

# NUTRITION IMPROVEMENT OF CHILDREN IN AFRICA USING SOYBEAN AS A MAJOR PROTEIN SOURCE

**Yasuhiko Toride, Ph.D.**

Ajinomoto Co., Inc.  
1-15-1 Kyobashi, Chuo-ku, TOKYO 104-8315 Japan

.....

**YASUHIKO TORIDE** joined Ajinomoto Co., Inc. in 1981. He was involved in the business of amino acids for animal feed and led studies on nutrition improvement with amino acid (lysine) fortification in rural communities in developing countries including China, Syria and Ghana. From 2005 to 2009, he worked at Ajinomoto Europe in France where he was in charge of R&D in Europe. He assumed his current post at R&D Planning Department in 2009 and has been directing nutrition improvement projects in developing countries including Ghana, Malawi and India. He earned his Ph.D. in Agricultural Chemistry from the University of Tokyo. His current interest is to establish a sustainable business for nutrition improvement in developing countries while forming strategic partnerships with various social sectors.



## ABSTRACT

Soybean is a key ingredient for the nutrition improvement of children in Africa because it is locally available in many countries and rich in essential nutrients such as protein and fat. The following two examples of fortified foods with soybean as the main protein source will be presented for the discussion.

### 1) Fortified complementary food supplement in Ghana

In Ghana, the traditional complementary food is fermented corn porridge with sugar called “koko”.

Since it is composed of only corn and sugar, it does not contain sufficient amount of protein and micronutrients for the growth of weaning children. The insufficient supply of protein/amino acids and micronutrients is considered to be the cause of malnutrition problems such as stunting and anemia. Complementary food supplements using locally available soybean, amino acid (lysine), sugar, palm oil, and micronutrients were formulated and tested for its nutritional efficacy. The delivery models for providing nutritional supplements and its ability to reach the target population were also studied.

### 2) “Ready to Use therapeutic Food” for the treatment of severe acute malnutrition

Currently, Ready to Use Therapeutic Food (RUTF), composed of milk protein and peanut as main ingredients, is widely used for the treatment of severe acute malnutrition. The innovative formulation of RUTF using soybean as the main protein source and supplemented with amino acids was developed and tested for its efficacy.

In both cases, the use of amino acids to improve the quality of the protein is key to achieving good efficacy as a food product for nutrition improvement.

## KEYWORDS

Nutrition, Children, Soybean, Amino Acid, Africa

## REFERENCES

Shibani Ghosh, Yasuhiko Toride, et al., 2014 Ann. New York Academy of Sciences. 1331 76–89

## Nutrition Improvement of Children in Africa Using Soybean as a Major Protein Source

December 2, 2016  
Yasuhiko Toride, Ph.D  
Executive Professional  
Ajinomoto Co., Inc.

1

## About Ajinomoto Co., Inc.

- Established : 1909 in Japan
- Expertise : Food Science and Amino Acid Nutrition
- Net sales : USD 12 billion (2015)



2

## Introducing Nutritional Supplement "KOKO Plus" for Traditional complementary food (fermented corn porridge) in Ghana through Social Business



Traditional Complementary Food  
"koko"



Nutrition Supplement  
"KOKO Plus"  
composed of soybean powder,  
amino acid (Lysine),  
micronutrients and sugar



Improving Nutrition of Children Aged 6 – 24 months  
→ Window of Opportunity for Nutrition Improvement

3

## Importance of Protein /Amino acid sources in the formulation of KOKO Plus

### Selection of Protein sources

Possible protein sources

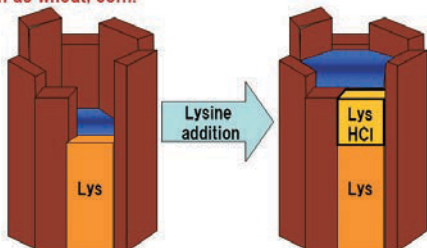
- Cow pea:** locally available but quality / supply is not stable
- Ground nut:** Difficult to control Aflatoxin contamination
- Soybean:** locally available, stable quality & supply.  
Local production is increasing.  
Nutritionally well balanced.

4

4

## Lysine Fortification can improve Protein Quality

Lysine: an essential amino acid most deficient in proteins of  
cereals such as wheat, corn.



**Left:** Protein utilization is limited with the deficiency of Lysine  
(Water level in the barrel stand for the level of protein utilization.)

**Right:** By adding small amount of Lysine, the efficiency of protein utilization is improved  
Since 1995, Ajinomoto supported studies on Lysine fortification in 5 countries  
(Pakistan, China, Syria, Bangladesh and Ghana)  
Impact of Lysine fortification on the health, nutritional status and growth of children  
was demonstrated.

5

## Formulating KOKO Plus to satisfy WHO recommendation

	Energy (kcal)	Protein (g)	Lysine score	PDCAAS	Utilizable Protein (g)	PE ratio
Recommend ation	260 - 270		1	> 0.75 or .80	4 – 6.5	6 - 10
KOKO (Maize + Sugar)	277	3.77	0.46	0.39	1.47	2.12
KOKO + KOKO Plus	231	6.91	1	0.85	5.90	10.2

6



## Acceptability test for "KOKO Plus"

by University of Ghana

7

## Innovation & Partnership

### Innovation

- Product**  
affordable  
acceptable  
aspirational
- Delivery System**

### Partnership

8

## Production & Pilot Studies

**Production**  
Local partner: Yedent Ltd.  
Co-creation and technical transfer

**Delivery model study -1**  
Using Network of Women "Village Savings and Loan Association" <CARE>

**Delivery model study -2**  
Using conventional market channel with Social Marketing <ESM>

**Efficacy study**  
1. KOKO Plus  
2. Micronutrients only  
3. Education only  
- One group 301 children  
- 6-18 months (12 months)

9

## Summary of Nutritional Efficacy Study

1. KOKO Plus, the combination of Protein (amino acids) and Micronutrients, is most effective in

- ① preventing stunting  
→ Comparison of Height for Age Z Score using a model analysis assuming 100 % delivery rate
- ② preventing Anemia  
→ Comparison of Hemoglobin level
- ③ preventing infection  
→ Comparison of acute infection

10

## Development of RUTF (Ready to Use Therapeutic Food)

What is RUTF?

Target	Severe acute malnutrition of children from 6 months to 5 years old.
Treatment	Community based Management of Acute Malnutrition (CMAM) Given for 6-8 weeks (200kcal/kg/day) in the community
Distribution	UNICEF and NGO buy it from suppliers and local governments distribute it.
Current product	Only Milk-peanut type is approved. This product, Plumpy'Nut® is developed by Nutriset (France). 70% of the product is produced in EU and USA
Market	Market size is 35000MT/yr in 2015 (10% of potential market).

UNICEF welcome new type of RUTF which satisfy the following conditions;  
1) Evidence of nutritional effect, 2) Safety, 3) Reasonable price, 4) local production  
Current RUTF ingredients: Milk= expensive, Peanuts paste=risk of aflatoxin

Ajinomoto and Valid Nutrition collaborate to develop new **Innovative RUTF** using locally grown ingredients (soy, maize, sorghum), low risk of aflatoxin (no use peanut) and good protein quality with supplemented amino acids, and good texture.

11

## Problems of Protein sources in the Current RUTF formulation

### Milk Protein

- expensive in Africa
- Lactose intolerance in African children  
→ Cause diarrhea

### Ground Nut

- Difficult to control Aflatoxin contamination

12

confidential

Development of next generation RUTF

Eat Well, Live Well.  
AJINOMOTO.

AJINOMOTO.

VALID

•Protein/amino acid nutrition

•Development of food product

•Expertise of RUTF development

•Relationship between international organization

Use each strong point!

Supported by

jica

GLOBAL INNOVATION FUND

Nutritional composition

• Local grown ingredients

• Protein / Amino acid nutrition

• Low cost linear programming

Product development

• Texture (soft and smooth)

• Process development

Development products

• Soy, Maize, Sorghum (SMS) based RUTF

• SMS+ low level skim milk RUTF

Acceptability test (May 2015)

Efficacy study was finished in August

Efficacy of Soy Maize, Sorghum based RUTF was equivalent to Milk-Groundnut based RUTF

13

Conclusion

Eat Well, Live Well.  
AJINOMOTO.

1. Soybean can play a key role in improving nutrition of children in Africa.

2. “Protein Quality” of grain-based food can be improved by amino acid supplementation.

3. Combination of Protein/ amino acids and micronutrients is effective in improving nutrition of undernourished children. (Preventing stunting & anemia, recovery from Severe Acute Malnutrition)

14

### **Chair Yamamoto**

The next presentation is 'Nutrition improvement of children in Africa using soybean as a major protein source' by Dr. Yasuhiko Toride. Dr. Toride is a Senior Advisor in Ajinomoto Company, Japan. He conducts nutrition improvement projects in developing countries including Ghana, Malawi, and India. So, please give the presentation Dr. Toride.

### **Dr. Yasuhiko Toride**

Thank you very much. My presentation is about 'Nutrition improvement of children in Africa using soybean as a major protein source.' Incidentally, my previous speaker talked about situation in Ghana and also Malawi. And I also introduce a project in Ghana and Malawi as an example of using soybean as a major protein source for nutrition improvement.

I belong to Ajinomoto Company which is a food and also amino acid company. Our expertise is food science and amino acid nutrition. So, we believe by applying this expertise, we think we can make unique contribution to nutrition improvement as this motto shows, Eat Well, Live Well.

First, I would like to introduce a project in Ghana, which is to introduce nutrition supplement as a complementary food supplement, which is called KOKO Plus. In Ghana, most commonly used complementary food or weaning food is called Koko, which is made of fermented corn and sugar. Because this porridge is made of only corn and sugar, it is not sufficient in protein, amino acid and also micronutrients like vitamin and mineral. So, that is one of the important reasons for the malnutrition during the weaning period. As this figure shows, from 6 months, the complementary food will be given to the children and especially this stunting (stunting means lower height than average.) increases quite rapidly up to 30% at the age of 2 years old. This is mainly due to the insufficient supply of nutrients during this period. And important point is this stunting is not just low height but also closely related to the development of intellectual capability or the immune system. That means to improve this stunting situation is very important. This period of 6 months to 24 months is very important and this is called window of opportunity for nutrition improvement.

To improve this nutrition situation in this period, we developed nutrition supplement which is called KOKO Plus, which is added to this porridge called Koko. Key composition is roasted soybean powder and amino acid, Lysine, and micronutrients and sugar. Actually because this is made of roasted soybean and also sugar, the taste is exactly same as the traditional Japanese food which is called Kinako. So, it is quite interesting.

When we formulate this KOKO Plus, we have to select protein sources. So, there are several candidates. For instance, cowpea, as several previous speakers explained, cowpea is widely locally available in Ghana, but quality and supply is not so suitable for the commercial production of this type of supplement. Groundnut is also produced in Ghana but the key point is it's a bit difficult to control Aflatoxin contamination. On the other hand, soybean which is locally available and relatively stable quality and supply and actually Ghanaian government is promoting local production and so we expect bigger production in the future. As you know, that is nutritionally well balanced.

So, we decided to use soybean. And also we use amino acid, Lysine, to improve the protein quality. This figure shows the principle of Lysine fortification. This is called a barrel model, and each piece represent the essential amino acid in the protein. Usually, in the cereal protein, cereal means corn, rice, or wheat, the most deficient amino acid is Lysine. Because the Lysine level is low, the efficiency of protein utilization becomes low. So, this water level shows the protein utilization efficiency. If small amount of Lysine, for example, Lysine hydrochloride, is added to this cereal protein like this, the protein quality becomes higher. In this case, the total protein quality becomes better. This is the principle of Lysine fortification. And we use this principle to improve the protein quality of the product, KOKO Plus.

We formulate this supplement KOKO Plus to satisfy WHO recommendation. For instance, this is the recommended value during the period of 6 months to 24 months. And traditional food which is called Koko is not sufficient in especially utilizable protein, but if we use KOKO Plus instead of sugar to traditional food Koko, this can satisfy utilizable protein requirement of the children. So, this is the key principle, and of course, we also try to satisfy micronutrient requirement by adding micronutrient to the mixture.

The important point is that the taste of the Koko with KOKO Plus should be acceptable for local people, because food culture is quite conservative. If the taste is quite different from the traditional one, they will not



accept it. So, we conducted acceptability test in collaboration with the University of Ghana and confirmed that this KOKO Plus can be acceptable for the local people.

For this project, two important factors are innovation and partnership. For the innovation, we have to have a product which is affordable for the local people, including high poverty area and also acceptable in terms of taste and flavor and aspirational, aspirational in this case means that mother feels proud of providing this kind of supplement to their children for better nutrition.

Another challenge is delivery system. We have to establish a delivery system to reach the target population. So, to achieve this, we have a wide range of partnership which includes local government and academia and also partnership with donor agencies like JICA and USAID and also international NGOs.

So far we conducted pilot studies with local production. The local production was done in partnership with local producers which is located around this area, the center of Ghana. Because this area is in fact soybean producing area, so it is easy to get constant supply of soybean in this area. So, we established the production facility in collaboration with a local partner and introduced a production system by transferring technology, experience, also creating together the best production system.

Using the product which is produced from here, we conducted a nutritional efficacy study in central region and we also conducted delivery model studies. We studied systems to deliver this kind of product to the target population in two areas, one in northern part which is very high poverty area in collaboration with international NGOs and another in the eastern region which is close to the capital city Accra by using the conventional market channel with social marketing.

As I explained, we conducted a nutritional efficacy study to demonstrate KOKO Plus can really improve the nutrition of children. So, the key point is KOKO Plus which is a combination of protein/amino acid and micronutrients worked better than micronutrients alone in preventing stunting as shown in the comparison of height for age Z score. We could also show that KOKO Plus was effective in preventing anemia which is caused by iron deficiency by comparing hemoglobin level. We could also show that it was effective in preventing infection by comparing acute infection markers.

Then, I would like to show the second example of the nutrition improvement in Africa, which is in Malawi. The example is development of ready-to-use therapeutic food. This ready-to-use therapeutic food is used to treat children of severe acute malnutrition from 6 months to 5 years old. This severe acute malnutrition means that without treatment they may not be able to survive. So, right now, UNICEF is promoting this ready-to-use therapeutic food, which is a kind of complete nutrition food to treat severe acute malnutrition. Currently, this RUTF, ready-to-use therapeutic food is produced mainly in France, and it is composed of milk protein and peanuts. Our challenge is to develop a formulation which is safe and with a reasonable price. And a key issue is whether we can produce it locally in Africa. The current formulation use milk protein and groundnut as protein sources. But there are problems about milk protein. It is expensive in Africa and it's not easy to get supply. It is also well known that many of the African children are lactose intolerant, that means the milk protein causes diarrhea. And it cannot be used for the treatment of severe acute malnutrition.

There is a problem with another protein source, groundnut, which is difficulty in controlling Aflatoxin contamination. So, that's why we tried to develop innovative formulation by using soybean, maize, and sorghum as raw material, which are locally available ingredients.

This project was done in collaboration with VALID Nutrition which is Irish NPO, which has been involved in RUTF production in Malawi for many years. So, by combining expertise of Ajinomoto, especially the amino acid nutrition expertise and their experience in RUTF, we tried to develop the innovative formulation for RUTF. This project was supported by JICA and also Global Innovation Fund. So far we could develop the formulation with soy, maize, and sorghum. One of the key points in the product development is we supplement several amino acids to improve the protein quality of soy maize sorghum formulation to make it comparable with the current milk-based formulation. We already completed acceptability test to confirm that taste of this new formulation is acceptable for the children in Malawi. Also, we conducted an efficacy study to confirm the recovery of the children from severe acute malnutrition. So far, we could confirm the efficacy of the RUTF with soy, maize, sorghum supplemented with amino acids was almost equivalent to the current formulation which is milk groundnut based RUTF.

This is the conclusion of my presentation today. First, the soybean in Africa can play a key role in improving nutrition of children because of the stable production and quality, and also we expect production of soybean in Africa will increase in the future. So, the soybean will play a key role in improving nutrition.

Then, when we think about protein source, protein quality is decided by amino acid balance, so protein quality of grain-based food can be improved by amino acid supplementation as shown in our study in Ghana and also Malawi. As for the nutrition improvement, the key message is this combination of protein, amino acid and micronutrient is effective in improving nutrition of malnourished children, especially preventing stunting, anemia, and recovery from severe acute malnutrition. Thank you very much for the attention.

**Chair Yamamoto**

Thank you very much. Dr. Toride introduced the trials to improve the children's nutrition in Africa using the KOKO Plus and also the potential of the new type of RUTF like the soy, maize, sorghum constituent. So, are there any questions or comments on his presentation? Yes, please.

**Male Questioner**

Thank you. I have one interest about your amino acid supplement. Is this amino acid supplement from legume or other crops or what is the donor source? Is it shareable or secret?

**Dr. Yasuhiko Toride**

Actually, Ajinomoto is a leading producer of amino acid itself by using fermentation technology, biotechnology. So, each amino acid is produced by fermentation or biotechnology. That purified amino acid is added to the protein. So, it's not vegetable or animal source protein. It's pure free amino acid.

**Chair Yamamoto**

Okay? Any other questions or comments? Yes, please.

**Male Questioner**

Thank you for nice contribution to nutrition in Africa. My question is that I may have missed hearing, what type of micronutrient is added, not only Lysine, also micronutrient you mentioned, what type of that?

**Dr. Yasuhiko Toride**

Micronutrient is added as a micronutrient mixture which is vitamin and mineral mixture. Especially in this case, mineral like iron or zinc are quite important as minerals. As for vitamin, vitamin A, vitamin B, and so on are quite important.

**Male Questioner**

The cost to produce such additions is very high or small?

**Dr. Yasuhiko Toride**

Not small, but to satisfy the micronutrient requirement, if we use only locally available ingredients, the cost will become much higher. So, in this case, to use industrially produced micronutrients or amino acid is the cost effective way to satisfy the requirement of children.

**Chair Yamamoto**

Any other questions or comments? Yes, please.

**Female Questioner**

It is very interesting to have the information about this kind of challenges to eradicate the severe acute malnutrition. My question is very simple and just from interest but how much does it cost for the moment as unit price to produce this kind of package and then of course, this can be used in the aid project or something, but for the further dissemination and utilization by the local people, how is the target price you are...?

**Dr. Yasuhiko Toride**

Okay. So, in the first case in Ghana, actually we plan to distribute it as a commercial product or in a commercial channel. In this case, we try to distribute it at the cost of around 10 US cents or 10 yen per package, which we believe is within affordable price range for most of the Ghanaian people. In the case of the RUTF, ready-to-use therapeutic food for severe acute malnutrition treatment, the cost is a bit higher, which is 30-40 cents per



package, but this is not what we call B to C business. We plan to supply it to UNICEF. That means UNICEF will buy it and distribute it through the local government network.

**Chair Yamamoto**

Thank you very much. Okay, the last question or comments, please. Yes.

**Male Questioner**

If UNICEF buys and distributes to the mothers, how sustainable is this going to be if for any reason UNICEF withdraws from buying, what is the next target population?

**Dr. Yasuhiko Toride**

Actually, for severe acute malnutrition, it is very difficult to ask children of severe acute malnutrition to bear the cost. That's why it has to depend on the donors' money like UNICEF. It is almost impossible to distribute it through market channel. Of course, as you say that whether it is sustainable or not depends on how we recognize the importance of treating severe acute malnutrition because without this treatment these children will die. So, it is quite urgent issue, so why not support this from donors' money? That's I think the principle for this RUTF.

**Chair Yamamoto**

Thank you very much Dr. Toride. It's a very interesting presentation. Thank you.