APPENDIX V-r

PN-AAS-573

Appendix 7: Substantive Progress Report
AID Contract ta-C-1286
Clinical Assay of High Protein Foods
March 1, 1978-April 15, 1979

SUGGESTIONS FOR FURTHER COLLABORATIVE RESEARCH

BETWEEN

THE CENTRO INTERNACIONAL DE LA PAPA

AND

THE INSTITUTO DE INVESTIGACION NUTRICIONAL

Instituto de Investigación Nutricional
Miraflores - Perú
February 15, 1979.

During the past several years we have been carrying out studies on the value of the white potato in infant nutrition. In conjunction with the Centro Internacional de la Papa we have focused up to the present time on protein quality and digestibility of the potato. Studies are now underway to evaluate the ways in which potatoes can best be used in the recuperation of severely malnourished children and in the dietary treatment of better nourished children recovering from an acute episode of diarrhea.

We have reached a point in the analysis of protein quality and digestibility data that we can draw some reasonably firm conclusions and make suggestions for areas of further collaboration. Nitrogen balance studies were carried out in six children at a critical level of protein (N x 6.25) intake of 5.0 - 5.2 % of calories as protein (for reference, human milk supplies approximately 6.0% protein calories). Cooked, oven dried potato (Mariba) provided 100% of protein. These studies have shown an apparent absorption of nitrogen of 65.9 $\pm$ 3.7% and an apparent retention of nitrogen of 33.9 $\pm$ 5.6% of intake. These figures were approximately 79% (absorption) and 77% (retention) of those for a casein containing control diet fed at isoenergetic - isonitrogenous levels. The apparent biological value (the percentage of absorbed nitrogen retained) of potato protein (51.0%) did not differ from that of the preceding casein control period (50.5%). When compared to rice and wheat protein, apparent nitrogen retention from potato was superior (as a % of casein control: potato 77%, rice 69%, wheat 51%). Plasma amino acid analyses during potato consumption are not yet completed but should help to define if there is a first limiting essential amino acid in terms of the requirements of the human infant or whether total nitrogen availability is first limiting.

One problem encountered in carrying out these studies was the large difference in nitrogen content of the two initial batches used. The first lot was analyzed to contain 5.7 g.protein and 343 Kcal/100 g. (6.7% protein Kcal), whereas the second lot contained 9.13 g. protein and 353 Kcal/100 g., a difference of protein content of more than 50%. The second lot of potatoes has been used in two further balance studies. Apparent N absorption was 81.5% (92% of casein) and apparent retention 41.0% (89% of casein), both substantially above the values obtained with the first batch. Apparent biologic value was 50.3%.

Because both lots of potatoes were boiled, peeled and oven dried, the question arises as to whether this marked difference in N content and apparent N digestibility was inherent in the two different harvests or was the result of the processing. Because a large percentage of N in the potato is present in the form of water soluble free amino acids, could variable amounts of these have been lost in the water in which the potatoes were cooked? If the difference between the two lots of potato of the same variety grown under similar conditions is real, this variability in protein content would be a minor constraint to the potato's use as a source of protein in infant nutrition unless different batches were mixed with each other to reduce variability.

Digestibility studies were carried out using diets in which potato provided increasing amounts of total energy in the diet. Each child consumed 25%, 50% and 75% of calories as potato in 9 day dietary periods with control periods interspersed. Non-potato calories were provided by casein, cottonseed - soybean oil, sucrose and corn starch. As designed the diets allowed us to attribute changes in the parameters of digestibility measured to increasing intakes of potato.

As potatc intake increased from 25 to 75 % of calories, there was no effect on apparent digestibility of protein. Nor was there an adverse effect on the absorption of fat from the diet, as has occasionally been seen with other staple foods. In contrast, consumption of increasing amounts was associated with an increase of stool wet and dry weight and of energy lost in the stool. At a level of 25 % of calories a potato, energy loss was 5.8% of intake, just above the cosein control. At 50% potato calories this increased to 6.9%, and at 75% potato calories to 10.6%. At this level stool wet weight had increased from 104 g./day (control&25% potato Kcal) to 267 g/day. Comparing potato to other staples (all fed to provide 48-50% of energy intake), potato is somewhat inferior to both rice and wheat pasta in terms of carbohydrate digestibility.

Stool wet and dry weight and energy loss consuming staples at 48-50% of total energy intake

	Stool Weight		Stool Energy
	Wet	Dry	Kcal/d.
	g/d	g/d	
Potato	165	20.3	78
Rice	67	11 6	58
Pasta	95	13.3	60

The difference in energy loss may be considered biologically insignificant. The increase in stool weight at these and higher levels of intake may however be interpreted by mothers as diarrhea and hence is undesirable. This factor combined with the bulk of the diet when potato is fed at this level of intake may markedly affect the acceptability of using large amounts of potato in the diets of small children.

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Areas for further study: Three main areas for further collaborative study seem obvious from the above results.

1.- Effect of cooking on amino acid content and availability. Many of these data may already be available from laboratory studies at the Centro Internacional de la Papa. If not, further investigation as to differences in N content of various harvests of the same variety of potato, the loss of amino acids during boiling and how to reduce this loss, differences between boiled and baked potatoes, etc., should be considered. If the differences found in the laboratory are not sufficient to explain those found in our studies, repeat studies in the human similar to those carried out should be considered.

2.- Effect of amino acid supplementation on N utilization. If preliminary analysis of amino acid results confirms that methionine is first limiting in the potato for infant nutrition, both short term balance and longer term growth studies at different levels of amino acid supplementation should be undertaken to see if N utilization can be improved. Although the "biological value" of potato protein did not differ from that of casein, amino acid supplementation might still prove to be of benefit. If total nitrogen availability is first limiting, the possibility of increasing the availability of nitrogen by processing should be looked at.

3.- Far and away the most important area to be addressed would seem to be that of digestibility of the carbohydrate component of potato. One obvious first question is whether or not there are differences in digestibility

among varieties of potato. Pilot studies in the human could be carried out to assess the digestibility of one or two other varieties of potato that "on paper" or in the laboratory appeared to differ significantly from Mariba. At the same time investigation of food processing methods to reduce the bulk of the diet and to modify the digestibility of the carbohydrate (and possibly the nitrogenous) component of potato should be undertaken. At appropriate points in these studies the value of the processing methods should be verified by further studies in the human. The long term goal would seem to be low cost simple technology that could be made available on a local basis in many countries.

In summary, studies of the potato in human infant nutrition suggest that the protein quality of the potato is quite high. Variability of N content either due to normal variation in the potato itself or due to processing is of concern. Bulk and poor digestibility of carbohydrate will most likely be the factors that limit consumption. Suggestions for further collaborative studies in these areas have been outlined.