# EFFECTS OF SUPPLEMENT LEANKID 100+BA ON NUTRITIONAL STATUS AND HEALTH OF 12-24 MONTHS OLD CHILDREN

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## ABSTRACT

The intervention study to evaluate the effects of nutritional product supplementation Leankid 100+BA on nutritional status and health of 12-24 months old children was completed in Ninh Binh in February 2024 with a control group (60 children) and an intervention group (60 children). ***Results:*** After two months of the intervention, the evaluation indexes of the intervention group comparing with the control group were: respiratory infection was lower 50% (3.3% vs. 53.3%); diarrhoea was lower 38.3% (1.7% vs. 40.0%); constipation was lower 16.7% (0% vs. 16.7%); anorexia was lower 40% (10.0% vs. 50.0%); difficulty sleeping was lower 38.4% (8.3% vs. 46.7%); average weight was higher 0.55 kg ($p<0.05$); average height was higher 0.56cm; risk of underweight malnutrition was lower 45.0%; risk of stunting was lower 18.4%; risk of wasting was lower 16.6%; underweight malnutrition was lower 33.3%; stunting was lower 16.6%, respectively; these differences were statistically significant ($p<0.05$). The rate of drinking enough milk was 93.3% with 2 meals/day. ***Conclusion:*** Supplementing of Leankid 100+BA product improved weight, height, digestion, anorexia, difficulty sleeping, and immunity system and reduced respiratory infection and risk of malnutrition. The product acceptability was high.

***Keywords:*** *micronutrients, formula milk, height, weight.*

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## I. INTRODUCTION

Child malnutrition is a global health problem, especially in developing countries including Vietnam. Children 12-24 months old is in the process of interaction between the passive immune system from the mother and the development of the child's active immune system, along with the digestive system adapting to new sources of nutrition gradually replacing breast milk; this is also the first stage of physical and mental development that is important throughout life. At this stage children are very susceptible to malnutrition, decreased resistance, increased risk of disease, affecting weight and height growth [1]. The nutritional regimen of this stage, in addition to energy, lipids, proteins, the role of essential amino acids and minerals are very important, including vitamins A, D, E, K and calcium, iron, iodine, zinc [2]. One of the solutions to improve children's nutritional status is to use formula milk supplements with energy, protein, fatty and micronutrients [3]. However, the composition and content of supplemented milk to be balanced and suitable for age is still an issue that needs to be studied [4]. This study evaluated the effectiveness of a formula product - Leankid 100+BA that provides energy and has nutritional ingredients aimed at children aged 12-24 months in accordance with the guidelines of the Ministry of Health and the World Health Organization [5].

## II. METHODS

**2.1. Research subjects:** Children 12-24 months old. Inclusion criteria: Children are

not overweight or obese. Exclusion criteria: Children with congenital malformations, mental or motor disabilities, or children with chronic diseases; having acute illnesses; using nutritional supplements or participating in other research.

**2.2. Research location and time:** Tam Diep City, Ninh Binh Province. Time: from August 2023 to February 2024.

**2.3. Research design:** Community intervention study with control group.

**2.4. Sample size, sample selection:** apply the formula to calculate the average comparison sample of 2 independent samples. Sample size: 60 children in the intervention group and 60 children in the control group. Subjects selection: Screening 300 children in 4 kindergartens schools, selecting 120 children according to the research criteria. Randomly selecting 2 schools for the intervention group (60 children) and 2 schools for the control group (60 children).

**2.5. Intervention materials and content:** Leankid 100+BA is a nutrition product produced by Nutricare Nutrition Joint Stock Company. 200ml of formula for a meal equivalent to 48 grams of milk powder and 2 meals per day providing: 480kcal, 16.32g protein, 2.88g whey protein, 1178mg lysine, 1358mg leucin, 756mg isoleucine, 898mg valine, 612mg arginine, 386mg histidine, 638mg phenylalanine, 542mg tyrosine, 636mg threonine, 336mg methionine, 200mg tryptophan, 175mg cystine, 3068mg glutamic acid, 1200mg aspartic, 318mg glycine, 496mg alanine, 1322mg proline, 800mg serin, 25g fat, 24mg DHA, 298mg omega 3, 1296mg omega 6, 3284mg omega 9, 46.2g carbohydrates, 3.46g fiber (FOS/inulin), 27.0mg HMO (fucosyllactose (2'-FL)), 33.6mg taurine, 153.6mg colostrum, 24mg nucleotides, 135mg choline, 1500IU vitamin A, 330IU vitamin D3, 5.1 IU vitamin E, 8.08µg vitamin K1, 15.4µg vitamin K2, 38.0mg vitamin C, 292µg vitamin B1, 618µg vitamin B2, 3312µg niacin, 1350µg pantothenic acid, 504µg vitamin B6, 78.2µg folic acid, 1.22µg vitamin B12, 10.1µg biotin, 244mg sodium, 582mg potassium, 532mg chlorine, 452mg calcium, 446mg phosphorus, 62.4mg magnesium, 6.16mg iron, 5.56mg zinc, 460µg manganese, 127.4µg copper, 32.8µg iodine, 10.18µg selenium, 9.8µg chromium, and 18.5µg molybdenum.

**2.6. Data collection:** Data were collected through a pre-designed questionnaire on nutritional status, digestion and infection; height and weight were measured and nutritional indices (Z- Score) were calculated before (T0), during (T1) and after (T2) intervention.

**2.7. Evaluation method:** Comparing the 2 groups in terms of height, weight and nutritional index (Z-Score) according to WHO standards [6] and some indicators of health, digestion and infection evaluated before and after intervention.

**2.8. Data processing and analysis:** Data were entered with MS.Excel 2016 software and analyzed with WHO Anthro 3.2.2 and SPSS 22.0 software.

**2.9. Research ethics:** The study was approved by the Ethics Committee of the Institute of Health Sciences and Technology in approval decision No. 223/HDDD-VKC dated 10 November 2023. The implementation process complied with good clinical practice.

## III. RESULTS

A total of 120 preschool children participated in the study, including 60 children in the control group and 60 children in the intervention group.

**.Table 1.** ***Characteristics of the two groups before intervention***

| Index \ Group | Intervention group (n=60) | Control group (n=60) | p (*T- test*) |
|---|---|---|---|
| Male rate | 32 ( 53.3% ) | 30 ( 50% ) | >0.05* |
| Age (months) | 20.16±3.21 | 19.72±3.29 | >0.05 |
| Weight (kg) | 9.84±1.05 | 9.79 ±1.02 | >0.05 |
| Height (cm) | 75.33±1.17 | 75.27± 1.87 | >0.05 |
| WAZ (Z- score) | -1.33±0.64 | -1.36±0.64 | >0.05 |
| HAZ (Z- score) | -1.14±0.42 | -1.11±0.73 | >0.05 |
| WHZ (Z- score) | -1.61±0.39 | -1.62±0.51 | >0.05 |
| BAZ (Z- score) | -0.89±0.52 | -0.89±0.09 | >0.05 |

* $\chi^2$ test.

Table 1 shows that before the intervention, there was no statistically significant difference (p>0.05) between the intervention group and the control group in terms of gender ratio, age, height, weight, and similar Z- score indexes: weight/age (WAZ), height/age (HAZ), weight/height (WHZ) and BMI/age (BAZ).

**Table 2.** ***Intervention effects on infection and digestive status***

| Index \ Group | Before intervention | | | After intervention | | |
|---|---|---|---|---|---|---|
| | Intervention group | Control group | p ($\chi^2$ test) | Intervention group | Control group | p ($\chi^2$ test) |
| Respiratory infections | 30 (50.0%) | 29 (48.3%) | >0.05 | 2 (3.3%) | 32 (53.3%) | <0.05* |
| Diarrhoea | 18 (30.0%) | 18 (30.0%) | >0.05 | 1 (1.7%) | 24 (40.0%) | <0.05* |
| Constipation | 13 (21.7%) | 11 (18.3%) | >0.05 | 0 | 10 (16.7%) | -- |
| Anorexia | 31 (51.7%) | 29 (48.3%) | >0.05 | 6 (10.0%) | 30 (50.0%) | <0.05 |
| Crying/Difficulty sleeping | 26 (43.3%) | 23 (38.3%) | >0.05 | 5 (8.3%) | 28 (46.7%) | <0.05 |

*(*) Fisher's exact – test ; (--)Not tested.*

Table 2 shows that before the intervention, the two groups had similar rates of respiratory infections, diarrhoea, constipation, anorexia, and difficulty sleeping (p>0.05). After the intervention, respiratory infections was 50.0% lower (3.3% vs. 53.3%); diarrhoea was 38.3% lower (1.7% vs. 40.0%); constipation was 16.7% lower (0.0% vs. 16.7%); anorexia was 40.0% lower (10.0% vs. 50.0%); crying/difficulty sleeping was 38.4% lower (8.3% vs. 46.7%); the differences between the two groups were statistically significant (p<0.05).

**Table 3.** ***Intervention effects on average weight***

| Time \ Group | Intervention group (n=60) | Control group (n=60) | p (*T- test*) |
|---|---|---|---|
| T0 | 9.84±1.05 | 9.79±1.02 | >0.05 |
| T1 | 10.28±1.15 | 10.02±1.13 | >0.05 |
| T2 | 10.75±1.18 | 10.15±1.19 | >0.05 |
| T1-T0 | 0.44±0.10 | 0.23±0.11 | <0.05 |
| T2-T0 | 0.91±0.13 | 0.36±0.17 | <0.05 |

*Data are presented as $\bar{X}$±SD.*

Table 3 shows the average weight of the two groups before intervention (T0) was similar, after 1 month (T1) and after 2 months (T2) there was a tendency to increase (p>0.05). The difference (T1-T0) of the intervention group increased by more than 0.21 kg (0.44±0.10 kg vs. 0.23±0.11 kg), a statistically significant difference (p<0.05); The difference (T2-T0) of the intervention group increased by more than 0.55 kg (0.91±0.13 kg vs. 0.36±0.17 kg), a statistically significant difference (p<0.05).

**Table 4.** ***Intervention effects on average height***

| Group / Time | Intervention group (n=60) | Control group (n=60) | p (*T- test*) |
|---|---|---|---|
| T0 | 75.33±1.17 | 75.27±1.87 | >0.05 |
| T1 | 75.86±1.53 | 75.53±1.55 | >0.05 |
| T2 | 76.43±1.49 | 75.81±1.62 | >0.05 |
| T1-T0 | 0.53±0.36 | 0.26±0.32 | <0.05 |
| T2-T0 | 1.10±0.32 | 0.54±0.25 | <0.05 |

*Data are presented as* $\bar{X}$±*SD.*

Table 4 shows that the average height of the two groups before intervention (T0), after 1 month (T1) was similar and after 2 months (T2) the intervention group tended to be taller (p>0.05). The difference (T1-T0) of the intervention group increased by more than 0.27 cm (0.53±0.36 cm vs. 0.26±0.32 cm), a statistically significant difference (p<0.05); The difference (T2-T0) of the intervention group increased by more than 0.56 cm (1.10±0.32 cm vs. 0.54±0.25 cm), a statistically significant difference (p<0.05).

**Table 5.** ***Intervention effects on nutritional status***

| Index / Group | Before intervention (T0) | | | After intervention (T2) | | |
|---|---|---|---|---|---|---|
| | Intervention group | Control group | p ($\chi^2$ test) | Intervention group | Control group | p ($\chi^2$ test) |
| *Malnutrition and risk of malnutrition (Z- score <-1SD)* | | | | | | |
| Underweight | 34 (56.7%) | 33 (55.0%) | >0.05 | 8 (13.3%) | 35 (58.3%) | <0.05 |
| Stunting | 26 (43.3%) | 24 (40.0%) | >0.05 | 14 (23.3%) | 25 (41.7%) | <0.05 |
| Wasting | 13 (21.7%) | 13 (21.7%) | >0.05 | 4 (6.7%) | 14 (23.3%) | <0.05 * |
| *Malnutrition (Z- score <-2SD)* | | | | | | |
| Underweight | 26 (43.3%) | 25 (41.7%) | >0.05 | 6 (10.0%) | 26 (43.3%) | <0.05 |
| Stunting | 12 (20.0%) | 14 (23.3%) | >0.05 | 4 (6.7%) | 14 (23.3%) | <0.05 * |
| Wasting | 9 (15.0%) | 7 (11.7%) | >0.05 | 5 (8.3%) | 6 (10.0%) | >0.05 |

*(*) Fisher's exact – test.*

Table 5 shows that before the intervention, the two groups had similar rates of malnutrition: underweight, stunting and wasting (p>0.05). After the intervention, comparing intervention group and control group showed that both malnutrition and risk of malnutrition was lower 45.0% (13.3% vs. 58.3%); stunting was lower 18.4% (23.3% vs. 41.7%) and wasting was lower 16.6% (6.7% vs. 23.3%); the rate of underweight was lower 33.3% (10.0 % vs. 43.3%); stunting was lower 16.6% ( 6.7% vs. 23.3%), these differences were statistically significant (p<0.05).

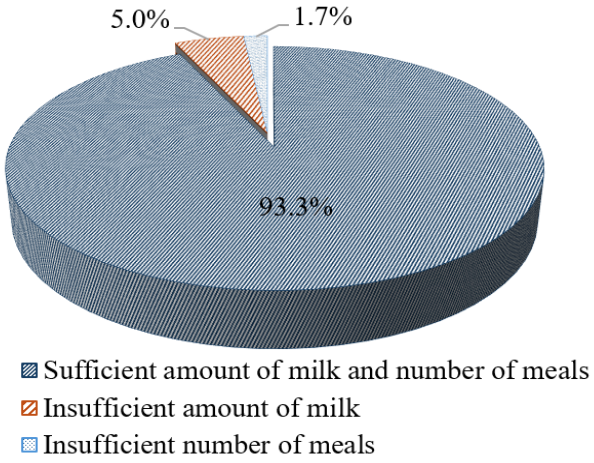


**Figure 1:** ***The rate of product usage***

The chart above shows the results of children using Leankid 100+BA for 2 months. There was 93.3% of children drank enough days and milk content, 5.0% of children did not drink half of the milk content at some point for various reasons and 1.7% of children stopped drinking at some point. The nausea and vomiting were very rare and there was no reaction to milk.

## IV. DISCUSSION

Supplementing of Leankid 100 + BA with a sample size of 60 children and 100% of children completed the milk program within 2 months; comparative analysis of nutritional and health indicators in the two groups had a scientific basis to evaluate the intervention results.

*Enhance immune resistance and improve infection and digestion:* Research results showed the rate of respiratory infection was lower 50.0% (3.3% vs. 53.3%) ($p<0.05$), diarrhoea was lower 38.3% (1.7% vs. 40.0%) ($p<0.05$), constipation was lower 16.7% (0.0% vs. 16.7%), anorexia was lower 40.0% (10.0% vs. 50.0%) ($p<0.05$) and the rate of crying/difficulty sleeping was lower 38.4% (8.3% vs. 46.7%) ($p<0.05$). Passive immunity from maternal IgG antibodies decreases from 6 months of age and the period from 12 to 24 months old is very important in the process of perfecting the child's active immune system. During this period, children become sensitive to infectious diseases such as diarrhoea, respiratory infections or allergies [1]. Nutrition plays a very decisive role in improving the active immune system because the nature of antibodies is protein; vitamins and minerals such as zinc, iron, calcium, magnesium also play a role in supporting functional activities and indirectly have a positive impact on the immune system. Supplementing vitamins, minerals, and essential amino acids also aid digestion, enhance the ability to absorb nutrients in children, and improve anorexia [7]. Daily supplemented milk ingredients 16.32g protein including 2.88g whey protein, 25.0g fat with 24mg DHA, 298mg omega 3 and micronutrients, especially supplemented 1178mg lysine can help children enhance immune function, reduce the risk of infection and help the digestive system absorb nutrients better and improve anorexia in children. Research results were consistent

with scientific evidence on nutrition; energy protein enhances the digestive tract protection function in young children and improves intestinal microflora, helping the digestive system adapt and absorb nutrients. Amino acids and micronutrients provided in sufficient amounts are raw materials for the development of new blood vessels, helping the body to maximally absorb and metabolize nutrients. Studies showed that soluble fiber, colostrum and nucleotides help the child's body develop cells, strengthen the immune system and support digestion, prevent constipation and diarrhoea; vitamins A, D, E and B also support to increase defence mechanisms and support immune functions, especially important against cytotoxic immune reactions; these important micronutrients also help the body increase the production of antibacterial peptides, increasing cell-mediated immunity. Minerals such as iron, zinc, copper, iodine, selenium... also play an important role in enhancing cell-mediated immunity and forming specific antibodies. Studies showed that the role of neutrophils in the immune system is closely related to zinc homeostasis in cells and when the body lacks zinc, it is related to diarrhoea and respiratory infections in children [8]. The research results showed that the rate of respiratory infections was lower 50.0% and diarrhoea was lower 38.3% ($p<0.05$), this result is consistent with the research results proving that supplementing iron combined with vitamin A with appropriate content reduces the rate of acute diarrhoea and respiratory infections in children; supplementing iron combined with vitamin C helps the body improve its ability to absorb nutrients ; essential amino acids are important components of the structure of enzymes, antibodies and hormones and actively participate in the digestive and metabolic processes to help children eat well [9].

*Improved weight gain and height and the status of malnutrition of children:* The average weight gain of the intervention group increased by more than 0.55 kg that of the control group and the average height increased by more than 0.56 cm ($p<0.05$). There was no overweight or obesity after intervention. At the time before intervention (T0), the children participating in the study were underweight, possibly because the normal diet did not meet the developmental needs at this stage. The supplementary milk in the intervention group added 480kcal of energy per day along with 16.32g of protein with 18 fatty acids. Essential amino acids and fats with 24mg DHA may be the appropriate nutritional content to meet the optimal absorption and metabolism capacity of the digestive system in the adaptation phase; supplement essential amino acids such as lysine (1178 mg) daily supports the production of carnitine, which is necessary for the transport and use of fats, supports the creation of new blood vessels, and helps the transport of nutrients and the growth of children [9]. In addition, we can mention the role of vitamins and minerals with appropriate content such as vitamin A, 330IU vitamin D3, 5.1IU vitamin E, 8.08µg vitamin K1, 15.4µg vitamin K2 and 3452mg calcium, 446mg phosphorus, 62.4mg magnesium, 6.16mg iron, 5.56mg zinc has helped the absorption and metabolism of nutrients in children, contributing significantly to improving the condition of underweight and increasing height. The research results also showed that the status of malnutrition and the risk of malnutrition were improved, in which the risk of underweight (Z- score <-1SD) was lower 45.0%, stunting was lower 18.4% and

wasting was lower 16.6% (p<0.05); the rate of malnutrition (Z- score <-2SD) for underweight was also lower 33.3%; stunting lower 16.6%. Monitoring the milk supplementation intervention process showed that the composition and nutritional content met the physiological needs of absorption, metabolism and improved the immune system of children, resulting in improved overall health and growth in this age group. This result also showed that the balance of micronutrient content in the daily diet did not affect biological activity and promoted the nutritional role of the substances, similar to the published intervention research results [10].

*The rate of high product usage:* There were 93.3% of children who drank enough milk for 2 meals/day in 2 months; at some points, children did not use up all the milk content in the day and the number of meals as prescribed, however, the observed results have statistical value. The milk supplement program was also supported by families, schools, authorities, and health care professionals. The participation rate proved that this product is suitable for the intervention group of children in terms of absorption capacity. The ingredients and nutritional content meet the energy, protein, fat, DHA, colostrum antibodies, soluble fiber (FOS/ Inulin) and 28 micronutrients calculated according to the recommended needs of the Ministry of Health and the World Health Organization, which is also a decisive factor for parents to support the usage of the product.

*Limitations of the study:* due to the sample size designed with the main objective of assessing nutritional status, health and the study period of 2 months, it may be not possible to evaluate changes in biochemical and immune indicators.

## V. CONCLUSION

Research on supplementing Leankid 100+BA nutritional milk in children 12-24 months old after 2 months improved the status of infection, digestion, and nutrition better than the control group with statistically significance (p<0.05): respiratory infection was lower 50% (3.3% vs. 53.3%); diarrhoea was lower 38.3% (1.7% vs. 40.0%); constipation was lower 16.7% (0% vs. 16.7%); anorexia was lower 40% (10.0% vs. 50.0%); difficulty sleeping was lower 38.4% (8.3% vs. 46.7%); average weight was higher 0.55 kg (p<0.05); average height was higher 0.56cm; risk of underweight malnutrition was lower 45.0%; risk of stunting was lower 18.4%; risk of wasting was lower 16.6%; underweight malnutrition was lower 33.3%; stunting was lower 16.6%, respectively; these differences were statistically significant (p<0.05). The study had 93.3% of children drinking enough milk (2 meals/day for 2 months) and was supported by families, schools, authorities and health care providers. Conclusion: Supplementing of Leankid 100+BA product improved weight, height, digestion, anorexia, difficulty sleeping, and immunity system and reduced respiratory infection and risk of malnutrition. The product acceptability was high.

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