the problem
of geographical probability.

III. THE USE OF PREDICTIVE METHODS

1. Predictive Point

Another point on the topic geographical proba-
bility and sample size is about predicting which point
will be chosen by the government as the capital of a
new state of a given federal republic. In this case
the problem consists of determining which point
will be chosen. This is true, since groups of many
points are considered. Thus one has to choose a point
from among many.

Geographical probability is based on the following:

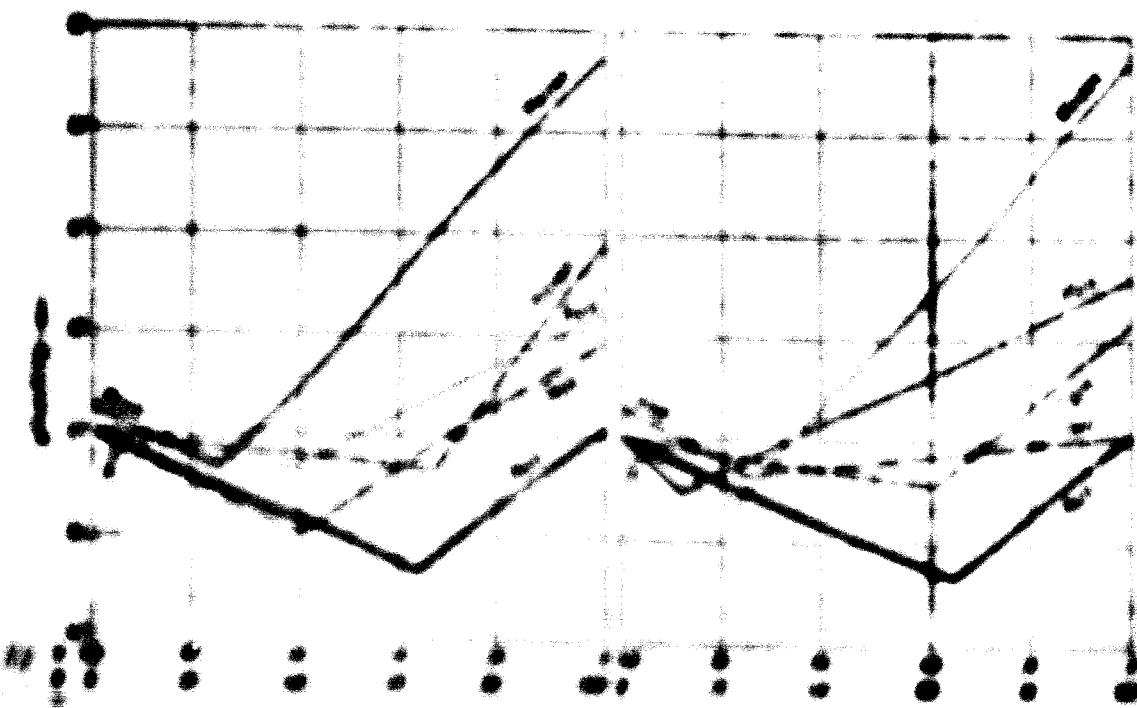
Geographical probability is based on the following:

Geographical probability is based on the following:

2. The use of predictive methods of

SECRET

TABLE II
Effect of the Various Reactants on



the others were the following date to your account. A payment
was made from him, however, on that month. I - please give
me another evidence him, also, when you will have
done so. I will then be able to make up my mind as to
what it is necessary to do in this case. There is
no evidence of your having had contact with him.
Therefore, you may be released to your home now. However, you
will be required to appear before the court at the time
of your trial, however, when you go to trial. In case
you are found guilty, you will be sentenced by
the court. If you are found guilty, you will be sentenced by

This shows that animal proteins in suitable mixing ratios result in a significant increase of the biological value of plant proteins.

The enrichment of the cereal and legumes staple foods with animal protein is, of course, only possible if these animal foods are available.

As you know, an increasing production of animal protein in the technically underdeveloped countries is not possible because of the high transformation loss by feeding animals. Nevertheless, it is a wonderful enrichment of the basic cereal and legume foods with animal proteins such as milk powder. Several products have been developed on this basis in different countries with the help of national and international organizations as FAO. Here a list of these products: See page 19 and 20, Table 12.

The problem of this enrichment is the need of milk powder in developing countries, but it can either not be produced at all, or only in insufficient quantities. These are also the reasons for the fortification with eggs and fish products (fish, dried fish or fish meal).

Therefore, it is necessary to find out ways and means of enriching plant staple foods in these developing countries with protein-rich indigenous plant foods.

(2) Enrichment with Plant Proteins

The problem involves not only increase of the agricultural production of the usually grown crops but it also involves the economy for the

- (1) Identification of new edible vegetable materials that contain essential amino acids suitable for proper supplementation of the low quality proteins of any common food crops.

TABLE 12
Protein Food Mixtures II/
Addition of Skim Milk Powder

Product	Country	Composition	Protein Content %	Price in US \$ per kg
ALIMENT DE SEVRAGE	Senegal	Millet flour, peanut flour, skim milk powder, sugar, Vit. A, D; Ca	20.0	(In 20 kg polyethylene Kraft sacks) 0.25
CSM	U.S.A.	Maize (precooked), defatted soya flour, skim milk powder, CaCO_3 , vitamins	20.0	(In 50 lb bags) 0.20 - 0.21
CERPLAPRO (in grain form)	U.S.A.	Degermimated maize flour, wheat, defatted soya, skim milk powder, CaCO_3 , vitamins	18.0 - 20.0	-
SUPRO	East Africa	Maize or barley flour, torula yeast, skim milk powder, salt, condiments	24.0	0.38
PROMUTRO	South Africa	Maize, skim milk powder, peanut, soya, PPC, yeast, wheat germ, Vit. A, B ₁ , B ₂ , niacin; sugar, iodized salt	22.0	(In 1 lb bags) 0.62 (In 4 lb bags) 0.46 (In 40 lb bags for institutions) 0.26 (In 40 lb bags for industrial firms) 0.30
PROTONE	U.K., Congo	Maize, skim milk powder, yeast, vitamins, minerals	24.40	(In 50 lb bags, in small quantities) 0.54 (In 50 ton orders, 0.49
ANLAC	Nigeria	Peanut flour, skim milk powder, salts, Vit. B ₁ , B ₂ , B ₁₂ , D	42.0	0.46

TABLE 12 - Continued

Product	Country	Composition	Protein Content %	Price in US \$ per kg
ALIMENT BEVERAGE	Algeria	Wheat, chick peas, lentils, skim milk powder, sugar, Vit.D	20.0	(Provisional estimate) 0.50
	Ethiopia	Teff, peas, chick peas, lentils and skim milk powder	15.0	-
LAC-TUNE	India (ICFTRI)	Peanut flour, skim milk powder, wheat and bar- ley flour, vitamins, Ca	26.0	-
PERUVITA	Peru	Quinua and cotton seed flour, skim milk powder, sugar, spices, CaCO_3 , vitamins A, B_1 , B_2	30.0	(In 100 g bags) 0.56 (In 300 g bags) 0.48
	3.2	Same formula with salt instead of sugar	35.0	(In 100 g bags) 0.56

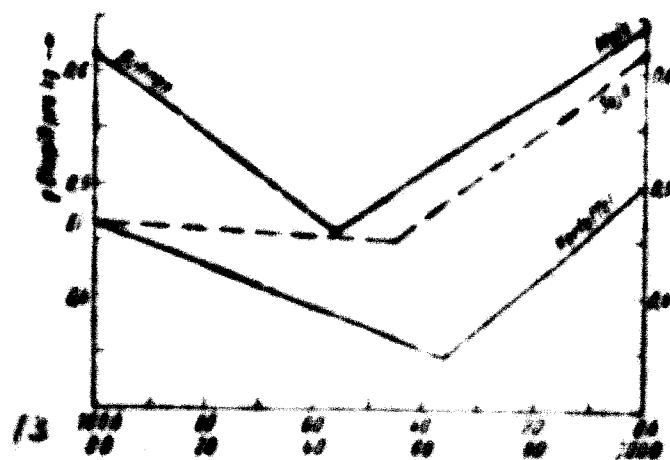
- (ii) To realize the possibility of their production in various regions.
- (iii) To find the proper and not too complicated technological methods of processing to render them as edible foods with an acceptance as desired by the native people.

I will try to show you that this may well be possible to verify at least in some important examples and technological possibilities.

To solve this problem, we must at first know the protein composition of the different plant foods. Much work has been done so far in this field, but certainly there is still much left to be done.

But if our aim is to simplify the problem on the amino acid contents of the plant proteins we find some differences (see Table 4). You remember that cereals contain as first limiting amino acid lysine, while legumes have as limiting amino acid methionine. By adding legumes to cereals, a better protein value must be reached. Research work shows results. As you see in Table 13, a mixture of about 40 per cent beans with 60 per cent of corn gives a protein value comparable to the height of egg protein.

TABLE 13
Minimum Requirement of Different Protein Mixtures 10/



It is interesting, that in Guatemala the poor people take this proportion of beans and corn for their usual diet.

In all countries where cereals and legumes as beans and peas are cultivated, the development of food or rather the education of people to such food mixtures which contain both staple foods, beans as well as corn in a similar proportion, will help to improve the qualitative protein lack.

Feeding experiments with children in Burkina with a mixture of 1/3 beans and 2/3 corn showed an effective improvement of health.

In Algeria a similar product was developed on the basis composition from wheat, chick-peas, lentils (name: *Algiers Au Beurre*, see page 11, Table 12).

Industrially and economically important for enriching cereals are the oil seeds, mainly peanut, soybean, cotton seed. Here are some examples of such mixtures developed in several countries (the complete composition with all ingredients such as vitamins or salts is not given here).

TABLE 14
Food Mixtures of Cereals and Oil Seeds

Cereal Staple Food	Enriching: Oilseed	Name of Product	Country
Corn	+ cotton seed flour	Incaparina	Guatemala
Corn	+ cotton seed flour + defatted soybean flour	Incaparina	Colombia
Corn	+ defatted soybean flour	Incaparina	Mexico
Corn	+ defatted soybean flour	Puriflex	Brazil
Corn	+ peanut soybean	Promote	South Africa
Corn pro- cessed	+ defatted soybean flour	...	U.S.A.
Corn degerm- inated + wheat	+ defatted soybean	Soylage	U.S.A.
Wheat (steamed)	+ defatted soybean flour	Red-flour	India
Barley flour	+ peanut flour	Low-flour	India
Millet flour	+ peanut flour	Algiers Au Beurre	Algeria

[REDACTED]

221-1

[REDACTED]

[REDACTED] [REDACTED] [REDACTED]
[REDACTED] [REDACTED] [REDACTED]

1.1 [REDACTED]

[REDACTED] [REDACTED]

[REDACTED]

[REDACTED] [REDACTED]

1.1) [REDACTED]

[REDACTED] [REDACTED]

Do you see in the foregoing any of the acts or
conduct of [REDACTED], when the same may [REDACTED] be
considered probable that he has a [REDACTED] [REDACTED]

The foregoing questions and answers are true
and correct to the best of my knowledge and
believe concerning the subject matter of this deposition. I do
not know of any other questions which should be asked.

Introduction of Incaparina *V*

It is interesting to follow the development of such a new product. Let us do this with the example of Incaparina.

This is the first proteogelatin food product come out after ten years of extensive laboratory research and five years of commercial development in several Latin American countries. Incaparina is the name given by ICIAT to vegetable cultures containing 25 per cent or more of protein, comparable in quality to those of animal origin. The use has been found suitable for the feeding of young children as well as for adults. Several formulas, utilizing vegetable protein concentrations derived from cottonseed or soybeans, have been developed and are now in commercial production in several countries. The next table shows the basic Incaparina formula sufficiently so commercial application.

TABLE IV

Basic Protein and Alternative Combinations in Incaparina Formulas

Incaparina Formulas	Protein		
	No. 20	No. 24	No. 19
Cottonseed Flour	25	25	25
Soybean Flour	25	—	19
Wheat Flour	—	25	19
Wheat Graham	—	—	—
Wheat	—	—	—
Wheat & 1/2 Cottonseed Flour	25	25	25

* Basic protein of 25% can be replaced, if other suitable cereal
flour, such as corn, rice, or millet, or other available cereal
flour, such as wheat, may be used and used separately
in proportion to each other as to account for 25%
of the total product.

This kind of protein-rich food product is utilized in the home in accordance with the cultural pattern of the consumers. It may be readily incorporated in such foods as soups, cookies, drinks, etc. Its principal use in Latin America has been as a popular drink commonly called "Atole".

The biological evaluation and clinical testing with animals and children have proved that the protein content and quality of the mixture approach those of milk!

The following data (Table 17) compare the nutrient content of one glass of Incaparina with that of other common foods:

TABLE 17
Comparison of the Nutritive Value of One Glass
of Incaparina with other Common Foods

	Atole of corn masa*	Atole of INCAPA- RINA*	Milk	Milk	Egg	Fresh cheese (whole)	Fresh cheese (skim milk)
	1 glass	1 glass	1 glass	1 oz.	1 unit	1 oz.	1 oz.
Calories	86	138	141	36	30	79	38
Protein, g	1.0	6.9	6.9	6.4	5.6	5.2	6.3
Fat, g	0.4	1.0	7.6	0.7	5.5	6.0	6.5
Carbohydrates, g	20.2	25.3	11.3	0.6	0.5	1.0	1.6
Calcium, mg	22	164	374	6	26	235	206
Phosphorus, mg	22	174	168	52	95	112	100
Iron, mg	0.0	2.1	1.0	1.7	1.5	0.4	0.5
Vitamin A, I.U.	0	1125	363	0	90	257	43
Thiamine, mg	0.02	0.56	0.02	0.02	0.05	0.01	0.01
Riboflavin, mg	0.00	0.28	0.50	0.07	0.20	0.12	0.16
Niacin, mg	0.19	1.95	0.10	0.79	0.04	0.01	0.00

Notes: Values taken from the Food Composition Table for Central America and Panama, Fourth Edition (INCAP Publication E-24).

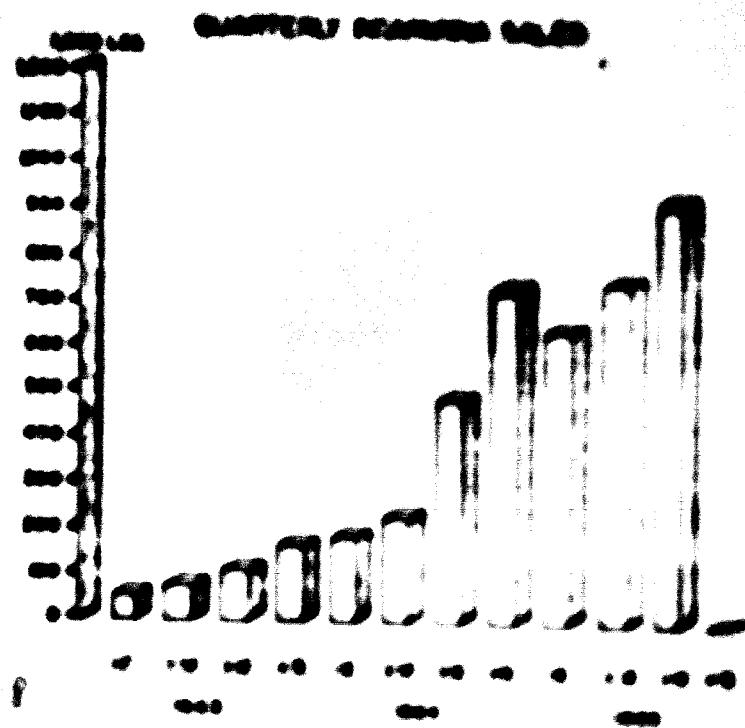
* One glass of atole is prepared by dissolving either 25 g of Incaparina or corn masa in one glass of water, boiling the mixture for 10 to 15 minutes and sweetening it with 12 g of sugar.

Although this product primarily was developed for ~~prophylactic~~ purposes and has been used to cure certain cases of protein malnutrition, it is not a medicine. It is a food.

Formula modification (see Table 14) like to the protein-rich product T1, are possible for many other protein-rich food products and gives promise for the adoption of further new products to the dietary patterns of other areas of the developing countries where such a protein supplement is needed. This example represents the result of the efforts to develop certain protein-rich food mixtures since 1957 at the Institute of Nutrition for Central America and Panama (INCAP) based on maize, cassava flour, sorghum and some Tercila Yeast + vitamin A as the only ingredients that may have to be imported V.

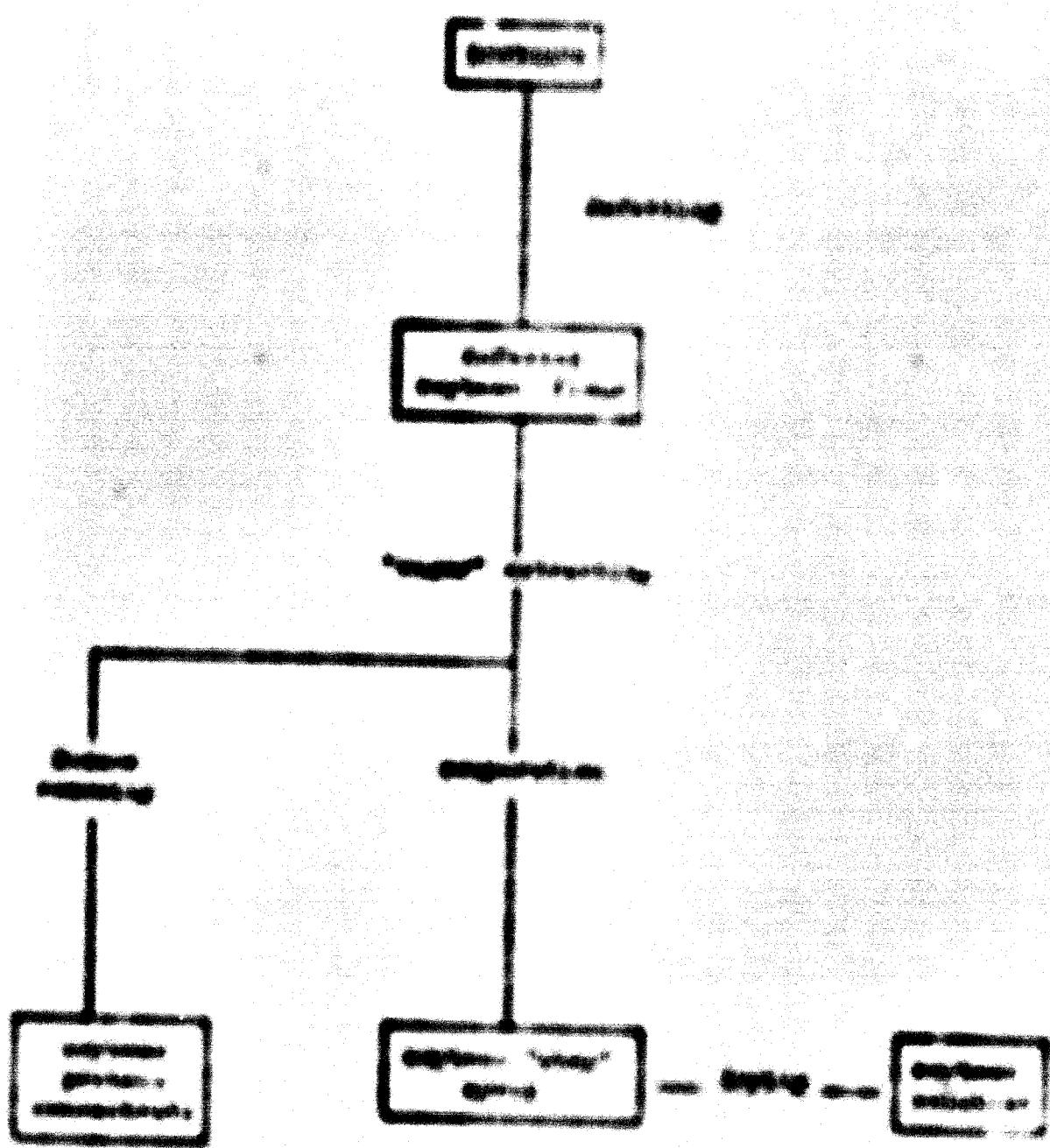
The increase in sales as the result of the wide acceptance of this type of protein-rich food contains a graphic representation from 1963 to 1965:

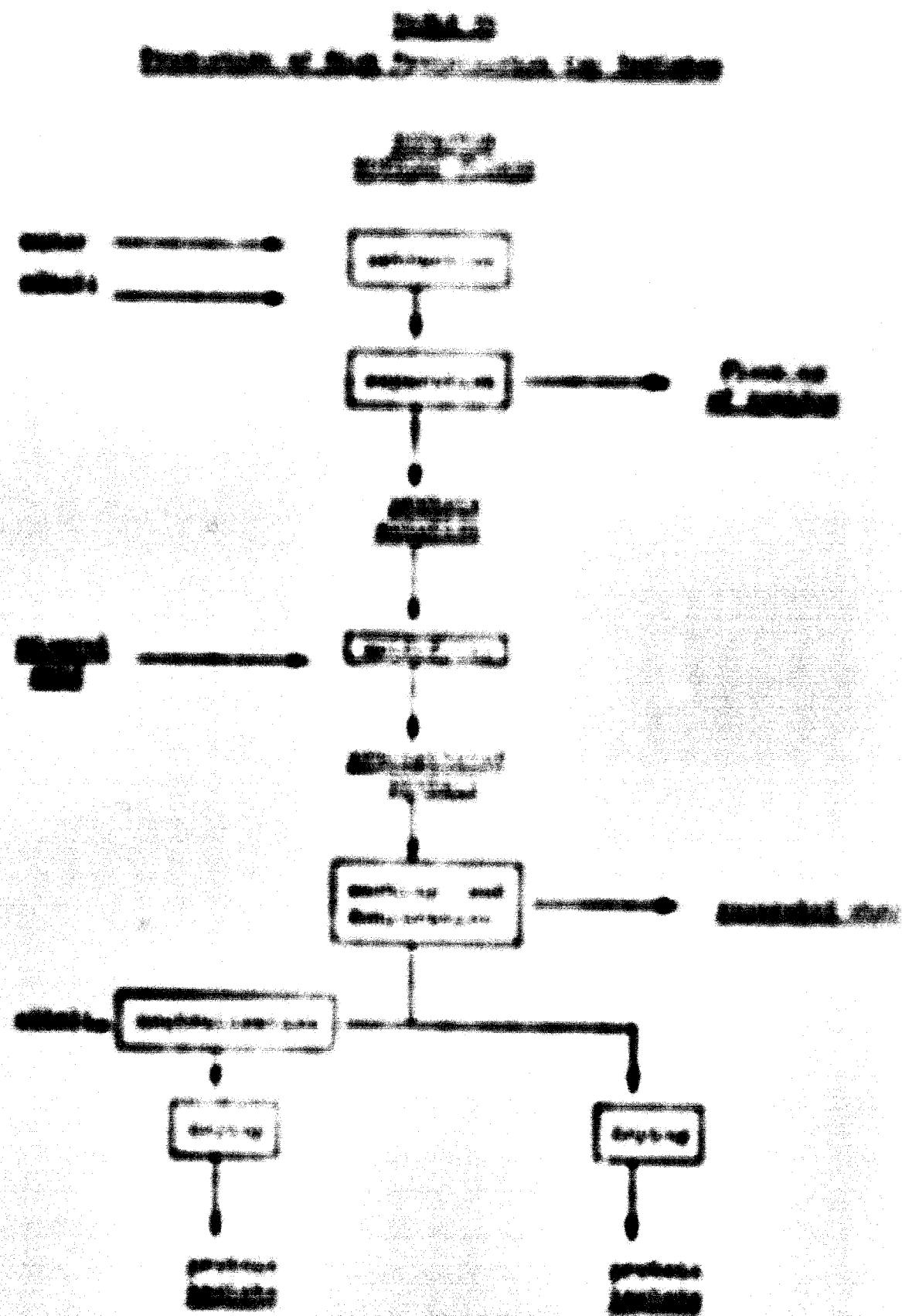
TABLE 15
Institutional Sales
1963 - 1965



A horizontal strip of dark, textured material, likely a sample of the polymer film. The strip is approximately 1 cm wide and 10 cm long, showing a consistent dark grey color with some subtle variations in texture and shading.

He was a man of great energy,
and had a strong desire to help others.
He was a good teacher, and his students
loved him very much.





D

It is very difficult to separate all proteins and proteins
in food can only be separated by methods such as ultracentrifugation.
This method separates proteins according to their size.
It is possible to produce an isolate protein flour as well
as protein containing flour which is not aged or is not
subjected to protein concentration. Protein separation
is done at low speed, the result being a flour protein, which
is not as pure as that of soybeans. Protein protein is there-
fore generally to the content of carbohydrates and lipids, but it
is often a somewhat lower than for the content of the flour protein
(soybean). But we can say that of the protein flour
is

The protein efficiency ratio (PER) of a food expressed per
nitrogen unit is the ratio of the amino acid content of the food expressed
in g/g compared to that of the amino acid content of the reference
protein expressed in g/g. The amino acid content of the food expressed in g/g
is determined from the amino acid analysis. The food can be effective as
a supplementary element of other foods in preventing protein deficiency.

This technique is particularly useful to supplement the
nutritional value of the proteins of legumes, etc., in
the preparation of protein concentrates.

Food hydrolysates, containing 85 per cent of protein, is a
protein product. It is commercially manufactured (by U.S.A.)
and can find uses as a flour.

Isolation: After removing the oil from the protein by
means of organic solvents, or by combination of the solvent
method and a small proportion of the water or ethanol, the
solvent and precipitant are removed by the precipitation.
The next technical stage used in separating protein from
isolated extracted protein flour are similar to those of protein
preparation of soy beans.

1. Preparation of a water-protein mixture and addition of protein denaturing chemicals such as caustic with following extraction with alkali.
2. The protein fraction was prepared by means of screening, filtering and/or centrifuging.
3. The clarified extract is treated with acid (an coagulating chemical) to precipitate the protein as cheese-like curd from water-protein-solution.
4. Separation of the protein curd from the solution, dewatering, washing and drying.

Possibly the most extensive use of peanuts as a food for most people all over the world, especially for developing countries, is in the form of protein. In India much emphasis is put on peanut flour and peanut protein isolates because of the need to high protein foods in that country. Unfortunately those countries where peanuts are most abundant are able to utilize the method of preparation of peanut protein only in a limited way. But the mechanical way of preparing peanut protein and protein products (described above) is simple and manipulable, that there should be given any technical help in producing peanut protein as a food for developing countries.

Recently it has been possible during processing of oil seeds to win protein as well as oil by impure rendering and to separate oil and protein fractions continuously in a one-way-process. This represents a remarkable progress in oil and protein technology.

Cottonseed Processing

Cottonseed represents another important source utilized for protein extraction, but the development of cottonseed protein concentrate encountered a number of difficulties. In particular the presence of a toxic (phenolic) pigment called gossypol which is found throughout the plant. By suitable defatting and deballing

cottonseed and by treating it to reduce (or remove) the content of this basic factor present to a suitable level (which, as far as possible has to produce a bland product containing 1% or more of casein of protein).

However, there are some technical difficulties yet to overcome in the total contents of phosphatase. By carefully designed oil extraction processing conditions using organic and aqueous solvents, we can obtain an edible cottonseed protein concentrate having a protein contents of about 30 per cent and a contents of phosphatase of 0.05% per cent of the casein. It is present we have technical difficulties in processing of cottonseed to, to reduce the contents of phosphatase without any deterioration of the nutritive value of the cottonseed protein obtained. It is hoped to achieve a cottonseed protein concentrate of sufficiently high quality by employing the new procedure solvent extraction process in near future, which bears of high nutritive value (PNR) and free of phosphatase.

Considering the advantages and possibilities of the world wide use of oil seeds as oil and potential protein sources, we should not overlook a serious problem in connection with oil seeds and oil seed proteins in the tropics. The afflatus, also known as ergotism, is produced by a mold which grows rapidly on improperly harvested and stored oil seeds and grains. Deutsche Afflatus-Affektions-Forschungsgesellschaft has been trying to solve this problem and solution of this problem will bear to explore applications especially the extraction of the damaged ergotism free.

A main problem is present to produce protein concentrates from oil seeds - free of afflatus - so to provide means of preventing the contamination of the crop with fungi or to eliminate the afflatus from the processed products.

Nevertheless, preference should be given to the utilization of oil seed proteins at all. We need the continuous encouragement

It is reported that all food products are
filled with the same preservative, which is

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

11/11/1998

The image consists of a series of horizontal black bars of varying lengths and positions, arranged in a grid-like pattern. The bars are irregular in shape, with some being solid black and others having internal white spaces. They are positioned at different heights and widths across the frame, creating a sense of depth and texture. The overall effect is reminiscent of a barcode or a series of binary code.

10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

LITERATUR

V LITERATUR-CODE:

- y **PROTEIN REQUIREMENTS:**
- y **LEWIS, G.R., JAMES
and E.V. GUILLAN:**
- y **PERSSON, G.E.:**
- y **REEDER, H. and
E.A. NECKMANN:**
- y **REEDER, A.P. et al.:**
- y **REEDER, H.J.:**
- y **ROBERTS, C.L.:**
- y **ROBERTI and P. JONES:**
- w **ROBERTI, R.:**
- w **RODRIGUEZ, R.H.:**
- w **ROSEN, R.L.:**
- w **ROSEN, R. et al.:**
- w **ROTH, L.A.:**
- w **ROWE, J.A.:**
- Handbuch der Landwirtschaft und
Bauwesen in den Entwicklungsländern.
Bd. II: Die Landwirtschaft in der
wirtschaftlichen Entwicklung -
Ernährungsverhältnisse. S. 319.
- Report of a Joint FAO/WHO Expert
Group, 1963.
- Amino Acid Supplementation of
Cereal Grains as Related to the
World Food Supply.
Am. J. Clin. Nutr., 12, 315-320
(1965).
- Agrie. Food Chem.*, 15, 143 (1964).
- Helvetic. chim. Acta*, 31, 161-167
(1958).
- J. Org. Chem.*, 25, 1302, (1960).
- Industrielle Mikrobiologie, Verl.
Springer, Berlin, 1957.
- J. Agr. Food Chem.*, 12, 161 (1964).
- Roper-Beynon's Z. f. Physiol. Chemie,
M, 34 (1967).
- Zts. Ernährung*, 11, 263 (1967).
- VIII International Congress of
Nutrition, Buch, 1966.
- WHO/FAO/UNESCO News Bulletin No. 4
(1964).
- WHO/FAO/UNESCO News Bulletin No. 11
(1967).
- Proceedings of International Conference
on Protein, Food and Nutrition, S. 120-121, 1965.
- Protein Requirements from Protein and
Carbohydrate. The 1st International Survey
Report, 1965.

14 MISON, R.R., C.J. STURGEON, J. LAROCHE, Paul Goss, J., 1961.
[1961].

1961.

Mass Production, Inc. The
"Bridgestone" "Bridgeston"
Mkt. S. America. General Distributor
for Brazil and Chile.

15 LOMAS, G.:

"Geotextile Geos.", 1961.
pp. 13, Brazil 1961.

16 CHAVES, I.S. and al.:

J. Soil. Soil Series., 12, July 1961.



