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FOOD FORTIFICATION IN PAKISTAN

by

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SUMMARY

This report covers consultations in Pakistan at the request of the Food and Nutrition Division, USAID/Islamabad, during the period November 21 - December 14, 1972, on the subject of food fortification. The primary purpose of the consultations was to advise the USAID Mission on the feasibility of fortifying a number of selected staple foods, including tea and wheat flour, with micronutrients.

Because USAID in Pakistan is currently in the process of developing a unified nutrition program but has not as yet done so, it was not possible to draw conclusions and frame recommendations in the context of such a program. Therefore, the conclusions and recommendations in this report should be reconsidered when the Mission's nutrition program has been developed. Even so, it is believed that a balanced program for improving the nutritional health of Pakistanis might properly include certain projects to fortify food staples, and that the fortification project described in this report might appropriately be made a part of a USAID/Pakistan nutrition program.

The major conclusions arising from the consultations were:

(1) There is sufficient evidence of general vitamin and mineral deficiencies in Pakistan to justify the continuation of projects to fortify staple food items with vitamins and minerals. The extent to which protein and specific amino acids are deficient in the diets of the general population is not yet sufficiently understood to reach decisions for or against fortification of staple foods with either added protein or specific amino acids. Studies of the nutritional status in Pakistan which the Mission is currently developing should help establish the extent to which protein deficiency is a problem and among which population segments serious deficiencies exist. Decisions on fortification with proteins and amino acid should await results of these studies.

amino acid is the building block in the protein

(2) Fortification of tea with vitamin A and atta (whole wheat flour) with vitamins and minerals both appear to be feasible methods of helping overcome dietary deficiencies among large segments of the population.

(3) Additional fortification possibilities, including fortification of salt with iodine and sugar with vitamins and minerals might be explored as a part of a long range nutrition improvement program.

As a result of these conclusions it was recommended that the USAID Mission act to promote tea and atta fortification in Pakistan through high priority projects. Specific recommendations on these projects are included in the text that follows.

→ consumption planning thinking →
Population with concern
Production, distribution

INTRODUCTION

In early 1972, the Food and Nutrition Division of USAID/Pakistan under the direction of William R. McIntyre started an investigation into the feasibility of undertaking various fortification programs in Pakistan. 1/ Special attention was given to possibilities for fortifying tea with vitamin A, atta (whole wheat flour) with vitamins and minerals, and imported PL 480 wheat with lysine. 2/ McIntyre found that fortification, especially tea fortification, appeared promising and AID/W was requested to provide a fortification specialist on short-term assignment to assist the USAID Mission to further assess the feasibility of these various possibilities. The following sections summarize the results of the TDY assignment. The report is organized to include a section on General Nutritional Deficiencies in Pakistan and a section on Fortification of Food Staples with subsections dealing with fortification of Atta, Tea, and Other Alternatives.

The section dealing with General Nutritional Deficiencies in Pakistan considers the need for supplementary nutrients in the Pakistani diet and therefore deals with the question of justification for fortification. The section treating Fortification of Food Staples is structured to cover (1) the potential benefits of fortification, largely in terms of alleviation of dietary deficiencies, (2) costs of fortification, (3) factors affecting potential implementation, and (4) recommendations for action.

1/ Fortification is the process of improving the nutritive value of common foods by the addition of nutrient supplements such as vitamins, minerals, amino acids, and protein concentrates.

2/ An AID/W sponsored research project with Kansas State University (AID/csd-1586) has also considered possibilities of improving the nutritive value of wheat in Pakistan through fortification.

1965-66 Nutrition Survey

A. GENERAL NUTRITIONAL DEFICIENCIES IN PAKISTAN

The most comprehensive study of the nutritional status of the general population of Pakistan is the Nutrition Survey of West Pakistan. 1/ Although the compiler of this report, Dr. Anwar Hussain, has expressed concern that the survey has not covered a representative sampling of the population and is deficient in certain other respects, he nonetheless reached a number of conclusions regarding nutrient deficiencies in Pakistan. Specifically he has concluded---

VITAMIN A DEFICIENCY

"Vitamin A deficiency is very widespread. The dietary intake of vitamin A is low in all income groups and average consumption is only about half the recommended allowance. The lowest income groups are the worst suffers."

"Clinical signs of vitamin A deficiency are observed in preschool children. Amongst the adult population 3.26% of pregnant women and 3.9% of child bearing age presented with bitot's spot, a sign which is usually related to vitamin A deficiency, though it may also be caused by other factors as well. The incidence of bitots' spot is more common in urban populations of the same age groups. These findings are further substantiated by the fact that 34% of the population assessed biochemically for vitamin A had deficient and low vitamin A levels. Ninety percent of the pregnant and lactating women with deficient and low levels are the worst affected groups followed by growing children of 5-15 years age groups. Repeated stress of pregnancy might be one of the reasons for the decrease of vitamin A reserve of the mothers and thus making them more vulnerable to deficiency."

IRON DEFICIENCY

"About 36% of the rural and 56% of the urban population suffers from anemia. Seventy-six percent and 100% urban pregnant and lactating women had low and deficient levels of hemoglobin. As the onset is slow and no dramatic deterioration occurs in health, the morbidity and mortality caused by anemia was not recorded as such. Though it was not possible to investigate the types of anemia, it is expected that the majority of them will be iron deficiency type."

1/ Nutrition Survey of West Pakistan (February 1965-November 1966) Directorate of Nutrition Survey and Research, Ministry of Health, Labour, and Family Planning, Gov't of Pakistan. June 1970.

RIBOFLAVIN DEFICIENCY

"The survey results indicate that 100% of the families consume less than the recommended allowance irrespective of income. Clinical evidence of deficiency is also widespread and 7.9% of the population presented signs related to clinical deficiency which implies that there are many more sub-clinical cases. Biochemical data or riboflavin excretion in the urine showed deficient and low levels in 2.2% of the cases in rural and 7.6% of the cases in urban areas."

In regard to protein and calorie deficiencies, the Nutrition Survey indicates that there were, at the time of the survey, deficiencies of both these nutrients. However, there is currently insufficient evidence as to the extent of these deficiencies and the distribution of deficiencies among regional, age, economic and other subsections of the population to base comprehensive decisions on protein-calorie interventions. The Food and Nutrition Division, USAID/Islamabad is currently developing the design for a nutrition study of Pakistan which in intended to provide better information on protein deficiencies.

In summary, then, it can be concluded that there is sufficient evidence of malnutrition due to widespread deficiencies of vitamins and minerals to justify efforts to fortify staple foods with those nutrients. But, at least for the present, there is insufficient evidence to support fortification of generally consumed food staples with protein concentrates and amino acids.

B. FORTIFICATION OF FOOD STAPLES

1. ATTA FORTIFICATION

Wheat contributes roughly half of all the calories and protein in the Pakistani diet and is generally consumed throughout Pakistan by all

socio-economic groups. During 1972-73, the projected domestic disappearance of wheat for food is estimated to be 6.9 million tons, which is equivalent to roughly 315 grams or 0.7 pounds per person per day. 2/

Although essentially all of the wheat is milled to flour and consumed as roti (Pakistani bread--chapati, nan, puri, etc.), most is milled in small chaki mills (stone grinding mills) from wheat procured directly by the consumer. However, approximately one-million tons or roughly 15 percent of the wheat is milled in roller-flour mills of the type used in the US and Europe. 3/ This wheat is supplied by the Government of Pakistan (GOP) and is believed to represent all imported wheat plus all wheat purchased by the GOP from farmers through the government procurement program. The GOP allocates this wheat to the provincial governments who in turn distribute it to the 147 roller-mills for processing. The quantity of wheat distributed in this way is shown in table 1.

Flour millers are required to mill wheat to produce certain proportions of various wheat products--currently the proportions are: bran (3%), white flour and farina (6%), and atta or "whole wheat" flour (91%). 4/ The atta is sold at the controlled price of Rs 18.37 maund

2/ Pakistan: Grain and Feed Report. Unclassified Islamabad PK 1096. December 11, 1972.

3/ Approximately one-million tons have been milled in each of the past five years; however, a larger quantity up to 2.1 million tons, has been forecast for FY 73 (Pakistan: Agricultural Subsidies, PK 2079, September 15, 1972).

4/ Atta is nominally the product made by grinding wheat to flour without removing any part of the wheat; however, the atta made in roller flour mills in Pakistan has had a part of the starchy endosperm and part of the bran removed and therefore is not literally whole wheat flour.

and distributed exclusively through ration ships in both urban and rural areas. Although this atta is sometimes available in "unlimited" quantities, in December 1972 a limit of one seer per person per week was set in some areas.

Table 1.--Statements showing monthly offtake to ration shops through flour mills of wheat from government stocks in W. Pakistan

Month	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
May-----	84,202	58,840	73,900	73,514	81,209	92,957
June----	76,035	33,207	53,477	83,000	35,026	79,430
July----	65,106	18,338	78,858	90,068	29,284	77,145
Aug.----	72,588	25,421	80,834	77,495	33,019	68,685
Sept.---	74,360	35,246	98,440	77,650	44,412	84,753
Oct.----	77,035	38,032	83,517	75,233	67,739	84,410
Nov.----	75,914	56,682	72,275	72,925	79,386	
Dec.----	75,524	65,721	87,624	85,635	102,508	
Jan.----	87,427	111,442	125,916	107,176	124,316	
Feb.----	95,178	103,600	125,504	111,771	171,610	
Mar.----	83,135	103,053	128,767	118,014	213,484	
April---	77,991	92,564	101,656	104,996	179,906	
	944,495	742,146	1,120,768	1,077,477	1,151,899	

Because wheat sold through the open market is generally regarded as having better quality than ration shop atta, and is, in fact, considerably more expensive than ration shop atta, it is believed that the rationed atta is purchased largely by low income groups. Thus persons consuming this atta would be expected to be among those in greatest need of supplementary nutrients.

Because the atta produced in roller flour mills is (1) processed in a relatively small number of central processing facilities, (2) consumed by a substantial number of persons, particularly low-income persons, as a food staple, and (3) controlled largely by the government, it appears to be a plausible candidate for fortification. This opportunity has been recognized by USAID/Pakistan and, for the past several years, possibilities for fortifying the atta produced in roller flour mills have been examined on an exploratory basis.

a. Benefits of Fortifying Atta with Vitamins and Minerals

It would be ideal to add sufficient supplementary nutrients so persons consuming the fortified atta would no longer be deficient in those added nutrients. An alternative is to add sufficient nutrients to supply a significant proportion of the recommended dietary allowance (RDA), for example, 25-50%, so that fortification should have a significant impact, but that consumption of nutrients (and cost) is not excessive.

As pointed out in the previous section, there is evidence of deficiencies of vitamin A, riboflavin, and iron in the Pakistani diet.

Other vitamins and minerals might also be deficient. But from the point of view of examining feasibility, it is sufficient at this stage to consider only the use of vitamin A, riboflavin (along with niacin and thiamine) and iron. 5/ Since it has been determined that vitamin A consumption is only about half the recommended allowance, it would be appropriate for fortified atta to provide the missing half of the RDA, or about 1,500 IU (see table 2 for Pakistani RDAs). Correspondingly, fortified atta might provide about half the RDA for iron, niacin, riboflavin, and thiamine.

Table 2.--Recommended Dietary Allowance (RDA) Pakistan a/

	Rural	Urban
Calories	2067	2088
Protein (grams)	58.5	59.5
Calcium (mg.)	464	466
Iron (mg.)	10.6	11.9
Vitamin A (I.U.)	3042	2984
Thiamine (mg.)	0.83	0.83
Riboflavin (mg.)	0.83	0.83
Niacin (mg.)	13.7	13.7
Vitamin C (mg.)	28.5	28.2

a/ Nutrition Survey of West Pakistan (Feb. 1965-Nov. 1966) Ministry of Health, Labour, and Family Planning.

The standard U.S. vitamin and mineral enrichment added to export flours when added to atta in the proportion of ¼ ounce per 100 pounds of atta, enables fortified atta to provide roughly half the RDA of vitamina A, niacin, riboflavin, and iron and all the RDA for thiamine

5/ Clearly the exact types and amounts of vitamins and minerals to be used should be determined by Pakistani nutritionists after thorough consideration of all relevant data.

when consumed at the rationed rate of one seer per person per week (see table 3). 6/ Furthermore, if this atta were consumed at the average per capita consumption rate of 0.7 pounds per day, it would provide essentially the total RDA for the added nutrients. Thus in the absense of more refined estimates of the requirements for added fortificants, the standard enrichment level of ¼ ounce of premix per 100 pounds of atta appears reasonable.

Table 3.--Vitamin and Mineral Fortification of Ration Shop Atta

Nutrient	Amount (%RDA) nutrient provided			
	Unfortified atta a/		Fortified atta b/	
	Basis c/ Ration (one seer per week)	Basis d/ Average per capita consumption	Basis Ration (one seer per week)	Basis Average per capita consumption
Vitamin A------	0 (0)	0 (0) e/	1380 IU (46%)	3280 IU (110%)
Niacine--------	1.7 mg (13%)	3.6 mg (26%)	5.7 mg (42%)	13.5 mg (99%)
Thiamine-- ----	0.40 mg (48%)	0.83 mg (100%)	1.0 mg (116%)	2.27 mg (273%)
Riboflavin-----	0.08 mg (10%)	0.17 mg (20%)	0.41 mg (49%)	0.96 mg (115%)
Iron----------	3.2 mg (27%)	6.7 mg (56%)	6.7 mg (56%)	15.9 mg (134%)
Calories-------	463 (22%)	970 (53%)	463 (22%)	1100 (53%)
Protein--------	13.0 (22%)	27.3 g (52%)	13.0 g. (22%)	30.9 (52%)

a/ Food Composition Tables - Minerals and Vitamins, FAO Nutrition Studies No. 11, Rome, 1954, (p. 10, Item 8, Soft Wheat Flour, medium extraction--80-93%).

b/ Fortified with N-Richment A, Type 6, (Pennwalt) at 0.25 oz. per 100 lbs. flour.

c/ Ration shop ration taken at one seer per person per week or 133 grams per day.

d/ Per capita consumption of wheat based on 6.9 million tons per year consumption (Pakistan: Food and Grain Report, PK 2096, 1971-72) and 60 million population, or 315 grams per day.

e/ Recommended dietary allowance (RDA) based on estimates in Nutrition Survey of West Pakistan (Feb. 1965 - Nov. 1966), Ministry of Health Labour and Family Planning, GOP, June 1970.

6/ Standard enrichment for export wheat flour contains 1.88 million IU vitamin A, 5,480 mg. niacin, 760 mg. thiamine, 460 mg. riboflavin, and 4,800 mg. iron per ounce.

In terms of nutritional benefits, if atta so fortified were to reach the population in the total amount of one million tons per year at the ration rate of one seer per person per week, over 20 million persons, 1/3 of the total population of Pakistan, would receive half of their RDA from the added vitamins and iron. In addition, if those persons consuming ration-shop atta are in fact the lowest income group, the fortificant would be expected to reach the segment of the population most deficient in these nutrients.

b. Costs of Fortifying Atta with Vitamins and Minerals

Costs of fortifying atta as an ongoing program may be considered in two categories--capital costs to initiate the program and operating costs to maintain the program. Capital costs consist largely of equipment and its installation to modify the 147 flour mills so that vitamin-mineral premix can be added to atta. Operating costs include costs arising from addition of the fortificant.

The addition of vitamins and minerals to flour is a standard operating procedure in many flour mills around the world. Fortification consists simply of metering a vitamin and minerals premix into the flour at a predetermined rate and continuously mixing the flour and V-M premix to assure uniformity. The V-M premix is normally metered with a dry-powder feeder, such as the Wallace and Tiernan Type NA Dry Chemical Feeder (see Appendix A). Mixing can be accomplished by use of special in-line mixers such as log agitators or with cut-flight mixing conveyors and the like. There is nothing new or unusual about the

technology; equipping Pakistani flour mills to fortify atta should consist of no more than procuring and installing the required equipment under the supervision of a trained milling engineer.

Cost of the dry-powder feeder should be about $1,000 per mill. 7/ This, together with an average $1,500 per mill for additional mixing equipment and installation, would mean roughly $400,000 (Rs 4.4 million) for equipping all of Pakistan's 147 flour mills. If dry-powder feeders are purchased from the US, these costs will include about $150,000 in foreign exchange and the remaining $250,000 in rupee costs. 8/ No additional capital costs of any significance are anticipated.

Costs of the V-M premix are estimated at Rs 70 per pound and, as described earlier, the V-M premix might be used in the proportion ¼ ounce per 100 pounds of atta. 9/ Thus, costs of the vitamin and mineral mix (including a 5 percent allowance for losses) would be about Rs 0.0115 per pound or Rs 0.95 per maund or Rs 26.5 per ton.

Because flour mills operate on a continuous basis, no significant additional labor or management should be required for fortification. Also, because the capital costs are very small, nothing need be allowed

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7/ Cost of the W & T dry-powder feeder was quoted at $930 plus $25 for export packing on November 13, 1972.

8/ As an alternative, Hoffman LaRoche has provided a prototype Brooke-Asian feeder which might be copied and built in Pakistan so that no foreign exchange would be required. Costs for the Brooke-Asian feeder are unknown.

9/ Cost of V-M premix based on FAS of W & T type 6 enrichment: $4.15 per pound plus allowances for shipping, insurance, duty (20%) sales tax (10%), and clearing and forwarding. Costs of procuring individual vitamins and minerals and mixing in Pakistan is expected to result in essentially equivalent costs, but would require development of a local mixing facility.

for depreciation, maintenance, and related costs. Thus, no additional processing costs would be incurred as a result of fortification. However, it would be expected that certain chemical analyses would be required to verify that V-M premix is being added and that the level of addition is proper. Assuming two analyses per mill per day (250 days per year) and Rs 25 per analysis, the total cost of quality control would be approximately Rs 2 million per year, or Rs 0.001 per pound if a million tons per year were produced.

Thus, total operating costs would be cost of ingredients plus losses plus quality control, or:

Total cost = Ingredients + Quality Control
= Rs 0.0115 + Rs 0.001
= Rs 0.0125 per pound or
Rs 1.0 per maund or
Rs 28 per long ton

This amount represents:

5.4% increase in cost of atta (based on atta at Rs 18.37 per maund, the ration shop price)
or
Rs 28,000,000 ($2.5 million) per year for fortification of one million tons per year.

Naturally, the costs of fortification could be higher or lower depending on variations in the amount and type of fortificant added. It should be noted in particular that the cost of the fortificant, which represents essentially the total cost of fortification, consists for the most part of the cost of the vitamin A--the U. S. cost of V-M mix with vitamin A is $4.15 per pound and without vitamin A is $1.57 per pound.

c. Factors Effecting Potential Implementation

It seems quite clear that it would be in the interests of the people of Pakistan, especially the low-income segment of the population, to fortify atta with vitamins and minerals. It also seems clear that it is technically feasible to incorporate beneficial levels of vitamins and minerals into a sizeable part of the atta which reaches low-income people by fortifying the atta produced in Pakistan's 147 roller flour mills.

On the other hand, the costs of fortification (i.e. up to around $400,000 in fixed capital costs and $3 million per year in operating costs) and the need, at least initially, for allocating foreign exchange for a part of the operating costs, creates a deterrent to atta fortification.

Because these costs are not insignificant, it is not reasonable to expect the roller-flour millers to absorb them. Instead it seems appropriate that the costs either be passed along directly to the consumer or, alternatively, that the GOP or some other public body bear the costs through subsidy. Since the GOP is already controlling and subsidizing wheat, perhaps government subsidy is the most realistic approach to introduction of fortification. But subsidization of atta calls for a public commitment to nutrition--a commitment which has not been especially strong in the past.

In spite of these negative factors, several conditions are now present which tend to counter-balance them and lead to the conclusion that atta fortification can and should be promoted in Pakistan. First,

the new government has expressed a strong interest in promoting the welfare of the masses of the people. A fortification program aimed at improving the nutritional health of the masses, especially the lowest income groups, would be a timely and extremely visible way for the government to demonstrate sincere concern for the masses. Second, the large industrial houses of Pakistan need ways of showing "social concern" and minimizing their former images. Flour millers who represent these business factors might well be interested in projecting a new image to both the people and the Government of Pakistan; active participation in an atta fortification program would tend to foster such an image. Third, fortification represents the least expensive and simplest method of overcoming deficiencies of micronutrients. Because no new nutrient delivery system is required and because the vitamins and minerals used in fortification require no special packaging or expensive processing or special promotion, there is no cheaper means of adding vitamins and minerals to the diet. And finally, atta fortification represents a means for millers and the government to replace the vitamins and minerals which are removed from wheat during processing. As illustrated in table 4, milling reduces the vitamin and mineral content of wheat due to removal of the bran and wheat germ. Although the extent of bran removal in manufacture of atta in Pakistan is relatively low, it might be expected that a sizeable percentage of niacin, riboflavin, and iron are removed during milling (see "medium extraction" table 4). If this is the case, it would be altogether fitting for the GOP to insure that the consumers of atta are not deprived of those nutrients by requiring that atta produced in roller mills should be fortified.

Table 4.--Affects of Milling on Nutrient Content of Wheat 1/

Nutrient	Content--mg./100 g (% of whole wheat)		
	Whole meal of flour 2/	Flour 3/ medium extraction	Flour 4/ white low extraction
Vitamin A--------	0	0	0
Niacine----------	5.4 (100%)	2.0 mg. (37%)	1.2 mg. (22%)
Thiamine---------	0.45 (100%)	0.34 (75%)	0.13 (29%)
Riboflavin-------	0.13 (100%)	0.09 (62%)	0.06 (46%)
Iron----------	4.1 (100%)	2.4 (59%)	1.0 (24%)

1/ Food Composition Tables - minerals and vitamins, FAO, Nutrition Studies No. 11, Rome. 1954.
2/ Extraction, 94 - 100% of whole wheat.
3/ Extraction, 80 - 93% of whole wheat.
4/ Extraction, less than 80% of whole wheat.

d. Recommendations for Action

The following recommendations are made to USAID/Pakistan for actions which will provide further support and justification for atta fortification and which will enable the Mission to advise and assist the GOP regarding the development of an atta fortification program.

(1) Work with GOP nutritionist to establish reasonable and appropriate levels of vitamin and mineral fortificants for atta.

(2) Demonstrate the beneficial effects of atta fortification--e.g. by showing (clinically) the results of increased intake of vitamins and minerals through consumption of fortified atta among persons known to be deficient.

(3) Study consumers of ration-shop atta to establish amount of atta

consumed, how atta is consumed, and to what extent consumers are deficient in nutrients carried by atta.

(4) Obtain analyses of typical samples of atta (and wheat from which produced) to determine levels of vitamins and minerals present and extent to which atta has been depleted due to removal of bran and germ during milling.

(5) Identify counterparts in GOP who are responsible for atta fortification and assist those persons in promoting atta fortification.

(6) Assist the Flour Miller's Association of Pakistan in developing a workable proposal for initiating and carrying out atta fortification--proposal might, if necessary, include a pilot project to demonstrate feasibility using AID technical and financial assistance. (A draft outline for a proposal is included as Appendix B).

(7) In developing the atta fortification project, include an evaluation component to assure that the intended beneficial effects are assessed. Consideration of evaluation procedures at an early stage is especially critical due to the need for base line data.

2. TEA FORTIFICATION

Tea is consumed widely throughout Pakistan and is unquestionably the most popular beverage in the country. It is generally accepted that tea becomes a part of the Pakistani diet at a very early age, perhaps at 1-2 years, and is consumed frequently by all income groups. Thus, tea apparently reaches all segments of the population including those groups of most concern to nutrition planners, i.e. preschool children and pregnant and lactating mothers.

Total tea consumption in Pakistan is estimated currently at 80,000,000 pounds per year and the growth rate is believed to be approximately 7 percent per year. 10/ All tea is imported with about 70 percent coming from Ceylon, 10-15 percent from China, and the remaining 15-20 percent from other sources including Iran, Turkey, Kenya, and Argentina.

Approximately 80 percent of the tea is in the coarse particle size grades or leaf tea (Orange Pekoe, Broken Orange Pekoe, Fanning, etc.) and the remaining 20 percent is in the fine grade which is called dust. All grades are imported in chests. 11/ The majority of tea, 60-65 percent is packaged and distributed by the major tea blenders of Pakistan, Brooke-Bond, Lipton, Ispahani, and Adam. Wholesalers, semi-wholesalers, and small merchants handle the remaining 35-40 percent.

The major tea blenders mix chests of tea in batches up to 2,000 pounds to obtain the proper qualities for distribution under their various brand names. 12/ Packaging ranges in size down to individual packets of only 1/8 ounce (selling for 6 paise or U.S. 0.5¢). Packaged branded tea normally retails for about Rs 8.00 per pound or about U.S. $0.75 per pound. Tea distributed by small traders is also frequently a blend of various teas but, according to the Tea Traders Association, unblended tea is also sold in some areas, particularly in the Northwest Frontier Province. Blending by tea traders typically is undertaken in

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10/ Tea Traders Association, Haji Razak Janoo, Chairman.

11/ Wooden boxes, sometimes covered with a gunny overwrap, containing 100 - 130 pounds of dry tea.

12/ A description of a large tea blending system is given in Appendix C.

small batches of around 20 pounds and consists of hand mixing varying proportions from perhaps 3-6 different tea chests.

It has been suggested that tea can act as a carrier for supplementary nutrients and in particular that vitamin A can be added to tea at beneficial levels without altering the taste or other tea quality factors. 13/ Work undertaken by Clinton Brooke in collaboration with Hoffman-LaRoche, manufacturers of vitamin A, has shown that a special vitamin A powder (250 SD) can be mixed with tea dust at levels of 125 IU of vitamin A per gram of tea and that the resulted liquid tea is indistinguishable from unfortified tea. In addition, Brooke has demonstrated that boiling fortified tea for up to one hour does not damage the vitamin A. Brooke calculated that tea fortified at the cited level would provide about 50 percent of the RDA for vitamin A when tea is brewed with three grams of tea per cup, when three cups of tea are consumed per day, and when the RDA is 2,000 IU of vitamin A per day. (In Pakistan, where the RDA is 3,000 IU per day, tea so fortified and so consumed would provide 38% of the RDA).

Brooke and Cort also considered possibilities for fortifying leaf tea and concluded that powdered vitamin A can not be mixed with leaf tea because the powder would tend to separate during shipping and handling thereby causing non-uniformity of fortification. They suggested instead that an emulsion of vitamin A in water might be sprayed on the leaves and the excess water removed by drying.

13/ Brooke, C.L. and Cort, W.M., Vitamin A Fortification of Tea, Food Technology, 26:50-52, 58, 1972.

The work of Brooke and Cort has provided the groundwork for tea fortification with vitamin A but, unfortunately, has not demonstrated that tea fortification is technically feasible (i.e. a specific method of fortification has not been shown to be workable and practical under actual commercial conditions). Additional work is clearly required to identify a practical method for fortifying leaf tea and also to demonstrate that dust tea can be properly fortified with 250 SD vitamin A (e.g., to show that vitamin A can be mixed effectively under commercial conditions, and prove that the vitamin A will not separate from tea dust during shipping and handling). However, as will be discussed later, it appears that the technical difficulties are minor and can probably be overcome with relatively little effort.

Considering the widespread use of tea in Pakistan, the need for additional vitamin A in the diets of Pakistanis, and the progress that had been made in incorporating vitamin A in tea, USAID/Pakistan has explored the potential for fortifying Pakistani tea with vitamin A. As of November 1972, this exploration had proceeded to the point where the major tea blenders of Pakistan and even some of the small traders had examined vitamin A fortified tea and one blender, Ispahani, had distributed about 20,000 pounds of vitamin A fortified tea dust to assess consumer acceptability.

For the most part these efforts led to a favorable reaction as to the acceptability of fortified tea. 14/ However, only Ispahani showed

14/ Only Brooke-Bond claimed that vitamin A fortified tea was noticeably different than unfortified tea; subsequently, on December 5, in the presence of N. Jafri and P.R. Crowley, Brooke Bond taste-testers compared fortified and unfortified dust and leaf tea and were unable to select correctly the fortified samples.

real interest in fortifying tea on a commercial basis. Both Lipton and Brooke-Bond indicated that they would not fortify tea unless other distributors also fortified so that all tea would be fortified. Isphani's interest seemed to stem from a desire to improve its share in the dust tea market by promoting improved health through consumption of its brand. Thus, the Ispahani interest represented a potential point of entry--but resistance by other blenders and lack of technology for fortifying leaf tea (80% of the total market) presented significant deterrents to widespread adoption of fortification.

a. Benefits of Fortifying Tea with Vitamin A

As in the case of atta, it would be appropriate to add sufficient vitamin A to tea to either (a) eliminate deficiencies among consumers, or (b) provide a significant portion of the RDA. Since the general population receives only about one-half of the RDA of 3,000 IU per day from usual foods, addition of up to 1,500 IU of vitamin A through tea would be reasonable. Alternatively, any amount in the range 25-50 percent of the RDA or 750 - 1,500 IU per day would be appropriate.

Unfortunately, there is very little quantitative information on tea consumption habits in Pakistan on which to base computations of the level of fortificant--it is not known how much tea is used per cup, how many cups of tea are consumed per day, or how these figures vary with need for vitamin A, age, location, income, etc. Clearly it would be desireable to obtain estimates of these factors for use in deciding on fortification levels. However, in the meantime, use of the Brooke

recommendation of 125 IU per gram of tea (or one gram of 250 SD vitamin A powder per 2,000 grams dry tea) appears to be a reasonable first approximation. As indicated earlier, the level would provide 38 percent of the average RDA if tea were consumed at the rate of 3 grams per cup and 3 cups per day. At these levels of fortification and consumption rates, it would be expected that nearly 20 percent of the population would receive the indicated 38 percent of the RDA.

b. Cost of Fortifying Tea with Vitamin A

Since neither the technology nor the levels of fortification can, at this time, be defined rigorously, cost estimations must necessarily be highly speculative. However, it should be possible to make a preliminary estimate of costs based on reasonable assumptions as to the type of technology that would be expected to be suitable and the level of fortification cited above and, thereby, obtain a "ball-park" cost. Accordingly, a cost estimate has been developed on the following assumptions:

(1) The amount of vitamin A used will be 115 IU per gram of dry tea but a 5 percent excess will be allowed for losses.

(2) Hoffman-LaRoche type 250 SD vitamin A powder (containing 250,000 IU per gram) will be used as the fortificant--this powder currently cost US $14.30 per kg. C & F Karachi, and is estimated to cost Rs 215 per kg., 20% duty and 10% taxes paid, delivered to a tea fortifier in Pakistan.

(3) The vitamin A powder can be coated with an adhesive, such as a vegetable oil, such that when mixed with either tea dust or leaf,

the powder will not segregate during shipping and handling--and the small amount of adhesive will not add to the cost of the vitamin A powder.

(4) Costs of adding vitamin A to tea and monitoring addition (quality control) will be insignificant and will be borne by tea blenders, distributors, and others so that no additional costs need be assigned for processing. Also, there will be no special requirements for packaging other than to specify the amount and type of fortificant on the label, and, therefore, there will be no additional costs for packaging.

Using these assumptions, the cost of fortifying tea would be

Rs 0.05 (or about US 0.5¢) per pound of tea

or Rs 0.0003 (or about US 0.003¢) per cup based on 3 grams of tea per cup.

This additional cost represents only a 0.6% increase in the cost of tea and, therefore, is so insignificant that it could easily be absorbed in the usual price variations of tea. However, if all the tea in Pakistan were fortified, a total of 19,000 kg. of vitamin A costing Rs 4.1 million (and $270,000 in foreign exchange) per year would be required.

C. Factors Effecting Potential Implementation

Fortification of tea with vitamin A would without question have a beneficial effect in relation to reducing vitamin A deficiencies in Pakistan. Furthermore, although there are a number of unanswered questions and a number of unsolved problems, no insurmountable obstacles have become evident thus far.

Perhaps the major unsolved problem at this time is the absence of support for tea fortification among the major tea blenders. Except for Ispahani's interest in fortifying its dust tea (which represents only 0.5 million pounds per year or less than one percent of total consumption) there is no evidence of support and a great deal of evidence of resistance to tea fortification among the blenders. Realistically, there is no clear basis for tea blenders to be interested in tea fortification except social concern or desire to project an improved image to the people and the government--fortification otherwise would simply be a minor drain on company resources and a possible hazard due to unknown business side affects. Therefore, unless the tea blenders develop a sense of social concern or have a desire to improve their image, (or the government requires fortification) enertia and fear of change and newness will prevent positive action.

Lack of demonstrated technology for fortifying tea leaf and dust is a second deterrent to action. However, it is believed this technology can be developed simply and quickly. A third deterrent is lack of sufficient information on tea consumption habits and tea consumers to quantify the best fortification levels and the expected beneficial effects. Additional problems, such as possible need for new food regulations also exist, but are solveable. 15/

On the other hand, as in the case of atta, both industry and government might well consider this to be the right time to publicly

15/ The legal aspects of tea fortification are being considered by USAID/Pakistan's legal advisors. As of Dec. 14, 1972, it was the opinion of Moizuddin Sayyed, Legal Consultant, that existing food regulations do not prevent fortification of tea but that it would be adviseable to obtain government approval.

demonstrate their interests in the welfare of the people by promoting public health programs, including tea fortification. Tea fortification requires very little in the way of additional expenditures (less than Rs 4 million per year) or in foreign exchange (less than $¼ million). Therefore, a major nutrition program with major visibility could be mounted with a minor investment. For these reasons it is believed that the balance of factors favor further effort to promote tea fortification in Pakistan.

d. Recommendations for Action

The following recommendations are made to USAID/Pakistan for actions which will provide further support and justification for tea fortification and will enable the Mission to advise and assist the GOP concerning the development of a tea fortification program.

(1) Study the consumption of tea to determine the amount of tea consumed, the characteristics of the consumers, and the need for additional vitamin A in their diets.

(2) Develop the technology necessary to fortify both leaf and dust tea. It is recommended that this work be undertaken in the U.S. under the direction of AID/TA/N-USDA and be demonstrated through reduction-to-practice in Pakistan.

(3) Work with GOP nutritionists to establish reasonable and appropriate levels of vitamin A fortification for tea.

(4) Demonstrate the beneficial effects of tea fortification--e.g. by showing (clinically) the result of consuming fortified tea by persons known to be deficient in vitamin A.

(5) Identify counterparts in GOP who are responsible for considering tea fortification and assist those persons and the tea industry in promoting tea fortification.

(6) Include an evaluation procedure in the project to assess the impact of tea fortification.

3. OTHER FORTIFICATION ALTERNATIVES

a. Lysine Fortification of PL 480 Wheat

In early 1972, as a follow-up to suggestions arising from a USDA study that grain shipped from the U.S. to East Pakistan might be fortified with lysine, USAID/Pakistan held discussions with the GOP and concluded that similar possibilities for fortifying PL 480 wheat shipments should be considered for (West) Pakistan. 16/ After considering relevant factors, it is recommended that this not be done at this time because:

(1) As indicated earlier in this report, there is insufficient information to determine need for general protein or amino acid fortification in Pakistan.

(2) Because PL 480 wheat is milled to produce atta in roller mills, and because fortification of wheat grain 17/ is considerably more expensive than fortification of wheat flour, it would be unnecessarily expensive to fortify wheat with lysine in the US ($5-10 per ton for wheat versus about $3.50 per ton for wheat flour, both at 0.1% added lysine). Thus, if lysine fortification of wheat was

16/ Rosenfield, D. et al, East Pakistan - Possibilities for Cereal Fortification, FEDS Report, March 1970.

17/ Technology for fortifying wheat involves addition of a small portion of "hot shot" wheat made by impregnating wheat grains with a high concentrate of lysine.

undertaken it would be better (economically) to add lysine to the wheat flour at roller flour mills rather than to the wheat in the U.S.

In light of these considerations, lysine fortification of PL 480 wheat shipped to Pakistan does not appear to be justified. This conclusion is, of course, specific to Pakistan and Pakistani's current wheat distribution methods and can not be extrapolated to other countries.

b. Sugar Fortification

Fortification of sugar with vitamins and minerals has been given serious consideration by nutritionists and, in Guatemala, fortification with vitamin A has been undertaken on a large scale pilot basis under the sponsorship of INCAP. Since sugar is produced in relatively few refining plants in Pakistan (reportedly only 12 plants) the Mission has considered possibilities of fortifying sugar.

According to Hoffman-LaRoche, the technology for fortifying sugar with vitamin A powder is essentially a matter of dry mixing vitamin A powder with refined sugar. Thus, as in the case of tea, separation of the vitamin during shipping and handling is a potential problem. If the sugar is of a small particle size or if it is sticky due to a high moisture content, the vitamin A might be expected to remain properly mixed. Otherwise, however, special steps might be required to prevent separation. Hoffman-LaRoche has suggested that the first step in assessing the feasibility of sugar fortification is to test representative samples for separation. That company has kindly offered to

undertake such testing on behalf of AID. Therefore, it is recommended that samples of Pakistani sugar be sent to USDA for forwarding to Hoffman-LaRoche for testing.

c. Salt Fortification

Possibilities for fortifying salt with iodine, as is the practice in the U.S., or with calcium and/or iron as is being evaluated in India, have been given consideration by USAID/Pakistan. The heavy incidence of goiter in parts of Pakistan certainly justifies investigations of the use of salt or some other carrier to provide supplementary iodine in the Pakistan diet.

A preliminary investigation of possibilities of salt fortification in Pakistan by C. B. Weinberg led to the conclusion that it did not offer a good possibility. 18/ This conclusion was based on information that the vast majority of food grade salt is rock salt mined in Punjab and that this salt is not crushed in any central location where a fortificant could be added.

Although Weinberg's analysis seems reasonable, it might be useful to examine the production and distribution patterns for salt in those areas in Pakistan where goiter is prevalent with a view toward identifying a practical intervention. 19/ The virtue of considering fortification of salt with iodine, of course, is that it is a well established concept and is extraordinarily inexpensive if fortification can be integrated with existing processing.

18/ Letter from C. B. Weinberg to Susan Alfano, April 6, 1972.
19/ Lack of time prevented an assessment of possibilities for fortifying salt in Pakistan during this consultancy. It is suggested that reasonable time period (perhaps one week) be allocated for this purpose during a subsequent consultancy.

C. GENERAL COMMENTS

1. Nutrition Surveys

As listed under recommendations for tea and atta fortification, it would be desirable to undertake a study of the consumers of those commodities in Pakistan in order to have a better quantitative basis on which to make forecasts. The types of information needed include: quantities consumed; forms in which consumed (recipes); sources, quantities, price, and packaging of purchased commodities; and a description of the consumers with emphasis on age, location, income (or expenditure), and nutritional status. 20/

Rather than undertake separate studies for each commodity, it would probably be more efficient to develop an integrated study of those several commodities which are being considered as possibilities for fortification--i.e. atta, tea, salt, and sugar. Also it would be good to coordinate consumer studies with other Mission survey work.

It would also be useful for the survey analyses to take into account the economic consequences of dietary deficiencies and the economic benefits which would result by overcoming those deficiencies.

Consumer surveys can range widely in quality depending on the experience and approach of the surveying organization. Bad surveys are worse than useless in that they can mislead decision-makers. The Mission can help assure good quality surveys by selecting properly qualified

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20/ Nutritional status might be derived either from independent nutrition surveys of the type now being planned by the Mission or from inquiries within the consumer surveys.

contract organizations for field work and analysis, and by exercising close control over the contract during the survey. It would be helpful for the Mission to engage a consultant to screen and instruct contract organizations. AID/TA/N-USDA will be pleased to assist the Mission in identifying a consultant to do these things.

2. MCH Feeding Program

The current interest by the Mission in working with other agencies, particularly UNICEF and CARE, in a project to reach preschool children through MCH Centers, is of special interest to AID/TA/N-USDA. AID/W is currently giving major attention to the key problem of how to reach preschool children. As a part of this effort, USDA is in the midst of a project to examine various means of reaching preschool children to improve their nutritional status and to assess costs and benefits of the various program possibilities. In addition, AID is interested in better use of using Title II foods in nutrition oriented programs. Thus, the Mission might wish to consider special inputs from these various central groups to help develop the MCH project.

One of the problems in the MCH project which was apparent during this consultancy was the lack of availability of a "satisfactory" food for the program, i.e. a food which could be taken home from MCH Centers by mothers and fed to infants. The WSB which is currently programmed for this purpose was severely criticized by project workers as unpalatible for infants (unless heavily sweeted) or so much like atta that it would be used as a general family food rather than given to infants.

Furthermore, it was said that infants are generally given milk rather than solid or semisolid foods and therefore WSB would not fit existing food habits in Pakistan.

These types of problems face not only Pakistan but many other countries and are of special concern to AID and USDA. Therefore, it might be entirely appropriate for AID/TA/N and FFP and USDA to jointly work with the Mission in developing solutions to the problem with a focus on the MCH project. Accordingly, the Mission might like to look into a joint effort with the groups cited to develop an MCH project with heavy "outside" support. 21/

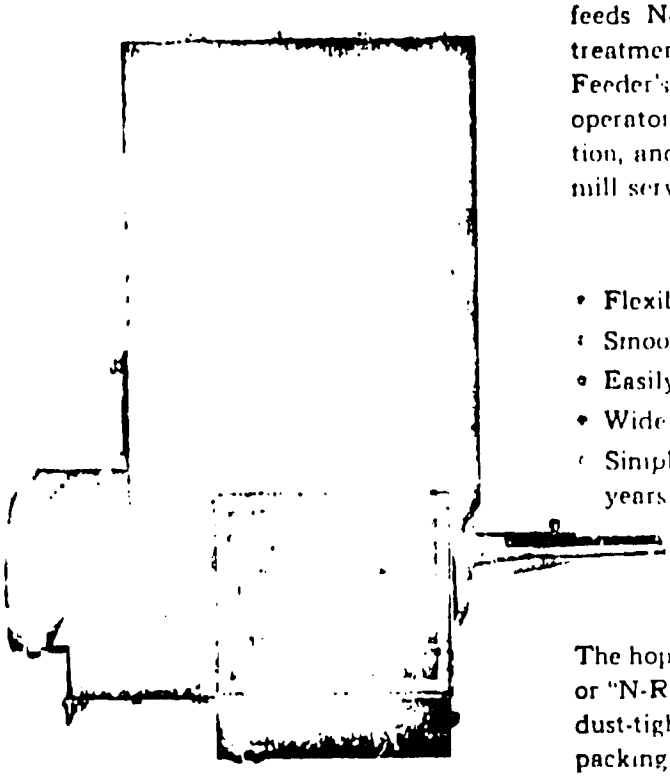
21/ The TDY of F. James Levinson during Jan. 1973 on Nutrition Planning is expected to concentrate on preschool children. Alternative approaches to the one suggested here might evolve from the Levinson visit.

WALLACE & TIERNAN

dry chemical feeder for flour treatment

Type NA

The Wallace & Tiernan Type NA Feeder is a utility dry chemical feeder designed and built for flour mills. It accurately feeds Novadelox®, "N-RICHMENT-A"®, or any other dry treatment ingredient. Operation is sure and easy, and the NA Feeder's mechanism is very responsive to control by the operator. Adaptability to any feeding job, simplicity of operation, and wide-range control make this feeder ideal for flour mill service.



Wallace & Tiernan
Type NA Feeder

- Flexible, oscillating hopper eliminates packing.
- Smooth, stainless steel feed rolls mean uniform feeding.
- Easily adjusted feed rate simplifies operation.
- Wide feed range to meet changing treatment requirements.
- Simplicity of operation and rugged construction assure years of trouble-free service.

The hopper of the NA Feeder holds about 20 lbs. of Novadelox or "N-RICHMENT-A." It is attached to the feed section by a dust-tight, flexible joint. This junction oscillates to prevent packing and assure continuous flow of chemical. Guide vanes in the hopper distribute chemicals evenly over the rolls in the feed section. Rolls are corrosion-resistant stainless steel. Their smooth surfaces prevent sticking, assure uniform feed. The rolls deliver a ribbon of chemical across the feed apron. A graduated feed slide changes the width of this ribbon, thus the feed rate.

The NA Feeder is available in both standard- and high-capacity models. The feed range of either may be varied by reversing a pair of easily changed gears. Gears run in an oil bath. The oil is maintained at a low level and cannot escape from the gear case.

Feeder drive is by a ¼ horse power electric motor hinged so that the drive belt is held taught. Feed rolls are accessible through a removable door. Sturdy construction and corrosion-resistant parts mean low maintenance and trouble-free operation.

The NA Feeder is compact and easily installed. The opening at the base of the feed section is 8" x 8½".

W/ Pennwalt Corporation
W&T Flour Service Division
2540 South 27th Avenue
RPORATED
EW JERSEY

WALLACE & TIERNAN

dry chemical feeder for flour treatment

close-up showing feed rolls

The material being fed flows by gravity from the hopper to the top of the feed section above the feed rolls. Arching and caking of material is prevented by an oscillating motion of the hopper's lower portion. Moving blades in the center of the hopper keep a uniform stream of chemical moving toward the feed rolls.

In the feed section, the material is formed into a smooth ribbon of uniform thickness by the feed rolls. Feed rate is varied by varying the width of the ribbon. This is done by adjusting a graduated feed slide. The slow-moving feed rolls deliver the ribbon of material at a uniform rate.

TECHNICAL DATA

capacity	Standard: 1 to 60 oz. of Novadelox per hour. High: 2 to 120 oz. of Novadelox per hour.
motor	¼ h.p., 115 v., 1 ph., 60 cy., totally enclosed.
hopper capacity	0.6 cubic feet.
equipment furnished	Items such as optional equipment, accessories, wiring, and elective features are included with the feeder as specifically listed in a quotation.
dimensions	Height, 2' 2¾"; width 2' ¾"; depth 9⅛".
weight	130 lbs.
shipping weight	270 lbs.

Progressive changes in design may be made without prior announcement.

W
25
Pennwalt Corporation
W&T Flour Service Division
2540 South 27th Avenue
Broadview, Illinois
RPORATED
NEW JERSEY

APPENDIX B

Proposal for Fortifying Atta (produced in Roller Flour mills and sold thru Ration Shops) with Vitamins and Minerals

1. Summary:

2. Background:

   a) Nutritional deficiencies for Vit. A, B, iron in Pakistan

   b) Debitilating affects of deficiencies of these nutrients

   c) Use of atta as a means of introducing additional nutrients in diet:

      i) Enrichment in other countries
      ii) Quantities of atta distributed thru ration shops
      iii) Consumers of ration shop atta
      iv) Potential of ration shop atta for reducing deficiencies

   d) Statement of intent of Flour Mills Association to assist the diet and the people of Pakistan by fortifying atta milled for the govt. ration shops.

3. Technology for Fortification:

   a) Proposed levels of fortification

   b) Means of adding fortificants to atta

   c) Means of assuring proper addition of fortificants (quality control)

4. Costs of Fortification:

   a) Capital costs

   b) Costs of additives:

      i) per unit of additive concentrate
      ii) per unit of atta
      iii) per year for all atta in ration shop

   c) Alternative methods of paying for fortification:

      i) government subsidy
      ii) increase in price of atta

5. GOP and others laws and regulations providing for fortification of atta:

6. Proposal by Roller Flour Millers:

(a) Millers will purchase and install equipment necessary to add vitamins and minerals to atta -- govt. must provide import license for non-indigenous equip ent.

(b) Millers will purchase and add V&Ms to all atta milled for distribution in ration shops -- govt. must provide import licenses for V&M premix.

(c) Millers will provide certified analysis establishing that V&M have in fact been added.

(d) Govt. will adjust the payments made to millers to reflect additional costs for fortification .

(e) Fortification will not be accompanied by any publicity during the first-year

(f) Fortification of atta provided thru ration shops will be inaugrated on _____.

POSSIBILE INPUTS BY USAID:

1) Provide milling technicians to advise each flour mill on installation of fortification equipment.

2) Comprehensive study* of Consumers of ration shop atta to:

(a) establish justification for atta fortification

(b) demonstrate acceptability of fortified atta .

3) Financial assistance through $ loans or Rs. grants for equipment and other fixed capital assets and/or for vitamins and minerals for some time period (e.g. one year) either for pilot program or for full scale operation.

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* Can include a clinical assessment of beneficial effects of consuming fortified atta.

APPENDIX C

Tea Blending System -- Brooke Bond, Karachi

Tea is blended in two identical batch mixing units, each sized to accommodate 1,600-2,000 pound loads. The general layout of the units is illustrated in the attached sketch.

Tea chests, 100-130 lbs. net weight each, are opened and manually dumped into hopper (1). A conveyer belt (2) transfers the tea as a bed approximately 1/2" deep under a magnet (3) to a bucket elevator (4). Tea discharging from the head of the elevator drops into a hold bin (5) where the requisite amount and types of tea necessary for the blend are accumulated. The accumulated load of tea is dumped into an octagonal, internally baffled mixing drum where it is blended for approximately 10-15 minutes. The blended tea is discharged from the mixing drum into either gunny bags or mobile hoppers for transfer to the packaging lines.

The entire mixing system from the point of discharge from the conveyer belt (2) through the mixing drum (6) is shrouded and under suckion (7) to remove "fluff" (very fine tea particles) and to control dust.

When blending dust tea, the capacity of the mixing drum is nominally 2,000 pounds and when blending leaf tea (which is of lower bulk density) the capacity is nominally 1,600 pounds.