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A Pioneering Project for Combatting Vitamin A Deficiency and Xerophthalmia with MSG Fortified with Vitamin A

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A Pioneering Project for Combatting Vitamin A Deficiency and Xerophthalmia with MSG Fortified with Vitamin A

by

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Film

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ABSTRACT

Vitamin A deficiency and xerophthalmia constitute one of the main nutritional problems in Indonesia. In Indonesia's Third and Fourth Five-Year Development Plans, it was stated that efforts will be made to distribute high levels of vitamin A and to fortify a foodstuff with vitamin A in an attempt to combat vitamin A deficiency. However, up to this point, efforts to fortify a foodstuff with vitamin A have only reached the level of determining the means of fortification (MSG, amongst others), and developing the technology to do this. The next step, the one which was taken in this study, was to organize an experiment at the field level to evaluate the acceptance of the fortified product by the community and its effectiveness in combatting vitamin A deficiency.

Ten villages, with a total of around 9,000 pre-school children, were divided into two groups. In the first five villages, MSG fortified with vitamin A (MSG-A) was marketed. This MSG-A was produced under the SASA label at the MSG factory in Surabaya. Bearing in mind that the average level of MSG consumption by a pre-schooler is 0.23 gram per day, around 3000 IU of vitamin A were added to each gram of MSG. It was hoped that the additional consumption of around 500-700 IU of vitamin A per day from the MSG-A would make up for the deficiency in the children's dietary intake. The producer and the SASA agent in Bogor co-operated by organizing the MSG-A marketing from the Bogor agent to the five experimental villages. The five other villages, where MSG-A was not marketed, constituted the control

area. Data on the prevalence of xerophthalmia, the average child's vitamin A status (sub samples of around 200 children were taken), vitamin A in breast milk, Hb (sub sample), the status of nutrition (sub samples of 5 % of children were taken) and health, were collected at the beginning of the study as well as six and twelve months later.

The results of this study showed that the prevalence of xerophthalmia (XIB) in the experimental area dropped from 1.24 % to 0.32 % after 6 months and 0.15 % after 12 months. In contrast, the prevalence of xerophthalmia in the control area rose slightly, from 0.77 % to 0.90 % after 6 months and stood at 0.80 % after 12 months. This reduction in the prevalence of xerophthalmia in the experimental area, in comparison to what occurred in the control area, is of significance. The vitamin A serum levels in the experimental area rose significantly from 19.3 ± 9.35 ug/dl to 22.4 ± 9.20 ug/dl after 6 months and 26.3 ± 9.52 ug/dl after 12 months. In the control area, the vitamin A serum value commenced at 22.5 ± 9.95 ug/dl, becoming 20.2 ± 8.60 ug/dl after 6 months and 20.5 ± 9.42 ug/dl after 12 months.

The Hb level in pre-schoolers in the experimental area rose significantly, that is, from 11.3 ± 1.55 g/dl to 12.3 ± 1.59 g/dl after 6 months and 12.1 ± 1.34 g/dl after 12 months. In the control area, the Hb level started at 11.4 ± 1.58 g/dl becoming 11.2 ± 1.48 g/dl after 6 months and 11.4 ± 1.39 g/dl after 12 months.

The vitamin A level in breast milk in the experimental area rose significantly, from 17.31 ± 8.43 ug/dl, becoming 19.11 ± 7.83 ug/dl

after 6 months and 19.20 ± 8.74 ug/dl after 12 months. In the control area, the level of vitamin A in breast milk did not rise. It was 17.58 ± 12.77 ug/dl at the beginning of the research, 16.47 ± 9.93 ug/dl after 6 months, and 16.65 ± 5.84 ug/dl after 12 months.

The decrease in the prevalence of xerophthalmia and the increase in the vitamin A levels in the serum, Hb, and vitamin A in breast milk show that:

(i) the MSG-A marketed was bought by families, and food that received additional vitamin A from this MSG-A was consumed by pre-schoolers; (ii) the MSG-A, marketed through normal marketing channels, was quite effective in combatting vitamin A deficiency; (iii) the vitamin A added to the MSG was adequate to make up for the vitamin A deficiency in daily consumption; and (iv) the intervention of vitamin A did not merely combat the vitamin A deficiency but also played a role in overcoming anemia.

The lower mortality rate among pre-schoolers in the experimental area (13.40%) compared with that in the control area (19.5 %) is interesting, indicating that the vitamin A intervention may have played an additional role in reducing mortality and illness rates. In order to be certain that this was not merely a coincidence, further research is needed.

The implementation of the fortification program at the national level needs to take into account: (i) the social impact concerning the issue of possible MSG toxicity, (ii) the cost of fortification, and (iii) a national concensus on the policy for the phasing of fortification. For these reasons, there needs to be a series of further actions at the completion of this study.

EXECUTIVE SUMMARY

We have examined the effectiveness of the use of MSG, fortified with vitamin A (MSG-A) to combat vitamin A deficiency. The MSG-A was channeled through the usual marketing outlets. The socio-economic conditions and food consumption in both the experimental and control areas were the same (Table 1 and Table 5).

After the MSG-A had been marketed for 5 to 11 months, there was a reduction in the prevalence of xerophthalmia, when the prevalence of Bitot's Spots (XIB) was used as the measure. This reduction, apart from being very significant, indicated that xerophthalmia had also reached a prevalence rate that no longer constituted a community health problem in the experimental area (Table 7 for cross sectional data and Table 8 for cohort data). This reduction in the prevalence of xerophthalmia was accompanied by an increase in the status of vitamin A, measured as the change in vitamin A levels in the blood (Table 17 and Table 19).

Other effects of the marketing of MSG-A observed in this study were the increase in the hemoglobin levels of pre-schoolers (Table 22 and Table 23) as well as the decrease in pre-schooler mortality (Table 24). Both of these effects still need confirmation through research.

The vitamin A added to the MSG was consumed not only by pre-schoolers but also each family member, as can be seen from the increase of vitamin A in breast milk (Table 21).

The results of this research show that the vitamin A was added to MSG in sufficient amounts to make up for its lack in food. Because all of the MSG-A marketed was able to be purchased by the community, the results of this study can be used as one of the considerations for implementing the fortification of a foodstuff(s) with vitamin A in Indonesia.

All of the MSG-A marketed during this study was sold, indicating the community's acceptance of the MSG. It was realized during the study that the fortification technology had yet to be perfected, as the yellowish color of the product could be observed with the naked eye if inspected "very" carefully. (Note: While this study was in progress, a group of experts from Wisconsin succeeded in producing "White Vitamin A" which will solve this color problem.)

If viewed scientifically, based on research, experiments, and on the results of a national MSG consumption survey, there is nothing regarding the toxicity of MSG that should cause concern. However, we must bear in mind the strong rumors which exist in the community that MSG can cause the onset of cancer. This question must be considered from the social point of view. The MSG consumed by the target group (families with low vitamin A status) was in small packets, therefore, with the fortification of MSG in small packets only, the target would have been reached.

The cost of fortification can be countered by reducing the quantity of MSG in packets by an amount equal to the price of the vitamin A added or by increasing the total cost of the MSG, including MSG that is not fortified.

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INTRODUCTION

Vitamin A deficiency and xerophthalmia constitute one of the main nutritional problems in Indonesia. A national survey on xerophthalmia (1977 - 1979) revealed that there was a prevalence of Bitot's Spots of around 1%, while a drying out and ulceration of the cornea were experienced by 6.4 out of every 10,000 pre-school children (1). The number of pre-school children with a low vitamin A status or deficiency amounted to 50 %, while around 70,000 pre-school children were threatened with blindness each year (1) (2). Apart from leading to blindness, vitamin A deficiency contributes to a high rate of illness and death, especially in infants and pre-school children (3).

Combatting vitamin A deficiency can be carried out through (i) nutritional education, (ii) a high-level of vitamin A distribution (200,000 IU) twice a year, (iii) fortification of a foodstuff with vitamin A (iv), and a general improvement in community health (4).

In Repelita III (5), the Third National 5-Year Development Plan, it was stated that vitamin A deficiency would hopefully no longer constitute a community health problem by the year 2000. It is hoped that by then, most people, including young children, will be able to satisfy their vitamin A needs through daily food intake. Before this can be achieved, efforts must be made to combat vitamin A deficiency. In the Third and Fourth Five-Year Plans, it was stated that the distribution of high levels of vitamin A and the

fortification of a foodstuff with vitamin A would be carried out in order to combat vitamin A deficiency. However, to date, only the distribution of high levels of vitamin A has been carried out while the fortification of a foodstuff with vitamin A is only at the research stage. The following efforts have been made towards implementing this fortification program: (i) a survey has been carried out on foodstuffs that could be suitably fortified with vitamin A and (ii) a fortification feasibility study was conducted (6). Both of these studies revealed that fortification could be carried out using white sugar, flour, monosodium glutamate (MSG or vetsin) and salt. The foodstuff with the greatest potential, MSG, fulfills the conditions for fortification: it has the most central production process, would reach a large section of the target group, its production is easy to control, it is not organoleptic, and has only a small variation in consumption (1) (6). Apart from this, fortification can only be carried out with MSG in small packets which are purchased by the target group, usually low income families.

Research into the literature on the toxicity of MSG has revealed that MSG is safe if consumed as an additive (mixed with food) because glutamate is metabolized quickly by the body. Research into the side effects was only carried out on amounts of MSG given in a parenteral manner or in mixtures with high doses; that is, a few hundred times greater than what is normally consumed as a food additive. Glutamate is an amino acid, the largest amounts of which (20%) are in the protein of prepared food. In pre-school children, glutamate consumption originating from the protein of prepared food is around 6,000 mg, while the amount from MSG is around 150 - 300 mg.

The results of a survey on the consumption of MSG in pre-school children reveal an average level of 0.23 g. per day per child. An addition of 3,000 IU of vitamin A per gram of MSG will increase the daily consumption by as much as 700 IU of vitamin A, or half of the daily requirement. This increase will hopefully increase their vitamin A status and prevent xerophthalmia.

Before the national fortification program is carried out, a trial of the fortification of MSG with vitamin A on a limited basis was conducted through normal marketing channels. This experiment indicate whether the community can accept the fortified product and whether this method is effective enough to reduce the prevalence of xerophthalmia.

AIM

General : To analyze the effectiveness of combatting vitamin A deficiency and xerophthalmia through the fortification of MSG with vitamin A.

Specific:

- To analyze the reduction in xerophthalmia prevalence (XIB)
- To analyze the vitamin A status of pre-school children
- To analyze the effects of the fortification of MSG on the vitamin A levels of breast milk
- To study the operational aspects of the fortification of MSG, with vitamin A, from the factory level to the consumer

METHODOLOGY

1. The Technology of Fortification

The technology for combining the MSG (white in color) with vitamin A (yellow in color) resulted in a product that approached the required color for MSG (a white appearance), and with unchanged homogeneity and pourability. The process consisted of first making a premix of vitamin A, a glue-type substance and MSG powder. A total amount of 800 grams of 250 cws (cold water soluble) vitamin A was

mixed with 60 g of hydroxipropyl-cellulose as a glue, which was then dissolved in 450 ml of absolute alcohol in a mixer with the brand name "Little Ford." This mixture was then combined with 3200 g of 100 mesh MSG powder so that the MSG powder stuck to the vitamin A particle by means of the glue. The premix was then dried by fanning and mixed, using a Peter Kelly blender, with MSG crystals to the ratio 5:95 until it was homogeneous. Thereafter, the MSG fortified with vitamin A was referred to as MSG - A.

The production of MSG - A was carried out at the SASA factory in Surabaya under the technical guidance of the Center for the Research and Development of Nutrition.

While this study was in progress, the following materials were required :

250 cws vitamin A	14	kg
.00 mesh MSG powder	3.5	kg
Absolute alcohol	8	litres
Hydroxipropyl-cellulose	2	kg
MSG crystals	1100	kg

The mixing and packaging were carried out by SASA employees

2. The Study Area

From introductory research on the marketing of MSG in the Bogor subdistrict, we obtained data that 70% of the MSG market was controlled by SASA. This group had no objection to participating in the Pioneering Project on the Fortification of MSG with Vitamin A.

Thus, the Bogor subdistrict was taken as a region where this project could be carried out.

The Cijeruk and Caringin subdistricts are in the Bogor regency area. Both these neighboring subdistricts are situated to the south of the Bogor municipality, as can be seen from the map in Attachment 1. The natural surroundings are cool, mountainous regions at 400 - 800 m above sea level.

The land in both these sub-districts is quite fertile, and consists mainly of hills and mountain slopes. Mount Salak is at the western end of the Cijeruk subdistrict and Pangrango mountain is at the eastern end of the Caringin subdistrict. The slope of the land in both subdistricts is around 0 - 40 %, with an annual average rainfall of approximately 4000 mm. The rice fields in the Cijeruk and Caringin areas are irrigated with river water all year round. The irrigation system in both these subdistricts is non-technical. There is no major harvest in either of these subdistricts due to the nature of the year-round crops that are planted. The main produce is rice. Other crops are cassava, corn, sweet potato, grains, vegetables and fruits, especially pineapples and bananas. Because of its fertile land and picturesque panorama, the Cijeruk subdistrict in the Bogor regency is one of the areas where the agriculture and tourism industries are being developed. The villages chosen as research areas were:

1. Cisalada
2. Cigombong
3. Tugu Jaya
4. Ciburuy
5. Ciburayut
6. Palasari
7. Pamoyanan (in the Cijeruk sub district)
8. Caringin
9. Pasir Muncang
10. Cinagara (in the Caringin subdistrict)

The MSG-A was marketed in the Cisalada, Cigombong, Tugu Jaya, Ciburuy and Ciburayut areas because of their distance from each other and their geographic similarity to the control area.

3. The Success Criteria

The first stage :

The MSG fortified with vitamin A was purchased by the public. Samples of MSG at local street foodstalls and homes contained vitamin A.

The second stage:

(i) The prevalence of xerophthalmia in the areas marketing MSG - A was significantly reduced and could possibly have reached a prevalence level, which, according to WHO criteria, would no longer constitute a community health problem.

(ii) The vitamin A status of pre-school children, determined from vitamin A serum levels, rose significantly. There was a shift from deficiency status to low status and from low status to normal status.

(iii) The vitamin A level in breast milk rose significantly, thereby constituting the main vitamin A source for babies. As MSG-A was consumed by the whole family, the mother would also have consumed extra vitamin A originating from the MSG-A.

4. The Marketing, Monitoring and Analysis of the MSG - A

The MSG-A was marketed through normal channels: it was produced in the SASA factory in Surabaya, then sent to the agent in Bogor. From this agent the MSG - A was sold to markets and foodstalls in the research area (the five villages in the Cijeruk subdistrict), while in the five control area villages the MSG was marketed as usual.

After one to eleven months of marketing, the vitamin A levels in the MSG-A were monitored. The sampling of MSG-A on the market was carried out by the field workers who purchased a few packets of MSG with the SASA label at each foodstall marketing this MSG-A. Samples at the consumer level were taken from 10 families in each village using the MSG with the SASA label.

An analysis of the vitamin A in the MSG-A was based, in a semi-quantitative way, on the Carr-Price reaction, which was modified. A sample of about one gram of MSG-A was mixed with about 10 drops of tricholoroacetate (TCA) at 60 % solution in chloroform. The blue color which resulted was immediately compared with the standard of the semi-quantitative color. The darker the blue color that resulted, the higher the vitamin A level in the MSG-A. The standard of this color is equivalent to successive vitamin A levels of 500 IU, 1000 IU, 1500 IU, 2000 IU, and 3000 IU (7)

This quantitative analysis of vitamin A in MSG was performed in the laboratory using the spectrophotometric method. A 2 gram sample of MSG - A was dissolved in 100 ml of water and isopropanol at the ratio 1 : 1. Five mls of this solution were further diluted with 50 ml of water and isopropanol at the ratio 1 : 3. The vitamin A level

in the sample was measured using the following formula:

$$A \times 19 \times \text{dilutent factor}$$

Note : A = absorption or optic density

19 = derived from:

$$\frac{1.000.000}{1750} \times \frac{10}{3} \times \frac{1}{100}$$

(the ekstinksi coefficient value = 1750)

5. <u>Sample Selection</u>

The number of pre-school children required for the experiment was determined assuming that after MSG-A was marketed for 6 to 12 months, the prevalence of Bitot's Spots would have dropped to around 50 % or that the prevalence of XIB would no longer constitute a community health problem. The formula used to determine the number (n) of pre-school children required for the experiment was:

$$t = \frac{(P_{T2} - P_{T1}) - (P_{K2} - P_{K1})}{\sqrt{\dfrac{P_{T1}.Q_{T1} + P_{T2}.Q_{T2} + P_{K1}.Q_{K1} + P_{K2}.Q_{K2}}{n}}}$$

$$n = \frac{t^2 . Sd^2}{2}$$

where :

P_{T1} = the prevalence of XIB (Bitot's Spots) cases in the experimental area at the beginning of the research

P_{T2} the prevalence of XIB cases in the experimental area at the second (follow-up) investigatio

P_{K1} = the prevalence of XIB cases in the control area at the beginning of the research

P_{K2} = the prevalence of XIB cases in the control area at the second/follow-up investigation

Q_{T1} = 100 % - P_{T1} (the prevalence of cases at the beginning)

Q_{T2} = 100 % - P_{T2} (the prevalence of cases at the follow-up investigation)

Q_{K1} = 100 - P_{K1} (the early prevalence in the control area)

Q_{K2} = 100 - P_{K2} (the prevalence at the follow-up investigation in the control area)

$$t^2 = (P_{T2} - P_{T1}) - (P_{K2} - P_{K1})^2$$

$$Sd^2 = (P_{T1} . Q_{T1} + P_{T2} . Q_{T2} + P_{K1} . Q_{K1} + P_{K2} . Q_{K2})$$

From this calculation for the Bogor regency (with the assumption of a 0.98 - 1 % xerophthalmia prevalence), n was obtained : 2780 pre-school children. Bearing in mind the possibility of "dropouts" at the follow-up investigation and that ethically, children suffering from xerophthalmia need treatment, this figure was increased to 4000 pre-school children for the experimental group and 4000 pre-school children for the control group. The latter were taken from the same district. However, there was no marketing of MSG fortified with vitamin A in this district.

Clinical eye and general health examinations were carried out on all children in the experimental and control groups. Anthropometric measurements, blood, and breast milk checks were made by sub-sampling. Data on socioeconomic conditions and food consumption were also collected.

Anthropometric Measurements:

Weighing and measuring children were carried out on as many as 20 % of both the experimental and control group children as well as on every child with a xerophthalmia case. The sampling was based on the systematic random sampling method. For this, anthropometry was carried out on children in multiples of 5 (100% /20% = 5). Nutritional status was determined based on body weight compared to age (BW/A) and body weight compared to body height (BW/BH).

Blood, Breast Milk and Hemoglobin Sampling

The number in the sample (n) for the blood check was based on the following formula :

Blood, Breast Milk and Hemoglobin Sampling

The number in the sample (n) for the blood check was based on the following formula :

$$n = \frac{(Z_\alpha \doteq Z_\beta)\ 2\ \ SD\ 2}{(D)\ 2}$$

With a confidence interval n of (α = 0.05) and (β = 0.20) a factor value (Z_α = Z_β) 2 = 6.2 was obtained with the one-tailed test (8). With a standard deviation (SD) of around 10 ug/dl (maximum deviation) and with the expectation of an increase (D) as high as 2 ug/dl, the value of n was calculated as follows:

$$n = \frac{(6.2)\ (10)\ 2}{4} = 155$$

To compensate for the possibility of there being "dropouts", which could be as high as 30% based on previous experience, the sample size was increased to 200 children per group.

Sampling was determined by the random sampling system. From the 3500 - 4000 children checked, 200 would have their blood tested at intervals of 3600/200 = 18. The initial number selected at random was the number 8, so blood tests were carried out on children whose forms were numbered 8, 26, 44 and so on. Blood was tested to determine the hemoglobin and vitamin A levels in the serum. If the child selected could not (for some reason) have his blood tested, the child with the next form number was tested instead.

Breast milk samples were taken from mothers who, at the time of the experiment, were still breast feeding their babies under 6 months old.

Data on food consumption and socioeconomic conditions were collected from 100 families in the experimental area and 100 families in the control area. Sampling was determined at random with the use of a computer.

6. Clinical Eye and General Health Examinations

The clinical eye examination to determine the existence of vitamin A deficiency included examinations for :

XIA = Conjuntival Xerosis

XIB = Bitot's Spots

X2/X3 = Corneal xerosis, ulceration of the cornea, and keratomalacia

The health examination sought information on :

General health status

Upper respiratory tract infections

Digestive system infections, including diarrhea

Measles

Other diseases requiring attention :

- Skin diseases
- Ear, nose and throat diseases

Data Collection, Equipment, and Examination Method

Experience in the pre-survey showed that the field workers at the village level did not fully understand their role in preparing for data compilation. As a result, for every two villages in the research territory, a coordinator was appointed from the research team who would be responsible for the smooth preparation and compilation of data. The efficiency of the field workers would become

the responsibility of the coordinator assigned to them. The roles of the coordinator and field workers are outlined below.

Outline of Duties. To facilitate the field research, a coordinator system was used. There were six coordinators in the ten villages to be studied so that one coordinator was responsible for the conduct of research in two villages.

A coordinator maintained a close working relationship with the field worker from the village. If problems were experienced by the field worker, then the coordinator had to solve them with the field worker.

A coordinator's tasks were as follows :

- With the field worker, design a schedule for carrying out investigations. This schedule was designed based on the particular village concerned, the community's routine on certain days as well as on the permission and willingness of the village officials, and the team's working days.

- Together with the field worker, determine the research location. The location chosen was to be a convenient one so that it could be visited by the community, in the hope that it would attract many respondents.

One or two days before going into the field, the field worker sought the permission of the local Head of the Neighborhood Association (RT). After obtaining permission, a location, such as home of one of the villagers, village hall or school was sought. The field worker then organized a work location which was readily accessible to mothers bringing pre-schoolers. When the location had

been determined, the field workers informed people of the date and time of the health examination by distributing invitation cards. In order to draw in a large number of respondents, the field workers went from house to house to inform residents and to remind mothers to bring birth certificates, if they possessed them. If on the set date there were two health examination venues, some field workers left earlier for the second location to inform people and prepare this location.

<u>Equipment.</u> Before departing for the field, the following had to be prepared:

Equipment comprising: a form related to clinical and anthropometric examination, a book for the registration of pre-schoolers per RT (Neighborhood Association) at the first examination, and a book for the registration of pre-schoolers, per RT, who had undergone health examinations earlier.

Plastic health card

Medicine and medical instruments

- Doctor's instruments : 1. Stethescopes
  2. Torches
  3. Prescription books
  4. Wash basins

Anthropometric instruments :

1. Triangular suspension scales
2. Bar scales
3. Sarong cloths

4. Microtoise

5. Microtoise nails

6. A measuing rod for babies

- Materials and equipment for blood testing :

1. A glass tube rack

2. A labelled Drabkin's glass tube

3. Wax

4. Band aids

5. An ice thermos

6. A capillary tube

- Equipment for breast milk extraction:

1. Labelled bottle for breast milk

2. Tissues

3. Thermos

- A small thank you gift for those who assisted.

For conducting examinations at the set locations, the following were

- A table used for registering participants
- An area for weighing pre-school children
- An area for measuring body height
- A doctor's surgery area
- An area/space for blood and breast milk testing
- An area for obtaining medicine.

Examination Method. At the work location, the children were checked by an eye specialist. Then weighing and body measuring took place, followed by the extraction of blood and breast milk from sub samples. Every child found to be suffering from xerophthalmia was immediately given high doses of vitamin A directly by the research team. It was hoped that 125-150 pre-school children could be examined each work day. It was planned that following the completion of health examinations in one village, another day would be set aside to cover children who had been unable to come when the first health examinations were held.

The first step before the health examination was registration. This was carried out by the coordinator and field worker for that particular area. Mothers of pre-schoolers were asked the identity of the child and to indicate this on the health examination form (see Attachment 2). Based on this information, a health card was prepared, which had to be kept by each parent. Children who underwent body measurement and blood tests and mothers whose breast milk was sampled in accordance with the random sampling system had this information indicated on their health card. The card was meant to facilitate examinations 6 and 12 months later.

When the blood and breast milk had been tested, those mothers/pre-school children requiring medication were able to have their prescriptions made up at the dispensary section. To reduce both the noise from children crying and anxiety, prepared snacks were distributed at the area where body measurement was carried out or at the dispensary area.

At the end of the examinations, forms were collected and re-checked. If there were omissions or mistakes on the forms, they were immediately rectified. The forms were then tied up in one bundle according to location and date.

Blood and breast milk samples were kept in an ice thermos so that their vitamin A content would not deteriorate. Data on the consumption of MSG were also collected. After reaching the laboratory of the Center for the Research and Development of Nutrition (Puslitbang Gizi), breast milk was placed in a refrigerator; blood samples were centrifuged and then placed in a refrigerator.

The completed forms were checked and corrected by the Center for the Research and Development of Nutrition, then the data were fed into the computer by the appointed staff. The results fed into the computer were then re-examined (cleaning data) and analyzed in order to obtain final results. At the follow-up health examinations, a more complex approach, using local governement officials, was adopted. A list of names was given to the village head and invitation cards were given out to the respondents according to the list of names obtained at the first health examination. In this way it was hoped that as large a number of respondents as possible would be covered.

7. <u>The Method Used to Obtain Blood Samples for Vitamin A Serum, Hemoglobin and Breast Milk Tests</u>

To examine vitamin A levels, blood taken from the finger tip was placed in 3-5 capillary tubes. The tubes were then sealed with molten

wax and placed in a larger tube on which the child's name, code ar date sample taken were recorded, then the samples were placed in a ice thermos. When the samples reached the laboratory, the blood i the centrifuge was separated from the serum. The serum was then kep in a cabinet to await analysis. To examine the hemoglobin, a pipett was used to collect the blood from the finger tip. About 2 microlitres of blood were placed with a Sahli pipette into a tub containing 5 ml of Drabkins's solution. This pipette was then rinse with a reagent 4 times, shaken and closed tightly. As soon as it reached the laboratory, the blood was immediately read with a spectrophotometer at a wave length of 540 nm.

For the vitamin A serum and hemoglobin checks, blood was extracted 3 times. The third extraction was done on different children because many mothers objected to their children undergoing 3 blood tests. As it was necessary to know the status of vitamin A in the pre-school child, for the third blood test, blood was taken from a different child than that in the first examination.

In this study, breast milk was taken 3 times from mothers still nursing babies up to 6 months of age: prior to fortification, and 5 and 12 months after the fortification program began. To avoid a variance in the fat levels of breast milk which could quite possibly have a bearing on the vitamin A level, the breast milk was extracted between 9.00 a.m. and 12 noon. Breast milk sampling in the 3 periods was done on different mothers, bearing in mind that some mothers who were nursing at the first examination were no longer nursing when the second examination was held or their milk supply had diminished so that it was difficult to extract.

Up to 25 ml of breast milk were extracted by a field worker using a "Breast Reliever," then placed into a bottle labelled with the mother's name, code and date sample was taken. This bottle was then kept in an ice thermos and taken to the laboratory. While awaiting further analysis, this milk was kept in a refrigerator.

8. <u>The Determination of Vitamin A Levels in the Serum, Breast Milk, and the Hemoglobin Levels</u>

Vitamin A levels in the serum were determined using the HPLC method (High Performance Liquid Chromatography), as suggested by the IVACG (International Vitamin A Consultative Group) (9). One hundred ul of serum were mixed with ethanol, which had a standard of acetate vitamin A with a concentration of around 25 ug/dl, and then shaken. The vitamin A and was extracted by adding a solution of 200 ul hexan into this mixture, and then mixing it in a vortex for 1 minute. The vitamin A extract was separated from the mixture via centrifugation for 10 minutes. One hundred ul of extract were removed with a pipette, then steamed with nitrogen gas until it became dry. The vitamin A was re-dissolved in 25 ul diethylether and 75 ul of methanol. Fifty ul of the final solution were injected into the HPLC equipment (Waters brand). The column used in this determination was the Bondapak C 18, the drip speed 2.5 ml/minute, the detector wave length 325 nm, the detector sensitivity 0.01 AUFS (absorption unit full scale) and the recording speed 1 cm/minute. The graph of the peak of the vitamin A sample would appear within 2.2 minutes, while the graph of the acetate vitamin A standard appeared within 3 minutes.

The vitamin A serum levels, which were stated in ug/dl, wer calculated as follows:

$$\frac{\text{The height of the vitamin A peak of the sample}}{\text{The height of the standard peak of the acetate vitamin A}} = \text{concentration of the acetate vitamin A standard}$$

Vitamin A levels in breast milk were determined out usin modified Neeld and Pearson methods (9).

One ml of breast milk was mixed with 1 ml KOH in solution wit 95 % alcohol, then incubated for 30 minutes at 60 degrees C. Two ml of ether petroleum were then added to the sample, mixed in a vorte for 1 minute and centrifuged for 10 minutes. One-half ml. of the to layer of the sample (vitamin A dissolved in ether petroleum) wa steamed with nitrogen gas until dry, then dissolved with a mixture o TFA: Chloroform (1:2). The blue color that emerged was quickly rea on a 620 nm wave length in no more than 30 seconds. The amount o vitamin A was calculated as:

$$\frac{\text{Abs sample}}{\text{Abs standard}} \times \text{concentration of the standard}$$

(Abs = absorption = optic density of 1)

The standard used was the palmitate vitamin A, the concentration of which was adjusted to the concentration of the sample.

The determination of hemoglobin levels was conducted using the cyanmethemoglobin method, as recommended by WHO. The Drabkin's solution containing blood from the field was read using a spectrophotometer with a wave length of 540 nm.

$$\frac{\text{Abs of sample}}{\text{Abs of standard}} \times \text{concentration of standard} = \text{g/dl}$$

9. Collection of Data on Food and MSG Consumption

Data on food consumption were collected using the "recall' method, 2 x 24 hours. The primary purpose of collecting these data was to obtain an idea of the children's carotene/vitamin A consumption levels, as well as energy, protein and other nutritional substances. These data were analyzed using the list of Foodstuffs Composition (see Attachments 3 and 4).

Data on MSG consumption, on the other hand, were collected through interviews based on questionnaires (see Attachments 5 and 6). The data collected covered the size of MSG packets used, how the MSG was used, and the types of foods to which MSG was added.

The weight of the MSG packets used by households was determined by purchasing various types of packets from the closest street foodstalls. These samples were then weighed carefully by the Center for the Research and Development of Nutrition in Bogor.

The consumption of MSG by pre-school children (Attachment 7) was calculated from the portion of food they consumed compared to all of the food the family cooked with MSG.

The consumption of MSG per child per day=

$$\frac{\text{the portion of food to which MSG had been added, which was consumed by pre-school children in one day}}{\text{portion of food of family}} \times \text{use of MSG by the family in one day}$$

Socioeconomic data were collected by visiting the experimental group villages and conducting interviews at the homes of the villagers who were sampled. The data collected covered : the physical size of the village, the population size, the level of education,

incomes, water sources, distance from house to water source and whether the family owned a toilet (Attachment 8).

10. Infant and Pre-School Child Mortality Rates

Data on infant and pre-school age child mortality rates were collected by the research team from the Center for the Research and Development of Nutrition, assisted by the field workers (see Attachment 9). The method used was directly questioning the family concerning infant and pre-school child deaths in the area over the last year, that is, for the duration of this study. If, at the time of the visit, neither the husband nor the wife was at home, information on infants' and pre-school children's deaths was sought from the head of the Neighborhood Association or the family's neighbors.

The calculation used was:

1. The infant mortality rate :

$$\frac{\text{The no. of infant deaths in the one year period}}{\text{The no. of births in the one year period}} \times 1000$$

2. The pre-school child mortality rate :

$$\frac{\text{The no. of deaths of children age 1-4 during the one year period}}{\text{The no. of child residents age 1-4 during the one year period}}$$

11. Processing and Analyzing the Data

The clinical data from the eye tests, body measurements, ocioeconomic situation, and consumption were fed into a "Wang" 220 omputer.

The data were then "cleaned" and analyzed by the research staff. The analysis covered:

1. A calculation of the prevalence of Bitot's Spots and XIA, as well as a measurement of the decrease in this prevalence using the proportional test (T-Test).
2. A calculation of the nutritional level, based on the weight according to age and weight according to body height, and a calculation of the prevalence of nutritional status, categorized as good nutrition, lack of nutrition or poor nutrition. A test of the decrease of the prevalence of lack of nutrition and poor nutrition was made using the proportional or T-Test.
3. A calculation of the prevalence of various kinds of infectious diseases. A test of the decrease/increase of the prevalence of these diseases was conducted using the proportional or T-Test.
4. Food consumption was converted to a measure of nutritional substance by using a bank of data on foodstuff composition that had been fed into the computer. The average consumption of nutritional substance and its deviations were then calculated.
5. For both the experimental and control groups, the socioeconomic data were noted in percentages for each category examined.

The calculations performed manually included the average vitamin A levels in blood, breast milk and Hb. A test of the difference was performed by using a student - T-Test, while a difference in the shift in vitamin A serum values, which occurred in both the experimental and control areas, was calculated using a proportional test.

In order to determine the difference in average nutritio consumption between the experimental and control groups, a studen T-test was performed manually, as was the calculation of the averag MSG consumption for pre-school children and other family members.

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RESULTS

1. Demography

The Cijeruk sub-district, 6,520 hectares in size, had a total population of 98,484, consisting of 49,652 women and 48,832 men, spread over 19,696 homes. The population density for the Cijeruk sub-district was 1,510 people/km2. The Caringin sub-district, in contrast, was 5,730 hectares in size and had a population of 65,902, consisting of 33,300 women and 32,602 men, spread over 13,933 homes. Its population density was 1,150 people/km2.

More than 99% of the population in both sub-districts were Moslem. The remaining 1% were Protestant, Catholic, Hindu and Buddhist.

In the Cijeruk sub-district, there were 86 primary schools, 10 junior high schools, 1 senior high school, 67 Islamic schools and 7 Islamic training centres. In the Caringin sub-district, there were 32 primary schools, 3 junior high schools, 2 senior high schools, 32 Islamic schools, and 8 Islamic training centers.

The health service facilities in the Cijeruk sub-district were : 2 community health centers, 2 assistant community health centers, 1 maternal and child health center, and 5 clinics with a health staff consisting of 4 doctors, a dentist, 3 supervisors/nurses, 6 mid-wives and 40 traditional mid-wives (dukun). In the Caringin sub-district there was 1 community health center, an assistant community health center, 3 polyclinics and one doctor's surgery clinic. Health care was provided by 2 doctors, a dentist, 5 mid-wives and 34 traditional mid-wives, 25 of whom had been trained.

The size of the experimental area was 2,434.5 hectares with a total population of 29,750 and a population density of 1,222 people/km2. The size of the control area was 2,295.2 hectares with a total population of 33,188 people and a population density of 1446 people/km2.

Of the villagers in the control group, 47.6% had completed the final grade of primary school, 43.8 % did not complete primary school, 5.5 % completed junior high school, 2.8 % completed senior high school, and 0.3 % completed tertiary education. Of the villagers in the control group, 49.6 % had completed primary school, 43.1 % had not completed primary school, 4.9 % had completed junior high school, 2.3 % completed senior high, and 0.1 % completed tertiary education.

The occupations of the villagers in the experimental group were: 5.66% owner-farmers, 41.51 % farm laborers, 18.87 % in their own business, 9.43 % public servants, 11.32 % laborers in industry and 13.21 % others. These figures for the control group are 8.26% 37,61%, 20.18%, 7.34%, 4.59% and 22.02%, respectively. Villagers in the experimental group who had visited the community health center over the past year numbered 70.75 %, compared to 78.90% in the control group.

The types of housing structures in the experimental area were as follows: cement 56.6%, wood 1.9 %, bamboo 20.7 %, and other types 20.75 %. In the control area there were 67 % cement houses, 13.76 % bamboo and 19.24 % other kinds.

The water source for the experimental group was mainly (47.2%) from a permanent well (surrounded by a brick wall), followed by the

spring 29.3 %, non-permanent well 12.3 %, river 8.5% and paddy field 2.7%. In the control area, 43.1% obtained water from a walled well, 38.4 % from the spring, 11.01 % from a non-permanent well, 7.3% from the river, and 0.2 % from the paddy field.

The distances from a villager's house to the water source in the experimental area were 61.5 % around the houses, 20.8 % 2 minutes away, 10.4 % 2-5 minutes away and 7.3 % more than 5 minutes away. In the control area the figures were: 61.3 % , 20.2 %, 9.2 % and 9.3 %.

In the experimental group, 11.3 % had western-style toilets, 18.9% squat-type toilets, 1.9 % used public toilets, 42.5 % relieved themselves in the garden, and 25.4 % used other ways. In the control group 5.5 % had western-style toilets, 8.3 % squat type toilets, 1.8 % public toilets, 56.9 % used the garden and 27.5 % used other ways.

Table 1. Size, Population, and Socioeconomic Conditions of the Experimental and Control Groups

Description	Experimental Group	Control Group
1. Land size	2,434.5 hectares	2,295.2 hectares
2. Total population	29,750 people	33,188 people
3. Population density/km2	1,222 people	1,446 people
4. Occupations (%)		
- Owner farmer	5.66	8.26
- Farm laborers	41.51	37.61
- Own business	18.87	20.18
- Public servant	9.43	7.34
- Laborer in industry	11.32	4.59
- Other	13.21	22.02
5. Educational level (%)		
- Not completed prim.school	43.8	43.1
- Completed prim.school/equiv.	47.6	49.6
- Completed junior high	5.5	4.9
- Completed senior high	2.8	2.3
- Completed Tertiary	0.3	0.1
6. Visits to the community health center over the last year (%)	70.75	78.90
7. House structure (%)		
- Brick house (cement)	56.6	67.0
- Wood	1.9	0
- Bamboo	20.75	13.76
- Other	20.75	19.24
8. Water source (%)		
- A walled well	47.2	43.1
- A non- perm.well	12.3	11.01
- River	8.5	7.3
- Spring	29.3	38.4
- Paddy	2.7	0.2
9. Distance to the water source (%)		
- Around the house	61.5	61.3
- 2 minutes away	20.8	20.2
- 2-5 minutes away	10.4	9.2
- More than 5 minutes away	7.3	9.3
10. Types of toilet (%)		
- Western -style	11.3	5.5
- Squat-type	18.9	8.3
- Public toilet	1.9	1.8
- Garden/river	42.5	56.9
- Other	25.4	27.5

2. The Marketing, Monitoring and Analysis of MSG-A

MSG-A marketing commenced in January 1985, one month after the basic data were collected. Because the MSG-A produced in the SASA factory in Surabaya was sent directly to the MSG agent for the Bogor area, supervision of the MSG-A distribution in the target area was facilitated. Thus, there was little possibility of the control area being penetrated by the marketing of MSG-A, even though this did occur.

In this study, initially, there were 5 villages in the experimental area in the Cijeruk sub-district, consisting of 48 "kampung." In the control area there were five villages consisting of 44 "kampung."

In the implementation of this study there was a penetration of MSG-A marketing in three "kampung" situated close to a control village. The reverse also occurred where six "kampung" in the experimental area were not affected by the MSG-A marketing because they were closer to the control group. Despite this, the number of pre-school children in the experimental group (42 kampung) and the control group (41 kampung) still fulfilled the statistical requirements. In the each area, around 4,000 pre-school children were examined. The MSG-A marketed was packaged in the weights shown in Table 2.

The results of monitoring the MSG-A revealed that there were about 2,650 IU of vitamin A per gram of MSG-A at the first sampling. After around 2 months, there were about 2,500 IU/g or 93 % of the first level. After 11 months of marketing, the content was in in fact

only 1,550 IU/g or around 58 % of what it was initially. More detailed data are provided in Table 3.

Table 2. Size and Price of MSG-A Marketed in the Experimental Area

Code*	Size/Weight (g)**	Price (Rp)
1 s	0.6468	5.00
2kt	1.2748	10.00
5kt	2.9057	15.00
15kt	6.4729	25.00
25kt	13.5526	50.00

* From the SASA factory
** The result of careful weighing by the Bogor Center for the Research and Development of Nutrition.

Table 3. The Results of Monitoring the Marketing of MSG-A Sold at Street Foodstalls

Length of Time Marketed (in months)	Vit-A Level IU/g ± SD	Retention %
1	2650 ± 1317	99 *
2	2500 ± 1026	93
4	2250 ± 1395	84
6	1600 ± 1184	60
9	1850 ± 1394	70
11	1550 ± 1060	58

*: 99% based on the previous research results that for 1 month's storage the Vitamin A retention remains 99 %.

The results of monitoring in households are provided in Table 4.

Table 4. The Results of Monitoring MSG-A in Households

Length of Time Marketed (in months)	Vit A Level IU/g ± S.D	Retention %
1	2800 ± 444	100
2	2450 ± 1187	92
3	2700 ± 674	100

The monitoring of MSG-A in households was carried out only up to the third month of marketing. It ceased when households questioned this activity and then the community requested detailed explanations about the MSG problem. Thus, so that the marketing could be conducted properly and suspicion in households would not become too great, MSG-A sample taking at the household level was stopped.

Overall, vitamin A levels in MSG-A obtained from households showed quite high retention. In general, at up to 3 months of being on the market, the retention was more than 90%. These results, which were slightly higher than the sample analysis results from the foodstalls, indicated there was a variability of vitamin A levels in each packet; thus, the mixing of vitamin A in MSG was not yet truly homogeneous.

3. The Consumption of Nutritional Substances and MSG

The results of the survey on nutritional substances consumed by pre-school children showed that there was no difference between experimental and control groups' consumption. The energy consumption for both groups was around 500 calories or around 40% of the required daily intake. However, the average provitamin A consumption of 138 children in the experimental group was 718 mg/day or 47% of the recommended required intake; for the control group, it was 789 mg/day or 49%. More complete data are provided in Table 5.

Table 5. The Nutritional Substance Consumption of th Experimental and Control Groups

Nutritional Substance	Experimental Group (N=138), average, prim. school	Requirement* %	Control Group (N=137) on the average, prim. school	Requirement* %
Energy (Kcal)	496 ± 287	39	518 ± 309	40
Protein (g)	13 ± 9	53	14 ± 9	56
Fat (g)	12 ± 9	-	13 ± 9	-
Provit. A(ug)	718 ± 1047	47	789 ± 1203	49
Vitamin C (mg)	18 ± 21	92	22 ± 29	108
Iron (mg)	3.2 ± 2.7	32	3.6 ± 3.3	36

Note : * Calculated based on the requirement recommended in Widya Karya Nasional Pangan dan Gizi, 1983.

Data on MSG consumption in food were collected from 110 families in the experimental group and 109 families in the control group. No babies under 3 months of age consumed food containing MSG.

The results showed that the average MSG consumption for each family member was 0.38 g in the experimental area and 0.37 g in the control area. The consumption of MSG for adults and pre-school children, respectively, was 0.40 g and 0.24 g for the experimental group. For the control group, the average MSG consumption for adults and pre-school children was 0.41 g and 0.21 g, respectively (see Table 6).

Thus, the consumption of vitamin A originating from MSG was around 650 IU per child per day at the beginning of the marketing period. This fell to around 400 IU per child per day during the 9th to 11th months of the marketing period, with an average of around 500 IU per child per day for 11 months.

The highest MSG consumption rate among adults was 1.6 g/person/day, while among pre-school children it was 1.1 g/pre-school child/day. Thus, the MSG consumption among adults and pre-school

Table 6. The Consumption of MSG in the Experimental and Control Areas

Village Code	Number of Families	Number of Adults	Number of Pre-School Children	Consumption in grams/person/day		
				Average Family member, standard deviation	Average Adult standard deviation	Average Pre-Schoo child, standard deviation
Experimental Are						
1	18	79	26	0.29 ± 0,15	0,27 ± 0,16	0,29 ± 0,13
2	21	103	33	0,34 ± 0,31	0,41 ± 0,34	0,26 ± 0,31
3	14	47	23	0,38 ± 0,26	0,47 ± 0,25	0,17 ± 0,10
4	30	131	43	0,61 ± 0,46	0,59 ± 0,47	0,35 ± 0,37
5	18	63	37	0,27 ± 0,22	0,27 ± 0,21	0,14 ± 0,10
Total Average	110	423	162	0,38 ± 0,28	0,40 ± 0,29	0,24 ± 0,20
Control Area						
6	21	98	29	0,39 ± 0,27	0,40 ± 0,34	0,27 ± 0,33
7	29	122	49	0,47 ± 0,25	0,56 ± 0,26	0,24 ± 0,17
8	19	89	26	0,43 ± 0,28	0,43 ± 0,28	0,18 ± 0,12
9	15	66	18	0,28 ± 0,31	0,29 ± 0,18	0,17 ± 0,16
10	25	104	44	0,29 ± 0,19	0,35 ± 0,21	0,18 ± 0,12
Total Average	109	479	166	0,37 ± 0,26	0,41 ± 0,27	0,21 ± 0,18
The "Acceptable Daily Intake" estimation with an estimation of 50 Kg. for adult body weight and 15 g. for pre-school child body weight					7,5	2,25

children was far below the safety limit set by WHO, that is, 0.15 g/kg of body weight/day. If body weights for Indonesian adults and pre-school children are estimated at 50 kg and 15 kg, respectively, then the limits regarded as safe for adults and children are 7.5 g/person/day and 2.25 g/person/day, respectively.

4. The Results of the Clinical Eye Tests

The "cross-sectional" data, which constituted the basic data and results of the two clinical eye tests, are displayed in Table 7. It can be seen from the table that the prevalence of Bitot's Spots sufferers in the experimental group before the marketing of MSG-A, based on basic data, was 1.24 % and in the control group it was 0.77 %.

Table 7. The Prevalence of Xerophthalmia Sufferers Before and After the Marketing of the MSG-A (Cross-Sectional)

Group	Period	N	X1B Prevalence (%)
Experimental	Basic data	3803	1.24
	Evaluation I	4059	0.32
	Evaluation II	4065	0.15
Control	Basic data	4135	0.77
	Evaluation I	4115	0.90
	Evaluation II	4400	0.80

After the MSG-A had been marketed for 5 months, the prevalence of Bitot's Spots in the experimental group was 0.32 % and in the control group it was 0.90 %. According to the calculated result of the proportional differences test (T-Test), which had been corrected

there was a significant reduction in the prevalence of Bitot's Spots in the experimental group (P<0.01).

After 11 months of marketing MSG-A, the prevalence of xerophthalmia in the experimental group was 0.15 % and in the control group it was 0.80 %. The result of the T-Test, which was corrected, revealed a significant reduction in the prevalence of Bitot's Spots (P<0.001).

The cohort data, which constituted the basic data and results of two clinical eye tests, can be seen in Table 8.

Table 8. The Prevalence of Xerophthalmia Sufferers Before and After the Marketing of MSG-A (Cohort)

Group	Period	N	XIB Prevalence (%)
Experimental	Basic Data	2102	1.24
	Evaluation I	2102	0.33
	Evaluation II	2102	0.19
Control	Basic Data	2169	0.83
	Evaluation I	2169	0.92
	Evaluation II	2169	1.11

From the table above it can be seen that the prevalence of xerophthalmia sufferers before the marketing of MSG-A in the experimental group was 1.24 % and in the control group it was 0.83 %. After MSG-A had been marketed for 5 months, the prevalence of xerophthalmia in the experimental area was 0.33 % and in the control area was 0.92 %. With the T-Test calculation which had been corrected, there was a significant reduction in the prevalence of xerophthalmia in the experimental group (P<0.01).

After 11 months of MSG-A marketing, the prevalence of xerophthalmia in the experimental area was 0.19 % and in the control

area it was 1.11 %. With the T-Test calculation, which had been corrected, there was a significant reduction in the prevalence of xerophthalmia in the experimental group (P<0.001).

Graph 1 illustrates the changes in the prevalence of xerophthalmia for both the experimental and control groups. The changes in the X1A prevalence determined from the cross-sectional data, can be seen in Table 9.

Table 9. The Prevalence of X1A Sufferers Before and After the Marketing of MSG-A (Cross-Sectional)

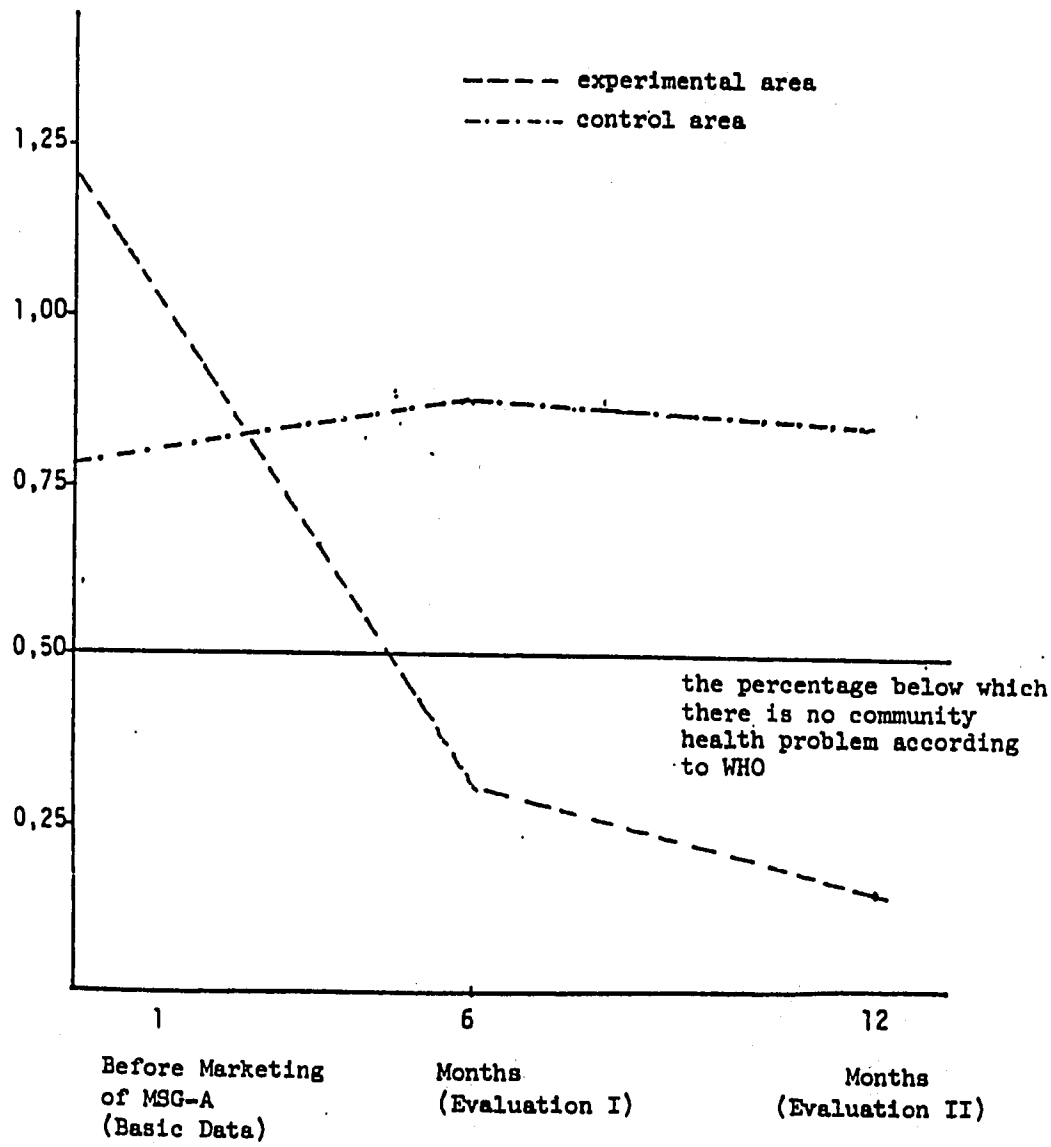
Group	Period	N	X1A Prevalence (%)
Experimental	Basic Data	3803	0.60
	Evaluation I	4059	0.34
	Evaluation II	4065	0.25
Control	Basic Data	4135	0.89
	Evaluation I	4115	0.73
	Evaluation II	4400	0.50

From the above table it can be seen that the prevalence of X1A sufferers before the marketing of MSG-A in the experimental group was 0.60 % and in the control group 0.89 %. After the marketing had continued for 5 months, the X1A prevalence in the experimental group was 0.34 % and in the control group 0.73%.

The T-Test calculation, which was corrected, revealed a P>0.05 result, which was insignificant.

After 11 months of MSG-A marketing, the X1A prevalence in the experimental group was 0.25 % while in the control group it was 0.50 %. The results of the corrected proportional test, comparing the basic and second evaluation data, were also insignificant (P>0.05).

Graph 1. Changes in the Prevalence of Xerophthalmia



The results of the cohort data on the prevalence of XIA sufferers can be seen in Table 10.

Table 10. The Prevalence of XlA Sufferers Before and After the Marketing of MSG-A (cohort)

Group	Period	N	XlA Prevalence (%)
Experimental	Basic Data	2102	0.38
	Evaluation I	2102	0.33
	Evaluation II	2102	0.29
Control	Basic Data	2169	0.60
	Evaluation I	2169	0.78
	Evaluation II	2169	0.65

From the table it can be seen that the prevalence of XlA sufferers before the marketing of MSG-A in the experimental group was 0.38 % and in the control group 0.60 %. After 5 months of the MSG-A marketing, the XlA prevalence in the experimental group was 0.33 % while in the control group it was 0.78 %. The T-Test calculation, which had been corrected, revealed that $P>0.05$, quite insignificant.

After 11 months of MSG-A marketing, the prevalence of XlA in the experimental group was 0.29 % while in the control group it was 0.65 %. The results were, in fact, insignificant at $P>0.05$.

For the prevalence of shortsightedness (XN), no acurate data were obtained because quite a number of children examined were not accompanied by their parents. Thus, neither the child nor mother who brought the child was able to answer the questions asked.

5. Children's Nutritional State Based on Body Measurement

The "cross sectional" data, which consisted of the results of checks on body weights at the beginning of the study and after the marketing of MSG-A, can be seen in Table 11.

Table 11. The Nutritional State of Pre-School Children Before and After the Marketing of MSG-A, Based on Body Weight/Age (Cross-Sectional)

Group	Period	N	Nutritional State					
			Good Nutrition		Lack of Nutrition		Poor Nutrition	
			n	%	n	%	n	%
Experimental	Basic Data	809	432	55.9	334	41.3	23	2.8
	Evaluation I	824	463	56.2	340	41.3	21	2.5
	Evaluation II	729	449	61.6	262	36.0	18	2.4
Control	Basic Data	868	425	49.0	410	47.2	33	3.8
	Evaluation I	864	395	45.7	425	49.2	44	5.1
	Evaluation II	788	448	56.8	315	40.0	25	3.2

From the table above it can be seen that in the experimental group the prevalence of good nutrition was 55.9 %, lack of nutrition was 41.3 % and poor nutrition 2.8 %, while in the control group there was a 49.0 % prevalence of good nutrition, 47.2 % of lack of nutrition and 3.8 % poor nutrition. After the MSG-A had been marketed for 5 months in the experimental area, the prevalence of good nutrition was 56.2 %, lack of nutrition 41.3 % and poor nutrition 2.5 %. For the control group, the prevalances were 45.7%, 49.2% and 5.1%, respectively. Thus, the prevalence of good nutrition in the experimental group had a tendency to increase after 5 months, while in the control group it decreased. However, after testing using the proportional test (T-Test), the result of $P>0.05$ was found to be

insignificant. The prevalence of lack of nutrition in the experimental group remained the same while in the control group there was an increase. However, after testing using the proportional test (T-Test), the result of P>0.05 was found to be insignificant. The prevalence of poor nutrition in the experimental group decreased while in the control group there was an increase. However, after testing using the proportional test (T-Test), with correction, the increases and decreases (P>0.05) were found to be insignificant.

The results of the proportional test (T-Test) after 11 months of marketing the MSG-A were insignificant (P>0.05) for the prevalence of good nutrition, lack of nutrition and poor nutrition.

The cohort data, based on body weight/age, can be seen from Table 12.

Table 12. The Nutritional State of Pre-School Children Before and After the Marketing of MSG-A, Based on Body Weight/Age (Cohort)

Group	Period	N	Nutritional State					
			Good Nutrition		Lack of Nutrition		Poor Nutrition	
			n	%	n	%	n	%
Experimental	Basic Data	360	200	55.5	151	42	9	2.5
	Evaluation I	360	193	53.6	160	44.4	7	2
	Evaluation II	360	219	60.8	136	37.8	5	1.4
Control	Basic Data	328	160	48.8	156	47.6	12	3.7
	Evaluation I	328	151	46	160	50	15	4
	Evaluation II	328	176	53.6	145	44.2	7	2.1

Data in Table 12 reveal that there was a 55.5 % prevalence of good nutrition at the beginning of the study in the experimental group while in the control group, it was 48.8 %. The prevalence of lack of nutrition in the experimental group was 42 % and in the control group

it was 47.6%. The prevalence of poor nutrition in the experimental group was 2.5 % and in the control group 3.7 %.

The proportional test (T-Test) revealed that the difference between the prevalence of good nutrition in the experimental and control groups for the basic data and after 5 months of MSG-A marketing was insignificant at P>0.05. In addition, there was an increase, although insignificant, at P>0.05, if the basic data are compared with Evaluation II.

The change in nutritional status among pre-school children after 11 months of MSG-A marketing in both groups was found to be insignificant after the T-Test was calculated.

After 5 months of MSG-A marketing, the result of the proportional T-Test for the prevalence of lack of nutrition also did not reveal significant differences. This was also the case if the basic data are compared with Evaluation II. A reduction can be seen for both groups, but after testing with the proportional test (T-Test), it was found to be insignificant (P>0.05). The result of the proportional test (T-Test) after 11 months of MSG-A marketing was also insignificant.

The result of the proportional test (T-Test) for the prevalence of poor nutrition between the basic data and Evaluation I was insignificant (P>0.05) for both the experimental and the control groups. This was also the case between the basic data and Evaluation II. The result of the proportional test (T-Test) after 11 months was also insignificant (P>0.05)

The "cross-sectional" data based on body weight/height can be seen from Table 13.

From Table 13, it can be seen that in the experimental group the prevalence of good nutrition was as high as 77.5 %, lack of nutrition 21 % and poor nutrition 1.5 % when basic data were collected. In the control group, the prevalence of good nutrition was 65.9 %, lack of nutrition 32.7 %, and poor nutrition 1.4 %. After 5 months of MSG-A marketing, the prevalence of good nutrition in the experimental group was 74.4 %, lack of nutrition 25 %, and poor nutrition was 0.6 %.

The result of the proportional test (T-Test) between both the experimental and control groups did not show a significant difference ($P>0.05$). This was also the case between the basic data and Evaluation I.

After 11 months of MSG-A marketing in the experimental group, the prevalence of good nutrition rose to 83.3 %, lack of nutrition fell to 16.7 % and there was no further incidence of poor nutrition. For the control group, the good nutrition prevalence rose to 79.4 %, lack of nutrition decreased to 19.8 % and poor nutrition decreased to 0.8 %.

The result of the proportional test (T-Test) between the experimental and control groups after 11 months of marketing also did not reveal a significant difference ($P>0.05$).

The cohort data, consisting of the results of anthropometric tests stated in body weight/body height, can be seen in Table 14.

Table 13. The Nutritional State of Pre-School Children Before and After the Marketing of MSG-A, Based on Body Weight/Body Height (Cross Sectional)

Group	Period	N	Nutritional State					
			Good Nutrition		Lack of Nutrition		Poor Nutrition	
			n	%	n	%	n	%
Experimental	Basic Data	809	627	77.5	170	21	12	1.5
	Evaluation I	824	533	74.4	286	25	5	0.60
	Evaluation II	729	607	83.3	122	16.7	0	0.0
Control	Basic Data	868	572	65.9	281	32.7	12	1.4
	Evaluation I	864	612	70.8	235	27.2	17	2
	Evaluation II	788	626	79.4	156	19.8	6	0.8

Table 14. The Nutritional State of Pre-School Children Before and After the Marketing of MSG-A, Based on Body Weight/Body Height (Cohort)

Group	Period	N	Nutritional State					
			Good Nutrition		Lack of Nutrition		Poor Nutrition	
			n	%	n	%	n	%
Experimental	Basic Data	360	281	78.1	74	20.6	5	1.4
	Evaluation I	360	261	72.5	96	26.7	3	0.8
	Evaluation II	360	297	82.5	63	17.5	0	0.3
Control	Basic Data	328	223	68.0	103	31.4	2	0.6
	Evaluation I	328	235	71.7	91	29.1	4	1.2
	Evaluation II	328	255	77.7	71	21.7	2	0.6

In the above table it can be seen that the prevalence of good nutrition in the experimental group 78.1 %, lack of nutrition 20.6 %, and poor nutrition 1.4 %. In the control group the prevalence of good nutrition was 68.0 %, lack of nutrition 31.4 % and poor nutrition 0.6 %. After 5 months of marketing MSG-A the prevalence of good nutrition in the experimental group was 72.5 %, lack of nutrition 26.7 %, and poor nutrition 0.8 %. In the control group the prevalence of good nutrition was 71.7 %, lack of nutrition 29.1 % and poor nutrition 1.2 %. The prevalence of poor nutrition in the

experimental group decreased while in the control group it rose. The result of the proportional test (T-Test) of the change was insignificant (P>0.05).

After 11 months of MSG-A marketing, the prevalence of good nutrition in the experimental group rose to 82.5 %, lack of nutrition declined to 17.2 %, and poor nutrition declined to 0.3 %. For the control group, the prevalence of good nutrition increased to 77.7 %, lack of nutrition declined to 21.7 %, and poor nutrition returned to 0.6 %. The proportional test result (T-Test) for each nutritional status in the experimental group compared to the control group was insignificant (P>0.05).

Children's nutritional state based on body weight/age differed from that based on body weight/body height. Bearing in mind that the nutritional state based on body weight/body height is a better measurement than one based on body weight/age, this difference indicates that when some pre-schoolers' body height does not increase as it should, this can be referred to as "stunted growth."

6 Disease Prevalence

The prevalence of diseases before and after the marketing of MSG-A can be seen in Table 15 (cross-sectional data) and Table 16 (cohort data).

Of the various kinds of diseases suffered by pre-school children at the time of the study, the only significant difference found was between the basic data and Evaluation I for upper respiratory tract infections. When the basic data were compared with Evaluation II no significant differences were found, which could be attributed to the

Table 15. The Prevalence of Diseases Before and After the Marketing of HSG-A (Cross-Sectional)

Group	Period	N	Diseases											
			Eye Infections		Upper Respiratory Track Infections		Skin Diseases		Digestive System Diseases		Measles		Diarrhea	
			N	%	N	%	N	%	N	%	N	%	N	%
Experimental	Basic Data	3803	87	2.29	480	12.62	159	4.18	111	2.92	25	0.66	128	3.37
	Evaluation I	4059	40	0.99	153	3.77	153	3.77	158	3.89	8	0.20	137	3.38
	Evaluation II	4065	50	1.23	682	16.80	157	3.86	253	6.20	-4	0.10	200	4.92
Control	Basic Data	4135	103	2.49	457	11.05	153	3.70	166	4.00	20	0.48	177	4.28
	Evaluation I	4115	60	1.46	645	15.60	172	4.20	149	3.62	13	0.32	167	4.06
	Evaluation II	4400	60	1.36	632	14.40	196	4.45	252	6.73	4	0.10	200	4.54

Table 16. The Prevalence of Diseases Before and After the Marketing of MSG-A (Cohort)

Experimental	Basic Data	2102	45	2.14	264	12.60	159	4.18	111	2.92	25	0.66	128	3.37
	Evaluation I	2102	17	0.80	258	12.30	153	3.77	158	3.89	8	0.20	137	3.38
	Evaluation II	2102	26	1.20	373	17.80	157	3.86	253	6.20	4	0.10	200	4.92
Control	Basic Data	2169	56	2.60	263	12.10	85	3.92	91	4.20	114	4.19	177	4.28
	Evaluation I	2169	31	1.43	353	16.40	89	4.10	74	3.41	78	2.87	167	4.06
	Evaluation II	2169	29	1.43	319	14.70	101	4.66	118	5.40	117	4.30	200	4.54

fact that only "point prevalence" data were collected; thus, many of the instances of illness throughout the year were not noted.

7. The Results of Vitamin A (Retinol) Serum Analysis

The results of the vitamin A serum analysis, before and after the marketing of MSG-A, can be seen for the cross-sectional data in table 17.

From this table it is obvious that the vitamin A serum in pre-school children in the experimental group at the beginning of the study was 19.3 ± 9.35 ug/dl, and after the MSG-A had been marketed for 5 months, it rose significantly to 22.4 ± 9.20 ug/dl (P<0.01). After the MSG-A had been marketed for 11 months, the vitamin A serum in pre-school children rose to 26.3 ± 9.52 ug/dl, indicating a very significant increase from the basic data (P<0.01).

Table 17. The Average Retinol Serum Before and After the MSG-A Marketing (Cross-Sectional)

Group	Period	N	Vit A Serum X ± SD	! P
Experimental	Basic Data	205	19.3 ± 9.35	<0,01**
	Evaluation I	258	22.4 ± 9.20	<0,01**
	Evaluation II	217	26.3 ± 9.52	
Control	Basic Data	240	22.5 ± 9.95	<0,05*
	Evaluation I	289	20.2 ± 8.60	<0,05*
	Evaluation II	290	20.5 ± 9.42	

** Very significant increase
* Significant decrease

In the control group, the average vitamin A serum at the beginning of the study was 22.5 ± 9.95 ug/dl, after 5 months (Evaluation I) it fell to 20.2 ± 8.60 ug/dl ; thus there was a

significant decrease. After 11 months of MSG-A marketing (Evaluation II), the vitamin A serum of pre-school children was 20.5 ± 9.42 ug/dl ; if compared with the basic data there was a significant reduction ($P<0.05$).

The effect of fortifying MSG with vitamin A on the shift in vitamin A serum levels for both the experimental and control groups for these data is shown in Table 18.

Table 18. The Effect of Fortifying MSG on the Shift in Vitamin A Serum Value (Cross-Sectional)

Group	Period	N	<10 ug/dl		10-19 ug/dl		20 ug/dl	
			N	%	N	%	N	%
Experi-mental	Basic Data	205	21	10.2	78	38.0	106	51.8
	Evaluation I	258	10	3.9	93	36.3	155	60.1
	Evaluation II	217	8	3.7	56	25.8	153	70.5
Control	Basic Data	240	22	9.2	93	38.8	125	52.0
	Evaluation I	289	29	10.0	121	41.9	139	48.1
	Evaluation II	290	30	10.3	115	39.7	145	50.0

The above table gives a picture of the distribution of vitamin A serum status in pre-school children in both groups under study. A child with a vitamin A serum level of < 10 ug/dl was classified as being deficient, between 10-19 ug/dl was classified as being low in vitamin A serum, and 20 or more ug/dl was classified as having sufficient vitamin A serum. The spread of vitamin A serum status, whether in the deficient, low or sufficient categories before the marketing of MSG-A, did not differ greatly between the experimental and the control groups. In the experimental group the percentages of children having a deficient, low or sufficient vitamin A serum level were 10.2 %, 38.0 % and 51.8 % respectively. In the control group the percentages were 9.2 %, 38.8 % and 52.0 %, respectively.

After 5 months of MSG marketing, there had been a shift to a better vitamin A serum status. In the experimental group, the percentage of those with deficient vitamin A serum fell to 3.9 %, and those with low vitamin A serum fell to 36.3 %, while the percentage of those with sufficient vitamin A rose to 60.1 %. The above shift was significant at $P<0.05$.

After 11 months of MSG-A marketing in the experimental group, the prevalence of those with deficient vitamin A serum status fell to 3.7 %, low vitamin A status fell to 25.8 % and those with sufficient vitamin A status rose to 70.5%. It would thus appear that there had been a shift from low vitamin A status to sufficient vitamin A status. In the control group, the percentage with deficient vitamin A serum status was 10.3 %, low vitamin A status was 39.7 % and sufficient vitamin A status was 50.0 %. Graphs 2 and 3 illustrate the shift in the vitamin A serum distribution in both the experimental and control groups.

The cohort data consist of the results of the vitamin A serum analysis. Data after 11 months of marketing MSG-A could not be compared, as many parents objected to blood tests being performed on their children at the second and third health examinations. Nevertheless, for the basic data and results of Evaluation I, the data on the vitamin A serum levels of pre-school children could be compared.

Table 19 shows the cohort data, consisting of the results of the vitamin A serum analysis at baseline and after 5 months of MSG-A marketing.

Table 19. The Average Vitamin A Serum Before and After the MSG-A Marketing (Cohort)

Group	Period	N	Vit A Serum X ± SD	P
Experimental	Basic Data	156	18.1 ± 8.25	
	Evaluation I	156	21.7 ± 8.77	<0,01**
Control	Basic Data	191	20.7 ± 9.58	
	Evaluation I	191	21.0 ± 8.19	>0,05(TS)

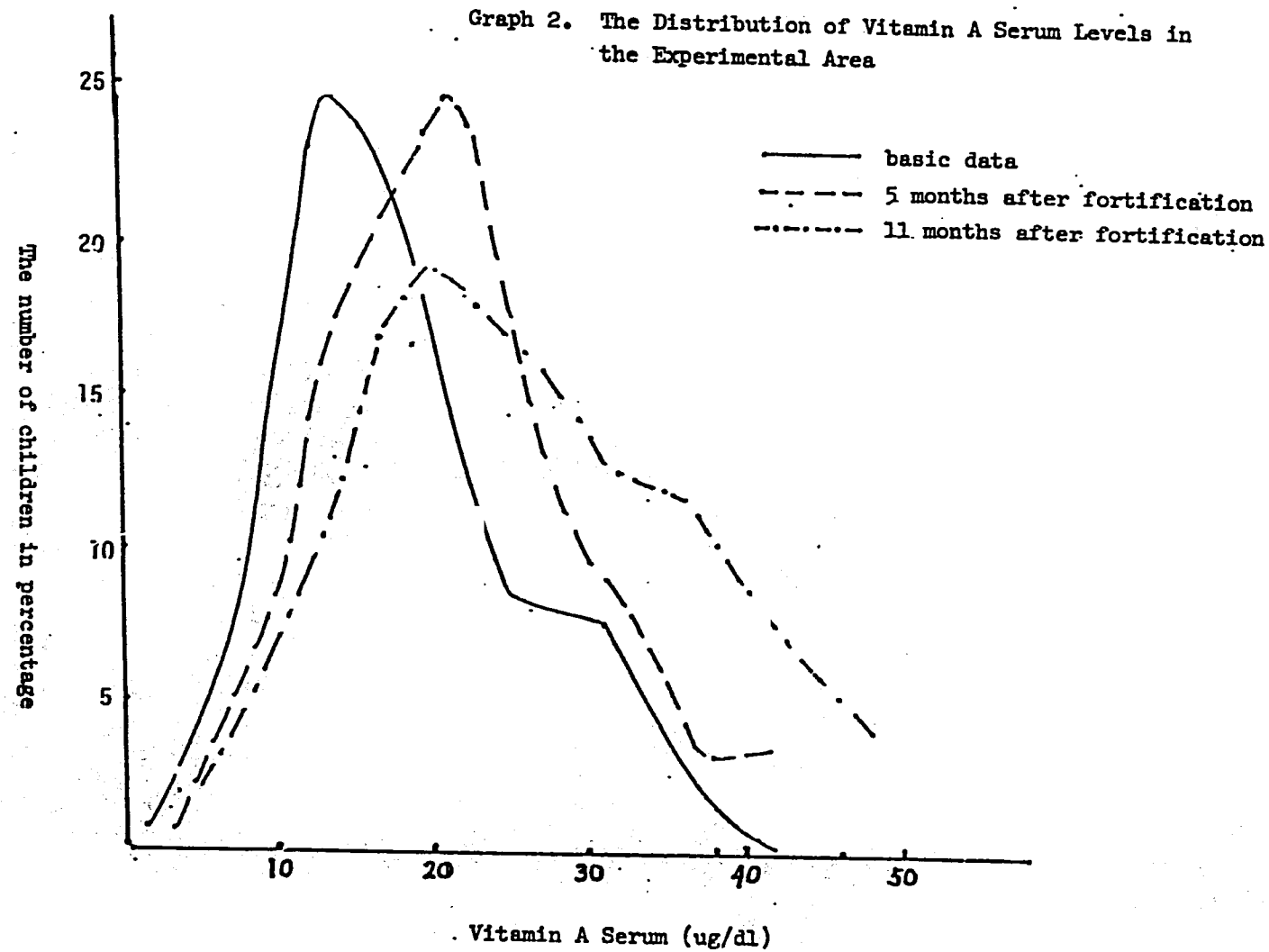
From the table above it can be seen that the vitamin A serum level in the basic data for the experimental group was 18.1 ± 8.25 ug/dl. For the control group it was 20.7 ± 9.58 ug/dl.

After 5 months of MSG-A marketing, in the experimental group, there was a most significant increase in vitamin A serum to 21.7 ± 8.77 ug/dl ($P<0.01$). In contrast, in the control group there was a slight increase, of little significance, to 21.0 ± 8.19 ug/dl ($P>0.05$).

The effect of fortifying MSG-A on the shift of vitamin A serum in the experimental and control groups, for the cohort data, can be seen in Table 20.

Table 20 reveals that there was a shift in the vitamin A status of pre-school children towards a higher value for the experimental group, while for the control group the shift that occurred was insignificant. The shift in the vitamin A serum levels in these cohort data is significant at $P<0.05$ for the experimental group.

Graph 2. The Distribution of Vitamin A Serum Levels in the Experimental Area



Graph 3. The Distribution of Vitamin A Serum Levels in the Control Area

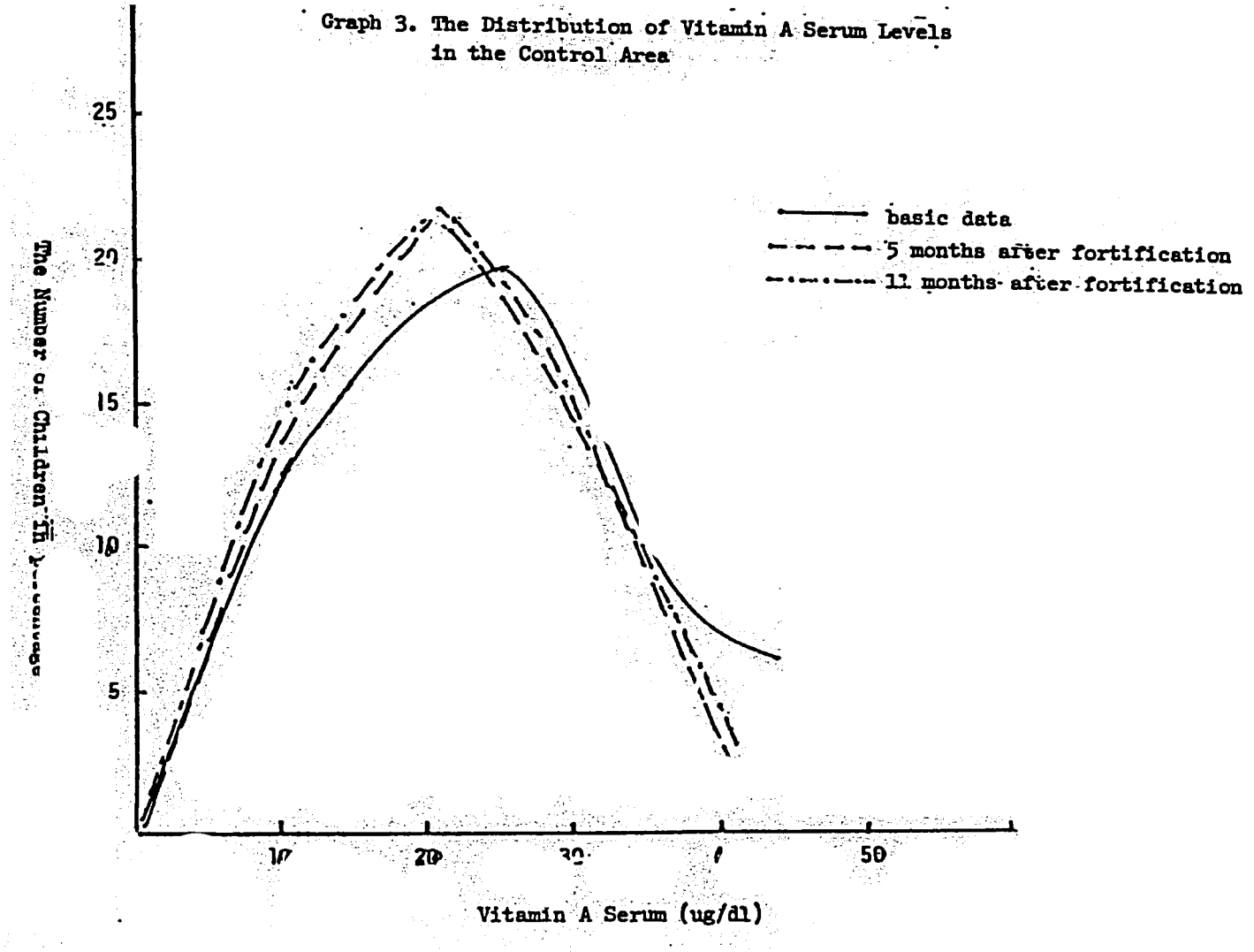


Table 20. The Effect of Fortifying MSG on the Shift of Vitamin A Serum Levels (Cohort)

Group	Period	N	<10 ug/dl		10-19 ug/dl		>20 ug/dl	
			N	%	N	%	N	%
Experimental	Basic Data	156	20	12,8	78	50,0	58	37,2
	Evaluation I	156	7	4,5	65	41,7	84	53,8
Control	Basic Data	191	22	11,5	74	38,7	95	49,7
	Evaluation I	191	18	9,4	81	42,4	92	48,2

8. The Results of the Test of Vitamin A Levels in Breast Milk

The results of the analysis of vitamin A levels in breast milk from the experimental group at the beginning of the study were 17.31 ± 8.43 ug/dl. Five months after the marketing of MSG-A, the vitamin A level in breast milk rose significantly to 19.11 ± 7.83 ug/dl ($P>0.05$). Eleven months after the marketing of the MSG-A, the vitamin A serum level in breast milk was 19.20 ± 8.74 ug/dl. The last result indicates that the vitamin A in breast milk rose significantly ($P<0.025$).

In the control group, the level of vitamin A in breast milk at the beginning of the study was 17.58 ± 12.77 ug/dl. Five months after the marketing of MSG-A, the vitamin A content in breast milk decreased insignificantly to 16.74 ± 9.93 ug/dl ($P>0.05$) and at the end of the study was 16.65 ± 5.84 ug/dl, of no significant difference when compared to the previous level of ($P>0.05$). The overall results can be seen in Table 21.

). The Results of the Hemoglobin Tests

The cross-sectional data results for the hemoglobin tests before and after the marketing of the MSG fortified with vitamin A can be seen in Table 22.

Table 21. Results of the Analysis of Vitamin A Levels in Breast Milk in the Experimental and Control Groups

Period	GROUP							
	Experimental				Control			
	N	X ± SD	t	P	N	X ± SD	t	P
Basic Data	178	17.31 ± 8.43			200	17.58 ± 12.77		
Evaluation I	218	19.11 ± 7.83	2.20	> 0.05*	245	16.47 ± 9.93	1.01	> 0.05
Evaluation II	263	19.20 ± 8.74	2.28	< 0.025*	192	16.65 ± 5.84	0.93	> 0.05

* indicates a significant increase

Table 22. The Average Hb Levels in Pre-school Children Before and After the Marketing of MSG Fortified with Vitamin A (Cross-Sectional)

Group	Period	N	Hb Level Average ± SD	P
			g/dl	
Experimental	Basic Data	205	11.3 ± 1.55	< 0,01*
	Evaluation I	258	12.3 ± 1.59	
	Evaluation II	217	12.1 ± 1.34	< 0,01*
Control	Basic data	240	11.4 ± 1.58	> 0,05 (TS)
	Evaluation I	289	11.2 ± 1.48	
	Evaluation II	290	11.4 ± 1.39	

* indicates a significant increase and TS = insignificant

From the above table it can be seen that the hemoglobin levels in pre-school children before the marketing of the MSG fortified with Vitamin A in the experimental group was 11.3 ± 1.55 g/dl and in the control group it was 11.4 ± 1.58 g/dl. The differences in hemoglobin

levels between the experimental and control groups in the basic data were insignificant (P>0.05). After 5 months of MSG-A marketing (Evaluation I), the hemoglobin levels of under-5 year olds in the experimental group were 12.3 ± 1.59 g/dl. When compared with the basic data, the increase was significant (P<0.001). After 11 months of MSG-A marketing (Evaluation II), their hemoglobin level was 12.1 ± 1.34 g/dl, an insignificant decrease if compared with Evaluation I (P>0.05), but if compared with the basic data there was still a significant increase of (P<0.001).

For the control group, in Evaluation I, the hemoglobin levels were 11.2 ± 1.48 g/dl, an insignificant decrease of P>0.05. At the second evaluation, the hemoglobin levels were 11.4 ± 1.39 g/dl, the same as the basic data, also indicating an insignificant increase.

If the results of Evaluation I for the experimental group are compared with the results of Evaluation I for the control group, there is a significant difference (P<0.001). This was also the case after 11 months of MSG-A marketing. The average Hb in under 5-year olds from the experimental area was 12.1 ± 1.34 g/dl and in the control area 11.4 ± 11.4 g/dl. The difference, at P<0.001, was significant. The cohort data, consisting of the results of hemoglobin testing before and after the marketing of MSG-A, could only be used for the basic data and Evaluation I because in Evaluation II, most children refused to have blood tests done. The data can be seen in Table 23.

From Table 23 it can be seen that the hemoglobin levels of under 5 year olds in the experimental group before the marketing of MSG

fortified with vitamin A was 11.4 ± 1.55 g/dl, and in the control area it was 11.3 ± 1.52 g/dl. The average Hb levels before the second marketing in the experimental and control groups were nearly the same and the difference was insignificant (P>0.05). After 5 months of MSG-A marketing (Evaluation I), the average hemoglobin levels of pre-school children in the experimental group was 12.4 ± 1.64 g/dl. When compared with the basic data, this was a significant increase (P<0.01).

For the control group where the MSG-A was not marketed, the average Hb level at the basic data was 11.3 ± 1.52 g/dl. After 5 months (Evaluation I), the average Hb level was 11.1 ± 1.44 g/dl, indicating an insignificant decrease (P>0.05).

Table 23. The Average Hb Levels in Pre-School Children Before and After the Marketing of MSG Fortified with Vitamin A (Cohort)

Group	Period	N	Average Hb Levels of Hb ± SD	P
			g/dl	
Experimental	Basic Data	163	11.4 ± 1.55	< 0,01*
	Evaluation I	163	12.4 ± 1.64	
Control	Basic data	191	11.3 ± 1.52	> 0,05 (TS)
	Evaluation I	191	11.1 ± 1.44	

* indicates "most significant" and TS indicates "insignificant"

10. <u>The Mortality Rates for Infants and Children Under 5 Years Old</u>

In the experimental group there were 157 deaths, consisting of 96 infant deaths and 61 deaths of children under 5 years old. In the control group there were 195 deaths, consisting of 111 infant deaths and 84 deaths of children under 5 years old (see Table 24).

The number of infants in the experimental and control groups were 1,199 and 1,134, respectively. Thus, the rough infant mortality rate in the experimental area was 80.1 %, while for the control area it was 97.9 %. The infant mortality rate in the control group was roughly 1.22 times that of the experimental group.

The number of 1-5 year olds in the experimental group was 4,556, while in the control group the number was 4,311. Thus, the mortality rate for children age 1-5 in the experimental group was 13.4 % and for the control group it was 19.4 %, 1.45 times that in the experimental group. The infant mortality rates in both the experimental and control groups were tested with the proportional test (T-Test) and were not found to be significantly different at ($P>0.1$).

With a similar test it was found that the infant mortality rate in the experimental group was significantly lower than that of with the control group ($P<0.05$).

Table 24. The Infant and Pre-School Child Mortality Rates in the Experimental and Control Groups

Group	Deaths		Births			
	Infants	Under-Five	Infants	Under-5	AKB*	AKBAL**
Experimental	96	61	1199	4556	80.1%	13.4%
Control	111	84	1134	4311	97.9%	19.5%

AKB* - Infant Mortality Rate
AKBAL** - Under-Five Mortality Rate

The causes of death stated were not based on anything definite, ıking it difficult to know the exact nature of the illnesses causing ıath. The causes of infant deaths in the experimental and control

groups were more or less the same, except that there was a greater incidence of deaths due to convulsions in the control group (14.4 %) than the experimental group (3.1%) as can be seen from Table 25.

Table 25. Reasons Given for Infant Mortality in the Experimental and Control Groups

Reasons Given	Experimental Group N	Experimental Group %	Control Group N	Control Group %
Fever	86	89.6	83	74.8
Convulsion	3	3.1	16	14.4
Cough	1	1.0	0	0
Diarrhea	2	2.1	3	2.7
Blueness	4	4.1	7	6.3
Infection of brain	0	0	2	2

The causes of death in under-five year olds in the experimental and control areas were relatively similar. In the experimental group, the reason given for 80.3 % of deaths was fever while in the control group it accounted for 91.7 %. The results can be seen in Table 26.

Table 26. Reasons Given for Pre-School Child Mortality in the Experimental and Control Groups

Reasons Given	Experimental Group N	Experimental Group %	Control Group N	Control Group %
Fever	49	80.3	77	91.7
Convulsion	1	1.6	1	1.2
Cough	3	4.9	0	0
Diarrhea	6	10	4	4.8
Others	2	4.5	2	2.3
Total	61	100	84	100

DISCUSSION

The general conditions, socioeconomic conditions, sanitation, education levels, and occupations of the inhabitants in the villages constituting the experimental group were relatively the same as those of the control group. Thus, the effects of those factors in the vitamin A deficiency problem were the same for both groups.

The results of the survey on food consumption, in general, were beneficial only in giving an idea of the consumption of nutritional substances. It was very difficult to obtain data on consumption that would give some idea of what people ate, on the average, for one whole year. For this reason, it was difficult to draw any conclusions on whether there was any connection between the status of nutrition and the status of vitamin A according to people's consumption of nutritional substances. West (10) endeavored to relate the results of the survey on vitamin A consumption with the xerophthalmia status and, in fact, found that both specificity and sensitivity were very low. The results of the survey on consumption in this study show that the consumption of vitamin A substances among xerophthalmia sufferers was not significantly different to that of non-sufferers. That there was no difference in vitamin A consumption in either group under study strengthens the original belief that vitamin A consumption is not a factor which has an influence on the difference in vitamin A status.

The prevalence of Bitot's Spot in the experimental group showed a marked decrease. This decrease continued in the second evaluation.

The main aim of the program to combat vitamin A deficiency is to reduce the prevalence of xerophthalmia so that it no longer constitutes a community health problem.

The prevalence being referred to is less than 0.5 %, if Bitot's Spot (X1B) is used as a basis for determining xerophthalmia.

In this study, 5 months after the MSG-A was marketed, the prevalence of Bitot's Spots in the experimental group decreased from 1.24 % to 0.32 %. From a statistical viewpoint, this decrease is most significant. From a community health perspective, this prevalence would suggest that vitamin A deficiency in the experimental area no longer constituted a community health problem. What was unexpected in this research was that evidence of the prevalence of early xerophthalmia in the experimental group (1.24%) was markedly higher that that in the control group (0.77%). The bias in this difference was eliminated by the following considerations: (i) the investigation was done three times in a one-year period so that the influence of seasonal variations could be neutralized; (ii) the differences found using the proportional (T-Test) had already taken into consideration the changes that had occurred in both the experimental and control groups; (iii) the consumption of nutritional substances did not differ significantly between the two groups; and (iv) the cohort data on the same children examined 3 times in succession also revealed a sharp decline in the prevalence of xerophthalmia in the experimental group (this was definitely due to the extra consumption of vitamin A which had been added to MSG, as the factors identified above did not differ between either group).

The prevalence of lack of nutrition and poor nutrition at the beginning of the study and after the marketing of MSG-A to the experimental group did not differ markedly from the control group. This was due to the fact that, in the control group, there was also a shift in the direction of prevalence of good nutrition. It is believed that the greater efforts on the part of the nutrition cadres during the research period and the continuity maintained in the monthly weighing of the under-five olds in both the experimental and control groups led to a shift towards better nutrition status. The results of other studies by the Center for the Research and Development of Nutrition (Puslitbang Gizi) indicate that the intervention of vitamin A had a marked effect on the shift towards better nutrition status at the $P<0.10$ level (12) (13).

The vitamin A serum levels in the experimental group after the MSG-A had been marketed, as seen from the cohort and "cross sectional" data, experienced a significant increase. This increase continued into the second evaluation period (11 months after the marketing of MSG-A commenced).

Similar findings, that is, a marked increase in vitamin A serum levels, were revealed in other studies by Arroyare in Guatemala (14), who used sugar as a base for fortification, Husaini in Indonesia (12) who used salt as a base and Solon et al. (15) in the Philippines, who used MSG as a base for vitamin A fortification. The results of the research by Solon et al. (15) and Husaini (12) indicated that the increase in vitamin A serum levels of the group receiving food fortified with vitamin A was greater than that in the group receiving high doses of vitamin A. The calculated amount of vitamin A reaching

a child through the fortification method in this research was only 500 IU per child per day while in other studies, 1000-1500 IU reached each child per day. The fall in the prevalence of xerophthalmia and the rise of the vitamin A serum reveal that an additional amount of around 500 IU per child per day is sufficient to make up for the lack of vitamin A consumption in daily food intake. The reasons put forward in favor of this low amount are (i) the vitamin A obtained from the fortification process is merely additional to the consumption of vitamin A in daily food intake (considered to be already marginal); (ii) an increase of only 3000 IU vitamin A/gram MSG (compared with 7500 IU per gram MSG in the Philippines) can reduce the problems related to cost and yellow color due to the vitamin A, which is yellow while, MSG is white. Because MSG producers object to the yellow color imparted by the vitamin A, there is a need to develop the appropriate technology to eliminate yellowing, which is not easy to do. Although steps have already been taken to achieve this, the process needs to be improved so that the effects of the yellow color of Vitamin A can be eliminated.

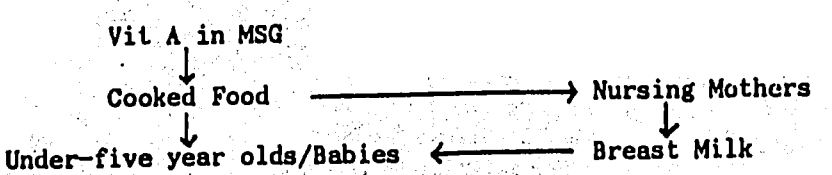
The results of the MSG consumption survey in the research area were slightly lower than the results of previous research in other areas. Research into this type of consumption in various villages in 5 provinces has shown that the average MSG consumption is 0.60 grams per day per adult and 0.20 grams per day for under-five year olds (16). The results of the survey on MSG consumption in the research area indicate that the average consumption of MSG is 0.4 grams per day per adult and 0.21 - 0.24 grams per day per under-five year old. The MSG consumption according to all age groups in Indonesia,

however, is 57-60 mg/person/day (Attachment 11). In spite of the fact that the MSG consumption per day is lower in this survey than earlier surveys, when one views the decrease in the prevalence of xerophthalmia and the increase in vitamin A serum levels, it is obvious that the amounts of vitamin A added to MSG are sufficient to eliminate any lack of vitamin A originating from food consumption.

The results of the vitamin A analysis at the street foodstall level show that vitamin A retention after one month of marketing was 2650 IU per gram. When compared with the results of previous studies, where the level after one month was around 2900 IU/g, and household survey which received 2800 IU/g, it can be stated that the mixing of vitamin A with MSG has not yet produced a homogeneous product. The retention of vitamin A, as found in samples taken 4 months after marketing began, was better that that reported in the earlier study, at around 84 %. The whole fortification process was carried out by the SASA factory workers alone, without any supervision from the research team. When we observed the vitamin A retention rates in samples taken from street foodstalls and households, it became obvious that the fortification process had been carried out very well by the factory. The homogeneity problem is one which needs to be handled by perfecting the fortification technology.

The vitamin A added to MSG was consumed not only by under-five year olds but also by other family members, including nursing mothers. The results of earlier studies on the levels of vitamin A in the breast milk of nursing mothers, as well as the results of this study show that, in general, the levels are low.

ıpplementary high doses of vitamin A can increase the vitamin A level of breast milk for up to 3 months, however, it then falls again after 6 months (17). The vitamin A level in breast milk in the experimental group after 5 months and 11 months of MSG marketing showed marked increases when compared with both the baseline data and data on vitamin A levels in breast milk of the control group over the same period of time. This increase in the vitamin A level of breast milk constituted an increase in vitamin A consumption which was very easily absorbed by babies being breast fed. Thus, vitamin A added to MSG was conveyed directly through the family's food, to which MSG-A had been added, and through breast milk, as per the diagram below:



The Hb levels in under-five year olds in the experimental group, after the MSG-A marketing, rose significantly. This increase in Hb levels as a result of adding vitamin A has also been observed by other researchers, including Husaini (12), Muhilal et al. (13) and Hodges et al. (18). Hodges et al. (18) reported that the condition of volunteers who became anemic after having been given diets low in vitamin A could only be corrected by administering vitamin A; administering iron did not help. Evidence from many studies showed that the intervention of vitamin A can rectify an anemic condition. Thus the program to combat a vitamin A deficiency has been beneficial not only in controlling xerophthalmia but also in controlling anemia.

The mortality rate of under-five year olds in the experimental area, during the period of this study, was markedly lower than in the

control area. It is difficult to conclude whether this low death rate was due to the consumption of vitamin A added to MSG or due to other factors. Such factors, among others, would be patterns of illness, sanitation, health services, education, socioeconomic conditions and the mortality rate of under-five year olds in the previous year. The data on these other factors, as already mentioned above, were relatively similar for both groups. The actual cause of death, however, was difficult to determine because the families merely knew certain symptoms. Efforts to obtain data on under-five-year old deaths in the previous year were also unsuccessful as the majority of families and Neighborhood Association Heads could no longer remember the details. Thus, with all of its weaknesses, the argument could be put forward that administering vitamin A by means of fortification has played a role in reducing the mortality rate in the under-five year olds observed. A similar finding was observed in a study in Aceh Province where high doses of vitamin A were distributed. Here, the mortality rate in under-five year olds was 11.1 o/oo compared with 14.5 o/oo for areas where vitamin A was not distributed (19). Sommer (20) also reported that the risk of death for people suffering from a vitamin A deficiency was marginally higher than for non-sufferers. These facts have led to the recent strong belief that the vitamin A intervention probably did not merely prevent blindness but also was instrumental in reducing the death rate.

The cost of fortificaton was calculated from the cost of the materials and other facilities used in the fortification process. The cost of materials used in fortification, according to the calculations in Attachment 10, was around 17 - 20 %. The increase in

cost due to fortification is relatively much lower than the packaging costs, which for the smallest packets were estimated to be 178 %. The funding source to cover the increase in cost for fortification has not yet been solved, should fortification be carried out on national scale.

A few alternatives for fund sources to cover the fortification program are:

1. Increase the cost of MSG, whether fortified or not. If MSG in small packets only is to be fortified, and this would constitute around 50% of all MSG production, then this would mean an increase in the cost of MSG of around 8 - 10 %.
2. Reduce the number of grams of MSG per packet, proportional to the fortification costs. Thus, the MSG contents in packets would be reduced by around 17 - 20 %.
3. Increase the cost of MSG in small packets. Bearing in mind that the cost of the packaging itself, according to the survey, was 178 %, then the increase in cost, due to fortification and after packaging, should only be :

$$\frac{17}{100 + 178} \times 100\ \% = 6\ \%$$

4. Increase the cost of MSG sold in bulk to cover fortification costs, but do not increase the cost of fortified MSG in small packets. This strategy is acceptable when it is remembered that the consumers of the small packets are from the poorer class, where the problem of vitamin A deficiency is generally found.

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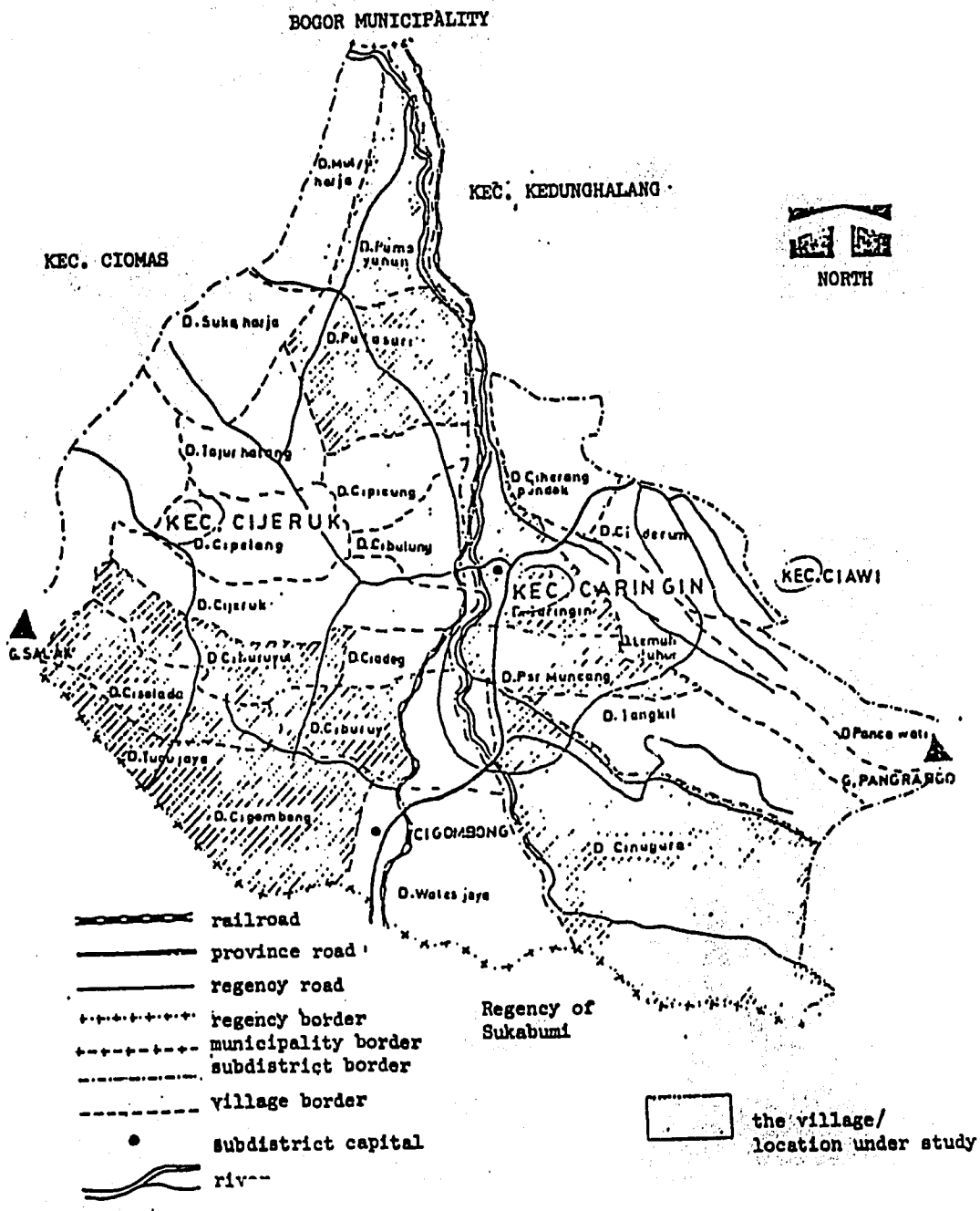
Attachment 1

MAP OF THE CARINGIN AND CIJERUK SUBDISTRICT.



Attachment 2

Rev.B.10/10/85
Form Fort. 04
3 pages

FORM FOR BODY MEASUREMENT, MEDICAL HISTORY AND CHILD HEALTH EXAMINATION

Under-5 Years old No. Team

Visit to :
Village Code :
RK/RT Code :
Household Code:
Child Code :

Part 1. Child's Identity

1. Name of Child:
2. Sex : (1) Male (2) Female
3. Age months
4. Date of birth: _____ Year _____ Month
5. Parents' names: a. Father : .....
   b. Mother : .....
6. MSG purchased from/food-stall : .....

	Yes	No
Clinical Examination	(1)	(2)
Anthropometric	(1)	(2)
Blood Test	(1)	(2)
Breast Milk Test	(1)	(2)
MSG-A Consumption	(1)	(2)

Part II. Body Measurement

7. Body Weight : ..... Kg.
8. Height/Body length: ..... cm.
9. Physical defects : (1) Yes (2) No

Part III. Medical History and Child Health Examination (completed only by eye specialist)

10. In the last week, has this child suffered from :

	Yes	No
a. diarrhea/loose stools	(1)	(2)
b. coughing	(1)	(2)
c. fever	(1)	(2)

If yes,
10 A. For how long ?

	<7 hr	> 7 hr.
a.diarrhea	(1)	(2)
b.coughing	(1)	(2)
c.fever	(1)	(2)

	Yes	No
11. In the last 2 months has the child suffered from: fever	(1)	(1)
11.A. If yes, for how long ? 1. <7 days 2. > 7 days		
12. In the last month has the child suffered from: measles	(1)	(2)
13. Is the child still breast fed four times or more per day ?	(1)	(2)
14. Does the child suffer from edema in the legs ?	(1)	(2)
15. Does the child suffer from short-sightedness	(1)	(2)
15.A. If yes, for how long ? < 1 month	(1)	
> 1 month	(2)	

If not, omit 15A and go on to No. 16

	Yes	No
16. Did the child suffer from short-sightedness six months ago ?	(1)	(2)

	Right Eye		Left Eye	
	Yes	No	Yes	No
17. Generalized conjunctival inflammation	(1)	(2)	(1)	(2)
18. Purulent discharge	(1)	(2)	(1)	(2)
19. Bitot's Spot	(1)	(2)	(1)	(2)
a. Nasal	(1)	(2)	(1)	(2)
b. Temporal	(1)	(2)	(1)	(2)
20. Corneal xerosis	(1)	(2)	(1)	(2)
21. Corneal ulcer, necrosis, fresh descemetocoelas, or perforations	(1)	(2)	(1)	(2)
22. Scarring	(1)	(2)	(1)	(2)

23. If yes,
23 A. Was this followed in 4 weeks or less than a month by scars?

	Right Eye			Left Eye		
	Yes	No	Don't Know	Yes	No	Don't Know
a. eye trauma	(1)	(2)	(3)	(1)	(2)	(3)
b. measles	(1)	(2)	(3)	(1)	(2)	(3)
c. Purulent eye infection	(1)	(2)	(3)	(1)	(2)	(3)
d. other evidence of marked malnutrition	(1)	(2)	(3)	(1)	(2)	(3)
e. marked or prolonged diarrhea	(1)	(2)	(3)	(1)	(2)	(3)
f. marked or prolonged cough	(1)	(2)	(3)	(1)	(2)	(3)
g. fever	(1)	(2)	(3)	(1)	(2)	(3)
h. worms or parasites ...	(1)	(2)	(3)	(1)	(2)	(3)
i. night blindness	(1)	(2)	(3)	(1)	(2)	(3)

24. Is the child suffering from any illness now ? ..... Yes (1) No (2)

If yes,
24.A. Explain
....
.....

25. The eye specialist complete this:

Name : .....
Code : .....

26. Date of examination :

....
date month year

Visit to :
Village Code :
Household Code :
Child's Code :

Attachment 3

Rev. A
20/1/84
Fort. Form 03
2 pages

CONSUMPTION BY
UNDER-FIVE YEAR OLDS

Village Code
RK Code
RT Code
Household Code
Child Code

1. Reasons for choosing this child :
   Random sample ..... (1)
   Abnormal/Control ..... (2)
   Random sample and abnormal/
   control ..... (3)

2. Indicate how many of the following types of food were consumed by the child over the last 24 hours. (If yes, use a ___ sign).

Food Type	Not Consumed	10-25 gm	25-50 gm	50-75 gm
Staple Diet:				
a. rice	(1)	(2)	(3)	(4)
b. yellow corn	(1)	(2)	(3)	(4)
c. cassava/other types of tubers	(1)	(2)	(3)	(4)
d. sweet potato	(1)	(2)	(3)	(4)
Side Dishes:				
e. liver	(1)	(2)	(3)	(4)
f. meat	(1)	(2)	(3)	(4)
g. eggs	(1)	(2)	(3)	(4)
h. fresh fish	(1)	(2)	(3)	(4)
i. salted fish	(1)	(2)	(3)	(4)
j. bean curd	(1)	(2)	(3)	(4)
k. tempe/oncom (k.o. tempe, orange in colour)	(1)	(2)	(3)	(4)
l. peanuts/raw/ koro, etc.	(1)	(2)	(3)	(4)

Food Type	Not Consumed	10-25 gm	25-50 gm	50-75 gm
Vegetables/Fruits:				
m.cassava leaves/ mlinjo leaves/katuk leaves	(1)	(2)	(3)	(4)
n.k.o. spinaches/ long beans/genjer (k.o. veg. that grows in swamp area)	(1)	(2)	(3)	(4)
o.tomato	(1)	(2)	(3)	(4)
p.carrot	(1)	(2)	(3)	(4)
q.manggo	(1)	(2)	(3)	(4)
r.banana	(1)	(2)	(3)	(4)
s.pawpaw	(1)	(2)	(3)	(4)
t.jack fruit	(1)	(2)	(3)	(4)
Processed Food:				
u.condensed milk	(1)	(2)	(3)	(4)
v.powdered milk	(1)	(2)	(3)	(4)
w.soya sauce	(1)	(2)	(3)	(4)
x.vetsin (monos-odium glutamate)	(1)	(2)	(3)	(4)
z.sugar	(1)	(2)	(3)	(4)
za.margarine/ frying oil	(1)	(2)	(3)	(4)
zb.fresh white bread/cake made with flour	(1)	(2)	(3)	(4)
zc.noodles	(1)	(2)	(3)	(4)

3. Field worker who completed the form :

   a. N a m e :
   b. Code :

4. Date form was completed :

   ....
   date month year

Village Code
RK Code
RT Code
Household Code
Child Code

Attachment 4

Sample Code : .....
Form Anl. : Fort 10.20.02.85

FORM FOR THE ANALYSIS OF FOOD STUFF

Unit No.	Name Of Cooked Food	Food Type	Computer Code Nr.	Weight URT	Weight Gram	Comment

Attachment 5

Rev. A.7.9.84
Fort. Form 09
3 pages

FORM ON THE CONSUMPTION OF MSG
BY FAMILIES, UNDER FIVE YEAR OLDS AND BABIES UNDER 3 MONTHS

Visit to :
Village Code :
Household Code :
Child Code :

I. Use of MSG Additive by the Family:

1. Do you use MSG as an ingredient in cooking ?
   a. (___) Yes b. (____) No

2. If yes, which brands do you use ?
   a. .....
   b. .....
   c. .....
   d. .....

3. In 1 day you would use :
   a. ..... packets of No. 1
   b. ..... packets of No. 2
   c. ..... packets of No. 3
   d. ..... packets of No. 4
   e. ..... packets of No. 5, according to the samples

4. Family members who would consume food to which MSG has been added.

No.	Name of Food	No. of adults (portions)	No. of under-5-yr (portions)	No. of babies (portions)	Amount Eaten Adult	Under-5	Baby
.1.	.....	.....	.....	.....	.....	.....	.....
.2.	.....	.....	.....	.....	.....	.....	.....
.3.	.....	.....	.....	.....	.....	.....	.....
.4.	.....	.....	.....	.....	.....	.....	.....
.5.	.....	.....	.....	.....	.....	.....	.....
.6.	.....	.....	.....	.....	.....	.....	.....
.7.	.....	.....	.....	.....	.....	.....	.....
.8.	.....	.....	.....	.....	.....	.....	.....
.9.	.....	.....	.....	.....	.....	.....	.....
10.	.....	.....	.....	.....	.....	.....	.....

II. Use of MSG as an ingredient in food for under-5 year olds:

5. Portion consumed by under-5 year olds :
   in 1 (one meal = x adult portions (3/4,1/2,1/3,1/4,1/5)

6. Is food for the under-5 year olds cooked separately ?
   a. (____) Yes b. (____) No

7. If yes, is any additive also added to this food ?
   a. (____) Yes b. (____) No

8. In 1 (one) day you would use :
   a. ..... packets of No. 1
   b. ..... packets of No. 2
   c. ..... packets of No. 3
   d. ..... packets of No. 4
   e. ..... packets of No. 5, according to the samples.

9. Use of MSG in cooking :
   a. every day
   b. 1 - 3 days
   c. > 3 days

10. Under-5 year olds who consume food to which MSG has been added.

No.	Type of Food	Amount Consumed	No. of under-5 yr. olds

11. Consumption of MSG per under-5 year old per day :

$$\frac{\text{under-5 yr. old portion (P5)}}{\text{portion of whole family (P4)}} \times \text{amount of MSG used/day (P3)}$$

III. <u>Use of MSG in food for babies < 3 months</u>

12. Portion for baby < 3 months :
    for 1 (one) meal = ... x adult portion
    (3/4,1/2,,1/3,1/4,1/5)

13. Is food for the baby < 3 months cooked separately ?
    a. (___) Yes (___) No

14. If yes, is any addiuive added to this food ?
    a. (___) Yes (___) No

15. In 1 (one) year you would use :
    a. ..... large packets
    b. ..... medium packets
    c. ..... small packets
    d. ..... very small packets

16. Use of additive :
    a. every day
    b. 1 - 3 days
    c. > 3 days

17. Consumption of MSG per baby < 3 months/day :

$$\frac{\text{Portion consumed by baby < 3 mths (12)}}{\text{Portion consumed by whole family (P4)}} \times \text{amount of MSG used/day (P3)}$$

Attachement 6

Forms Anal: Fort II
20/2/85

FORM FOR THE ANALYSIS OF MSG CONSUMPTION IN THE HOME

Nr.	Family Number	Family Member: Adult	Family Member: Under 5-yr	Family Member: Baby	Use of MSG/day in the family	Average Fam.consumption/day *)	Nr. adult x portion x amount consumed by fam. (I)	Nr.under 5 yr x under 5yr portion x amount consumed by fam. (II)	Consumption of MSG by under 5 yr /day (III)	Nr. of under 5 yr old	Amount Consumed by all under 5yr olds

*) $\frac{\text{Use in 1 day}}{\text{Nr. of family members}}$

III) $\frac{II}{I + II}$ x use of MSG/day

Attachement 7

FORM FOR THE RESULTS OF ANALYSIS OF VITAMIN A DETECTION
IN MSG IN HOUSEHOLDS AND IN FOOD STALLS

Rev.A.20/1/84
Form Fort. 10
1 page

I. To be completed by indicating the results of analysis of Vitamin A Levels still existing in MSG (3000 IU, 2000 IU, 1500 IU, 1000 IU, 500 IU)

Household /foodstall Code	Month																							
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV

2. The Field worker completing this form : a) Name : .....
b) Code : .....

Attachment 8

Rev.B 26/4/84
Fort. Form 02
3 pages

FORM ON SOCIO-ECONOMIC BACKGROUND

Visit to :
Village Code :
Household Code :

Part I. GENERAL INFORMATION

1. House No. :.....
2. Household and House No.:.....
3. Head of Household :.....

   a. Name : .....

   b. Main work : Farmer .....(1)
   Laborer .....(2)
   Industrial Laborer .....(3)
   Own business .....(4)
   Civil servant .....(5)
   Other (mention) .....(6)

Part II. HOUSEHOLD DATA

4. Does this household own a rice-field or plot of land for growing produce ?

   ..... (1) Yes (2) No

   If yes,
   4.A. Was the produce sufficient for the household's consumption over the last year ?
   ..... (1) Yes (2) No

5. Did any member of your family visit the Clinic/Community Health/Mother & Child Welfare Center/Hospital over the last year ?

   .....(1) Yes (2) No

6. The main building material used in the respondent's house construction:

Cement/brick .....(1)
Wood .....(2)
Bamboo .....(3)
Other .....(4)

7. Source of drinking water and bathing water :

	Drinking	Bathing
Tap	(1)	(1)
Well/permanent	(2)	(2)
Rain water	(3)	(3)
Non-permanent well	(4)	(4)
River	(5)	(5)

8. Distance from house to source of drinking and bathing water :

	Drinking	Bathing
At the house/around the house.....	(1)	(1)
< 2 minute walk	(2)	(2)
2 - 5 minute walk	(3)	(3)
> 5 minute walk 1	(4)	(4)

9. Place for defecating :

Upright toilet, private .....(1)
Squat-type toilet, private .....(2)
Public toilet .....(3)
Garden/river .....(4)
Other .....(5)

10. Give the name of each family member, even if they are not at home, and supply other details for each family member

Code	Name	Sex: Male	Sex: Female	Age in Years	Highest Educational level
01	.....	(1)	(2)	.....	.....
02	.....	(1)	(2)	.....	.....
03	.....	(1)	(2)	.....	.....
04	.....	(1)	(2)	.....	.....
05	.....	(1)	(2)	.....	.....
06	.....	(1)	(2)	.....	.....
07	.....	(1)	(2)	.....	.....
08	.....	(1)	(2)	.....	.....
09	.....	(1)	(2)	.....	.....
10	.....	(1)	(2)	.....	.....

11. The field worker who completed this form :

a. Name : .....
b. Code : .....

12. Date this form was completed:

..... _ _ _ _ _ _ _ _ _ _ _ _
Date Month Year

Visit to
Village Code
Household Code

Attachment 9

FORM FOR DATA ON INFANT AND UNDER 5 YEAR OLD DEATH
(January, 1984 - December, 1984)

Dec. 21'85

Subsdistrict : .....
Village : ....

Nr.	RK	RT	Child's Name	Father's Name	Mother's Name	Age at Death	Month of Death	Remarks

FORM FOR DATA ON INFANT AND UNDER 5 YEAR OLD DEATH Dec. 21'85

Subsdistrict : .....
Village : .....

Nr.	RK	RT	Child's Name	Father's Name	Mother's Name	Age at Death	Month of Death	Remarks

Date of survey : .....
Field Worker : .....

Attachment 10

ESTIMATION OF INCREASE OF FORTIFICATION COSTS

Premix Costs :

60 g. hydroxipropyl cellulose	:	Rp. 100.-
450 ml. alcohol	:	Rp. 2,000.-
200 g. Vitamin A	:	Rp. 18,400.-
3200 g. powdered MSG	:	Rp. 6,720.-
4060 g.	:	Rp. 27,220.-
(converted into 3400 g.)		can still be increased
Premix value	:	Rp. 8,000.-/Kg.

Increase in Cost of MSG-A :

95 Kg. MSG	:	Rp. 199,500.-
5 Kg. Premix	:	Rp. 40,000.-
		Rp. 239,500.-
Cost of MSG-A	:	Rp. 2,395.-/Kg.
Cost of normal MSG	:	Rp. 2,100.-/Kg.
		increase in price: 14%

Increase in Cost of MSG Packaging :

0.6 g. MSG	:	Rp. 1.26
0.6 g. MSG in packet	:	Rp. 3.50
		increase in price: 178%

Attachment 11

MSG CONSUMPTION IN INDONESIA *

Expenses	City		Village	
	Population Percentage	MSG Consumption	Population Percentage	MSG Consumption
Rp.**	%	mg/head/day	%	mg/head/day
3,000	0.16	57.1	2.65	171.4
3,000	1.19	185.7	5.98	242.9
4,000	2.34	185.7	9.80	242.9
5,000	4.14	228.6	11.91	257.1
6,000	11.11	314.3	22.64	285.7
8,000	13.06	371.4	16.86	328.6
10,000	27.71	400.0	19.47	357.1
15,000	16.79	485.7	6.16	457.1
20,000	14.13	542.9	3.23	585.7
30,000	4.65	600.0	0.74	642.9
30,000	4.74	600.0	0.57	571.4
Average		455.0		318.2
Average for Indonesia			338.7	

* Source : SUSENAS - BPS - 1981

** In 1981, US$1 = Rp. 600.-