Comparison of the Nutritional Values of Toddler Milks Available in Italy

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Abstract: If breast milk is not available infant formula ensures a balanced intake of nutrients and is undoubtedly more suitable for infants than cows' milk. In particular, it should point out the absolute necessity to postpone to the end of the first year of life, or even after the 2 nd year, the use of cow's milk for the extreme imbalance of nutrients that lead to high-protein diets and low levels of polyunsaturated fats, iron and zinc. As a consequence, in the absence of breast milk, the use of an appropriately adapted formula in the first year of life and the use of "toddler milk" from 12 to 36 months may represent adequate nutritional alternatives, especially when compare to the use of cow milk, and in particular may appear to play a fundamental role in the prevention of iron deficiency anemia.

Different varieties of toddler milk are currently available in Italy. This review outlines the nutritional differences between breast, toddler and cows' milks, and compares different brands of toddler milk.

Keywords: Pediatric nutrition, toddler milk, cow's milk, iron, protein intake, growth.

INTRODUCTION

In the first years of life, nutritional aims include the following:

(i) supply of adequate nutrients for growth, immunity and neurodevelopment;

(ii) prevention of nutritional excesses or deficiencies;

(iii) reduction of the risks of allergization and infection;

(iv) establishment of a correct nutritional approach.

Adequate feeding benefits the nutritional status of the infant, plays a main role in determining growth and development, and can contribute to prevent later adult diseases [1]. Breast milk is the food of choice for babies since it is species-specific, safe from a microbiological and hygienic point of view, immunologically active, cost effective and, above all, it is balanced from a nutritional aspect. International organizations recommend exclusive breastfeeding during the first 6 months of life and breastfeeding continuation during the entire period of weaning [2]. Moreover breast feeding has proven benefits also for many infants with inherited metabolic disorders in particular affected by phenylketonuria [3, 4]. The uniqueness of human milk is not only due to its content as for useful molecules from a nutritional point of view, but also and especially in its content in terms of the so-called "functional nutrients." In the absence of breast milk, infants should be given formula milk, avoiding the introduction of cow's milk in the first year of life. Its composition is in fact very different from breast milk [5] (Table **1**), causing serious risks in infants whose organs have not yet fully developed. First, proteins found in cow's milk, as beta-lactoglobulin and casein, have a high level of allergenicity. Polyunsaturated fatty acids are almost entirely absent, while there is a predominance of saturated fatty acids. Lactose content, like vitamins, is much lower in cow's milk than in breast milk, while the excess of minerals, especially sodium, can lead to an increase in the activity of the physiological mechanisms for renal compensation.

Thus, we should point out, for both breast-fed infants and formula-fed babies, the absolute necessity to postpone to the end of the first year of life, or even after the 2 nd year, the use of cow's milk for the extreme imbalance of nutrients that lead to high-protein diets and low levels of polyunsaturated fats, iron and zinc [6]. As a consequence, in the absence of breast milk, the use of an appropriately adapted formula in the first year of life [6, 7] and the use of a toddler milk from 12 to 36 months represent adequate nutritional alternatives to prevent potential nutritional mistakes: nutrients excess or deficiency [8]. Toddler milk is an effective food which may assure a balanced diet for children and supports growth and development while respecting their nutritional requirements, especially when compare to the use of cow milk. However other alternatives, such as the use of non-dairy whole food

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Table 1: Breast Milk Versus Cow's Milk Versus Toddler Milk (Average Values from Various Brends): Different Composition (per 100 ml)

	Breast milk	Whole cow's milk	Toddler milk
Kcal	65- 70	65	60- 70
Proteins (g)	0.9	3.4	1.5-1.9
Lipids (g)	3.5	3.5	2.5-3.1
Carbohydrates (g)	6.7	4.4	7.8- 8.5
Iron (mg)	0.03-0.09	0.05-0.09	1.2
Zinc (mg)	0.1-0.3	0.42	0.9
Calcium (mg)	20-25	116	69-110
Vitamin D (µg)	0.03	0.1	1.1-2.6

Modified from reference [5].

(unrefined cereals and legumes), could be considered to solve the problem overeating protein and prevention of iron and zinc deficiency.

In Italy, the recommended daily allowances for children from 12 to 36 months of age are [9]:

(i) protein intake: 1.00 g/kg body weight;

(ii) lipids: ranging from 35% to 40% of calorie intake; adequate intake of docosahexaenoic acid (DHA): 100 mg/day

(iii) iron: 8 mg/day;

(iv) zinc: 3 mg/day;

(v) calcium: 700 mg/day.

(iv) Vitamin D: 15 µg/day

Considering the composition (Table **1**), toddler milk from 12 to 36 months, respect to the use of cow, may allow:

- low intake of proteins, avoiding nutritional excesses that may have negative consequences later in life (overweight, obesity);
- adequate intake of micronutrients (iron, zinc), important for the correct functioning of natural defense mechanisms, for the development-activity of the immune system cells and neurological development, and for the prevention of iron deficiency anemia;
- adequate intake of vitamins, essential fatty acids and in some formulations also of long-chain-polyunsaturated-fatty-acids (LCPUFA) for normal growth and appropriate neurobehavioral development;
- modified intake of minerals, well-tolerated by the renal apparatus of the child;
- better digestibility, since the carbohydrate content includes not only lactose but also polysaccharides, more digestible and ensuring a lower fermentability.

CONSEQUENCES OF EARLY INTRODUCTION OF COW'S MILK

Proteins Excess

Excessive protein intake early in life may lead to not negligible negative consequences from a digestive-metabolic point of view with negative effects later in life [10], in particular with an increased risk of developing obesity and thereby non-communicable diseases (NCDs).

Protein Hypothesis

The hypothesis is that a high intake of protein that exceeds metabolic requirements may increase weight gain during infancy and thus the risk of developing obesity in later years ("the early protein hypothesis") [10, 11]. In particular several observational studies have shown an association between a high-protein intake (>15 energy %) early in life and an increased risk of developing NCDs later in life [12]. It is known that high protein intake has endocrine consequences, causing high levels of insulin and of insulin-like growth factor-1 (IGF1), which may lead to 1) an increased weight gain in the first 2 years of life and to 2) an increase in fat cells hyperplasia (preadipocytes), biological base for the development of obesity in later time [11].

1) Recently, two systematic reviews have reported the positive association between rapid weight gain in early life and subsequent development of obesity [13, 14]. The weight gain would be an early anthropometric marker of obesity development during adolescence and adulthood, and hence of the related metabolic consequences (type 2 diabetes), more predictive than birth weight. Moreover, data have been published showing that increased weight gain in early childhood independently predicts autoimmunity at pancreatic islets level in children with first-degree relatives with type 1 diabetes [15]. As a consequence, according to the "accelerator hypothesis", a rapid weight gain in the first years of life, probably caused by excessive protein consumption, may induce the destruction of pancreatic beta cells in genetically susceptible individuals and thus also the onset of type 1 diabetes [15].

2) Preadipocytes, once there and although not visible, after "hyperplastic" phase (i.e. multiplication of the number of cells), would pass more easily, already from the second year of life, to "hypertrophic" stage (filling up with fat) due to the most common dietary mistakes (excessive intake in terms of energy, saturated fats and carbohydrates with high glycemic index). Through hypertrophy, adipocytes would then rise to the phenomenon of so-called "early adiposity rebound", i.e. the physiological increase in body mass index that, instead of in the fifth-sixth year of life, would take place earlier [11]. Early adiposity rebound would then be another early anthropometric marker, together with weighted growth increase, of the subsequent development of obesity during adolescence and adulthood [11, 16].

Not all proteins are able to trigger these metabolic responses; particular attention is placed on animal proteins compared to plant proteins, and among the animals sources those derived from milk and dairy products compared to those of meats. There are studies showing that during school-age years an increase from 13% to 20% of protein intake for 7 days, determined by increased consumption of cow's milk, is able to determine an augmentation of IGF-1 by 20% and of fasting insulin by 100% [10, 17]. However in a cross-sectional study of 2.5-year-old children,has been found that protein intake was positively associated with height and IGF-I, explained by intake of dairy protein [18]. There was also a positive association between protein intake and weight, but here it was the vegetable-based protein and not the milk that explained the association. The effect of dairy protein on height has been shown in many studies [19]. The effect that early dairy protein intake has on linear growth might also be associated with later risk of NCDs, as adult height is associated negatively with cardiovascular disease [10]. These associations are complex and difficult to transfer into recommendations about protein intake during the first years of life [10].

In contrast support for the notion that dairy products and their components have some benefits in the maintenance of healthy body weights has been provided [20]. In particular an inverse relationship has been found between the number of servings of dairy products and body fat in preschool children [21]. In addition, dairy consumption had a strong inverse association with the ten-year cumulative incidence of obesity and with the insulin resistance syndrome in adults in a large multicenter, population based, prospective observational study [22]. Dairy proteins has been proposed to be of benefit to food intake regulation and maintenance of healthy body weight [20]. Indeed the protein content of food, and perhaps its source, is a strong determinant of short-term satiety and of how much food is eaten. However the role of protein in the regulation of long-term food intake and body weight is less clear. Further research to define its role is necessary.

The strongest evidence of a positive association between early protein intake and later BMI comes from a large multicentre RCT in which infants who were exclusive formula fed within the first 2 months after delivery were randomised to formulas with high or low protein content. A breast-fed control group was included in the study. The European CH ildhood O besity P roject, CHOP Project [23] funded by the European Community, involves 5 European countries (Belgium, Italy, Germany, Poland, Spain). The European countries involved have followed 1.366 children from birth (currently CHOP is still ongoing and children are 7-8 years old), collecting extensive data over time on feeding and growth for each child participating in the study. For the first 4 months, the PE% values were 7.1% and 8.8% in the low- and high-protein formula, respectively, and from 4 months the follow-on formula was used with 11.7 PE% and 17.6

PE%, respectively. At 12 months, the mean PE% values in the total diet of the two groups were approximately 13 PE% and 16 PE%, respectively. The intervention lasted until the age of 12 months, but the children are followed up, and up to now data from the 2-year follow up have been published. The main result, recently published [23] was that both weight-for-length and BMI z-scores were significantly higher in the high-protein group compared with the low-protein group, both at 12 and at 24 months, 1 year after the end of the intervention. At the age of 24 months, the difference in weight for- length was about 0.2 z-scores. The low-protein group was not significantly different in any of the growth parameters from the breast-fed group at any time point.

Data obtained in this study, therefore, indicate that [11]:

- Lower protein formula is able to determine a growth curve similar to that of breast-fed.
- These results should stimulate the revision of the recommendations regarding the composition of the formulae and pediatricians should be provided with tools for the selection of the most appropriate formula in the case of lack of breast-milk.

Whether this statistically significant but small difference in growth observed in infants fed higher-protein formula persists and is related to obesity risk in later life is the subject of ongoing investigations. Currently, these preliminary results do not allow conclusions to be made on the effects of protein intake with regard to obesity development.

Moreover recently data from CHOP intervention study have been published on a positive dose-response association between the protein content in high-protein formula, low-protein formula and breastmilk and the level of both IGF-I and insulin secretion at the age of 6 months [24]. This result may support the hypothesis that the difference in protein intake causes the difference in IGF-I and insulin observed between breast-fed- and formula-fed infants [10, 25]. However, in later life it seems that the relationship is reversed as children breast fed in infancy have higher IGF-I concentrations in later childhood [10, 25]. IGF-I levels are associated with early obesity, but the relation is complex and differs with age. Further studies and reviews support that there is a programming of the IGF axis, with higher levels during early life being associated with lower levels in adulthood, but more studies are needed to better understand the role of IGF-I, especially in the early development of obesity.

There are several observational studies supporting this effect of a high-protein intake not only in the first year of life but also later, on overweight and obesity. In a Swedish study, protein intake at 17 -18 months and at 4 years were independent risk factors for a higher BMI at 4 years [26]. In another observational study, having a protein intake above the median both at the age of 12 and 18-24 months was associated with a higher BMI and body fat percentage at age 7 years [27]. In a study from Iceland, protein intake in late infancy was also positively associated with BMI later in childhood, at the age of 6 years, but only in boys [28]. However in a Dutch study protein intake at 9 months was positively associated with both weight and length but not with BMI or body fat measured by a dual-energy X-ray absorptiometry (DEXA) scan at 10 years [29].

In conclusion present data do not allow conclusions to be made on the effects of protein intake with regard to obesity development. To better understand the mechanisms behind the association between a high protein intake and later obesity, there is a need for longitudinal studies that also include measures of body composition.

Many countries recommend that cow's milk should not be introduced before the age of 12 months. The main reason for this recommendation is the low iron content in cow's milk, but such a recommendation will also result in a lower protein intake in late infancy. Excessive protein consumption during the first 2 years of life is in fact the most common nutritional mistake in Western countries, as documented by several surveys on dietary habits [30]. Indeed in industrialized countries many infants and young children have a high protein intake, above 15 PE% or more than three times their physiological requirements, and with the ranges in protein intake in some of the studies some infants are receiving more than 20 PE%.

Risk of Iron and Zinc Deficiency

One of the main drawbacks of the introduction of cow's milk in infancy is its association with decreased iron reserves and an increased risk of iron deficiency [31]. Infants and toddlers are exceedingly vulnerable to iron deficiency because their natural diet tends to be low in iron, while at the same time, their needs for iron are unusually high due to rapid growth [32]. Rapid growth with high iron needs makes infants and young children a particular risk group for iron deficiency anemia, especially those aged 6–24 months [33]. Iron plays many important functions in the body, taking part in the distribution of oxygen, in the immune system and the development of certain brain functions; the lack of this element can therefore have a major impact on health. Two recent reviews has highlighted the positive relation between a good contribution of iron in childhood and psychomotor development indices [33, 34].

Staples of the infant and toddler diet, including breast milk, vegetables, fruits, and cow's milk are all low in iron. In fact, without iron fortification it is quite difficult for infants and toddlers to obtain an adequate iron intake. Although iron-fortified foods such as cereals and infant formulas are available, they are not universally used for economic as well as cultural reasons.

By what mechanism cow's milk affects iron status is not entirely clear.

Several different mechanisms may act synergistically [31, 32]:

1. The low iron content of cow's milk (Table **1**).

2. Calcium and casein provided by cow's milk in high amounts because calcium and casein together inhibit the absorption of dietary nonheme iron.

3. Cow's milk also has low contents of lactoferrin and vitamin C, important for proper absorption of iron.

4. The resulting low iron biovailability for absorption. Estimating <0.05mg iron/100 g cow's milk, and an absorption rate of 10%, <5mg/100 g intake should be absorbed. Even breast milk has a low iron content, but the iron found in breast milk has a higher bioavailability than cow's milk (50% vs. 10%).

5. Occult intestinal blood loss in approximately 40% of normal infants during feeding of cow's milk. Indeed cow's milk proteins, casein in particular, are more difficult to digest than serum proteins and can cause micro-hemorrhages in the intestinal mucosa.

Iron status in the first and second year of life is related to the status at six years of age [35]. Considering that the period of greatest risk of iron deficiency in childhood is between 6 and 24 months [33] and that this period overlaps the critical period of brain development, iron deficiency during early childhood may therefore be associated with abnormalities in brain development [33].

Considering that a iron supplementation may significantly improve measures of cognitive function and development in infants, children and adolescents, a policy should focus on prevention of iron deficiency anemia [33]. Food-based strategies are safe methods to control and prevent mild micronutrient deficiencies, as iron deficiency. Several studies have documented the effectiveness of iron fortification of cow's milk. A recent double-masked, randomized trial among children 1–4 years evaluated the effects of micronutrients (especially of zinc and iron) delivered through fortified milk on growth, anemia and iron status markers [36]. After one year of intervention, children in micronutrients group had 88% lower risk of iron deficiency anemia [36]. In an other 20-wk randomized placebo-controlled trial [30], healthy nonanemic 12–20-mo-old children were assigned to 1 of 3 groups: red meat (toddlers encouraged to consume 2.6 mg iron from red meat dishes daily), fortified milk [toddlers' regular milk (1.5 mg iron/100 g prepared milk)], or control [nonfortified (0.01 mg iron/100 g prepared milk) cow milk]. By 20 wk, in comparison with the control group, serum ferritin and body iron were significantly higher in the fortified milk group, and serum ferritin was significantly higher in the red meat group. The authors concluded that consumption of iron-fortified milk can increase iron stores in healthy nonanemic toddlers, whereas increased intakes of red meat may prevent their decline [37].

Beside the recognized effect of iron on child nutrition and development, increasing data concern the role of zinc, which deficit is associated with growth retardation, increased susceptibility to infections and modest motor skills deficit [38, 39]. Zinc is an essential cofactor for many enzymes participating in a variety of metabolic processes. In particular, zinc participates to the development of the central nervous system [38]. However we must not forget that zinc deficiency is also associated with a limitation of growth in the prenatal period, neonatal phase and early childhood. It is now recognized as one of the leading causes of stunting in children under the age of 5 years [39]. Adequate intake of zinc would have positive effects on weight-for-height growth. In addition, the cells and tissues having a high turnover are primarily affected in the case of zinc deficiency: the immune system, the barrier of the gastrointestinal tract, lungs and skin are immediately damaged. In fact, zinc deficiency in infants and children is characterized by growth retardation as well as by appearance of eczema, gastrointestinal disturbances (diarrhea), anemia, and reduced immune function with increased susceptibility to infections [39]. Zinc becomes an important nutritional element for children from the sixth month of life, because at this age zinc content in breast milk starts to be insufficient to cover growing needs. Zinc requirement is about 5 mg per day between 6 to 12 months, 10 mg per day between 1 and 4 years [9].

Low Levels of Essential Fatty Acids and LCPUFA

Associations frequently reported of an improved neurobehavioral development in breast-feeding infants against bottle-fed babies have suggested hypotheses on the possible role of LCPUFA [40]. The hypothesis that LCPUFA may have a role in the performance of the nervous tissue is supported by experimental, pathologic and clinical data [41]. The term LCPUFA refers in particular to arachidonic acid (AA, 20:4 n-6) and docosahexaenoic acid (DHA, 22:6 n-3), respectively, arising from linoleic acid (LA, 18:2 n-6) and from alpha-linolenic acid (ALA, 18:3 n-3). Alpha-linoleic acid and linolenic acid may not be synthesized by mammalian cells due to a shortage of certain enzymes: they are therefore considered essential fatty acids. The fatty acids of the series (n-3) cannot be converted into (n-6) and vice versa, so both series are essential. Essential fatty acids in the diet are metabolized in the liver to achieve their long chain derivatives, AA and DHA. DHA appears to be "conditionally" essential for growth and structural and functional development of the brain in infants. Brain accumulation of DHA starts in utero, increases during the second half of pregnancy and continues in extra-uterine life, reaching levels of about 4 grams of DHA between two and four years of age [42]. DHA appears to be the only long-chain polyunsaturated fatty acid that preferentially accumulates in brain and retina during development [42]. Brain growth is accelerated during the second half of pregnancy and remains high during the first year of life [42]. In this period of time important milestones are reached in terms of cognitive, visual and motor development. In cow's milk, polyunsaturated fatty acids are contained in small quantities (only LA and traces of ALA and AA are present). Breast milk does contain LA, ALA, AA, DHA and EPA [5, 6]. Moreover, human milk has an LA/ALA ratio that allows a more balanced synthesis of fatty acids deriving from both series (n-6 and n-3). Therefore, an LA/ALA ratio between 5:1 and 10:1 would prevent both an excess of LA in the diet and the reduced DHA synthesis that is associated with such excess [6, 43]. Several studies have also demonstrated the beneficial effects associated with ALA administration, which increases the availability of substrates for DHA synthesis [44]. Therefore in such a delicate phase, the first years of life, it is essential that fetus, infants and toddlers receive an adequate diet in terms of quantity and quality of both essential and long-chain polyunsaturated fatty acids, allowing to meet nutritional needs [43]. The proposed adequate intake of DHA for infants older than 6 months of age and young children younger than 24 months is 100 mg [9, 43].

Toddler milk also represent an adequate source of some vitamins ...

In early life it is important to ensure an adequate intake of both fat soluble and water-soluble vitamins, to allow harmonious growth and prevent deficiency diseases.

Water-Soluble Vitamins

Vitamin C

Vitamin C or ascorbic acid is a water-soluble vitamin that acts as a cofactor in the hydroxylation reactions, promotes the absorption of iron and the reduction of folic acid in its coenzyme forms. It also has a powerful antioxidant effect. The concentrations of vitamin C in plasma and leukocytes undergo a rapid decline during states of stress and infectious disease. It has been shown that supplementation with ascorbic acid increases the activity of lymphocytes and NK cells, lymphocyte proliferation and chemotaxis. Vitamin C helps maintain the redox balance of cells and thus protects cells from reactive oxygen species (ROS) generated during the inflammatory response. An adequate intake of vitamin C can reduce the symptoms and duration of respiratory infections, including common cold, and reduce the incidence and improve the clinical outcome of pneumonia, malaria and infectious diarrhea, especially in children in the poorest countries that show low plasma vitamin levels. The recommended requirement of vitamin C is equal to 35 mg/day in infants, with subsequent increases until it reaches values of 40 mg/day for 12-36 months children [9].

Group B Vitamins

Vitamin B6 is involved in more than 100 enzymatic reactions and is important for protein metabolism, for the conversion of tryptophan to niacin and, among other functions, for neurotransmitters development. The deficiency of this vitamin is rare. Symptoms of deficiency are cheilosis, stomatitis, neuropathy and central nervous system effects (including depression). Rare are the conditions of toxicity. High doses up to 500 mg/day have been associated with neurotoxicity. As for vitamin B12, it acts as coenzyme in reactions of lipid and carbohydrate metabolism, protein and hematopoiesis synthesis. Vitamin B12 deficiency may result from inadequate intake (as for vegetarians including "vegans"), malabsorption, gastric or ileal disease. Symptoms of deficiency are macrocytic anemia and neurological abnormalities.

Fat-Soluble Vitamins

Vitamin A

Cow's milk has a low content of vitamin A, on average 29 ug/dl [5], unlikely to be able to meet the daily requirement in the age group between 1 and 3 years, which is about 400 ug [9]. Vitamin A is essential for the mechanism of vision and cell differentiation. A first sign of vitamin A deficiency is the decreased low-intensity light adaptation (night blindness). Vitamin A deficiency is also associated to an increased risk of morbidity and mortality due to infectious diseases [45]. Some studies have shown that supplementation reduces measles incidence and duration of respiratory involvement and mortality [45, 46]. Moreover, the relationship between supplementation and severity of episodes of infectious diarrhea appears to be significant, although the effects depend on the type of pathogen involved [45, 46].

Vitamin D

Cow's milk has a low content of vitamin D, on average about 0.1 ug/dl [5]. The recommended daily intake of vitamin D for term infants is, in many countries and also in Italy, of 400 UI, corresponding to 10 μg [9, 47]. Although a minimum dose of 100-200 UI/day (2.5-5.0 μg) of vitamin D is able to prevent in the majority of term newborn infants, in the presence of a normal exposure to sunlight, the onset of rickets, a requirement of at least 400 UI/day (10.0 μg) seems to be most suitable as it is completely safe and appropriate even in the absence of exposure to sunlight [47].

Recent studies have shown that vitamin D is not only important for bone health, but also exerts a total inhibitory activity on the adaptive immunity system, resulting in decreased production of pro-inflammatory cytokines such as IFN-γ and IL2 and, overall, playing a regulatory activity of the immune system [48]. Indeed experimental models have shown a possible role of vitamin D in the prevention and treatment of diseases such as inflammatory arthritis, autoimmune diabetes, inflammatory bowel disease and forms of autoimmune encephalitis [48]. The latest guidelines from the American Academy of Pediatrics (AAP) recommend additional vitamin D to all breastfed infants, children and adolescents not sufficiently exposed to the sun and that do not ingest at least 1 liter of fortified milk per day to ensure the daily intake of at least 400 UI of vitamin D [47]. The daily requirement in the age group between 12 and 36 months is 600 UI/day (15.0 μg) [9]. In New Zealand, recently has been demonstred that habitual consumption of vitamin D-fortified milk (toddler milk) was effective in achieving adequate year-round serum 25(OH)D ($\geq$50 nmol/L) for most healthy toddlers [49].

... and CALCIUM supply

Cow's milk has an average content of calcium of 116 mg/dl and of 98 mg/dl of phosphorus [5], with a calcium/phosphorus ratio of about 1.2. In infant growth milks the ratio of calcium/phosphorus is higher, on average around 2, allowing better absorption of calcium and avoiding the risk of hypocalcaemia due to excessive intake of phosphorus. The ideal calcium/phosphorus ratio should be greater than 1, since an excessive dietary intake of phosphorus can lead to symptomatic hypocalcaemia in early infancy.

For proper bone development, beside an adequate intake of vitamin D, an appropriate consumption of calcium and phosphorus is also needed. The daily requirement of calcium in infants is 260 mg, in children aged 12 to 36 months 700 mg [9]. Epidemiological investigations carried out both in Italy and in Europe have shown that daily calcium intake is often below the recommended consumption levels, especially starting from school age [50].

THE USE OF TODDLER MILK IN ITALY

The so-called toddler milks have a lower protein content than cow's milk and are supplemented with trace elements, including iron, essential fatty acids and vitamins. The commercialization of toddler milks continues to increase in many countries worldwide,

Table 2: The Compositon of Different Toddler Milks Currently Available in Italy

Formula number	1	1A	1B	1C	2*
Amount of ingredient/ 100 ml					
Calories (kcal)	65	82	82	60	67
Protein (g)	1.7	2.1	2.1	1.7	1.5
Whey/casein ratio (%)	30/70			30/70	
Lipids (g)	3.0	3.0	3.0	2.5	3.0
Saturates					
Monounsaturates					
Polyunsaturates					
LA/ALA	500/60	500/60	500/60	500/60	620/76
DHA (mg)					4.3
AA (mg)					4.3
Carbohydrates (g)	7.8	11.6	11.6	7.8	8.4
Lactose (g)					6.4
Sodium (mg)	34	45		30	30
Potassium (mg)	100	100	100	90	82
Chlorine (mg)	71	60	60	71	
Iron (mg)	1.2	1.5	1.5	1.2	1.0
Zinc (mg)	0.9	1.1	1.1	0.9	0.73
Calcium (mg)	90	110	110	84	78
Phosphorus (mg)	59	66	66	50	
Vitamin A (µg -RE)	75	75	75	75	76
Vitamin D (µg)	1.6	1.6	1.6	1.6	1.2
Vitamin B1 (µg)	160	160	160	160	140
Vitamin B2 (µg)	150	150	150	150	210
Vitamin B6 (µg)	100	100	100	100	80
Vitamin B12 (µg)	0.25	0.25	0.25	0.25	
Vitamin C (mg)	15	15	15	15	12
Fiber (g)					
GOS (g)					

(Table 2). Continued.

Formula number	2 A	2B	2C	3	3 A
Amount of ingredient/ 100 ml					
Calories (kcal)	70	81	82	69	65
Protein (g)	1.9	2.3	1.9	1.4	1.5
Whey/casein ratio (%)					
Lipids (g)	3.1	3.6	2.9	3.1	3.0
Saturates	0.83	0.96	0.89	1.1	1.1
Monounsaturates				1.4	1.3
Polyunsaturates	0.75	0.93	0.67	0.6	0.6
LA/ALA	660/90	830/100	600/70	561/71	550/69
DHA (mg)					
AA (mg)					
Carbohydrates (g)	8.5	9.5	12.0	8.8	8.0
Lactose (g)	3.5			3.5	5.5
Sodium (mg)	30	30	30	21	25
Potassium (mg)				72	94
Chlorine (mg)				46	62
Iron (mg)	1.3	1.3	1.3	0.8	0.8
Zinc (mg)	2.1	0.9	0.95	0.7	0.7
Calcium (mg)	104	109	84	69	104
Phosphorus(mg)				38	72
Vitamin A (μg -RE)	100	140	76	70	78
Vitamin D (μg)	2.1	2.6		1.2	1.3
Vitamin B1 (μg)	150	170	90	5.8	3.1
Vitamin B2 (μg)	170	190	150	71	65
Vitamin B6 (μg)	210	260	150	64	72
Vitamin B12 (μg)	0.21	0.21		0.14	0.13
Vitamin C (mg)	8.5	13	6.8	11	13
Fiber (g)		<0.5	0.12	0.5	
GOS (g)				0.5	

(Table 2). Continued.

Formula number	4 §	5	6	7	8
Amount of ingredient/ 100 ml					
Calories (kcal)	66	83	69	74	61
Protein (g)	1.9		1.5	2.7	1.7
Whey/casein ratio (%)			20/80		
Lipids (g)	2.7	2.8	3.0	2.5	2.5
Saturates	1.0	1.4	1.1	0.97	1.2
Monounsaturates	1,1	0.9	1.3		
Polyunsaturates	0.6	0.5	0.6		
LA/ALA	500/70		543/69	299/42	437/42
DHA (mg)					
AA (mg)					
Carbohydrates (g)	8.5	7.5	9.0	10.2	8.0
Lactose (g)	8.5		6.4		7.7
Sodium (mg)	30	28	20	38	28
Potassium (mg)	84		71	123	95
Chlorine (mg)	73		46	78	50
Iron (mg)	1.2		0.8	1,2	1.2
Zinc (mg)	0.7		0.7	0,5	0.6
Calcium (mg)	69		59	96	68
Phosphorus (mg)	50		37	77	50
Vitamin A (µg -RE)	65	80	64	56	63
Vitamin D (µg)	1.4	2.0	1.1	1.1	1.5
Vitamin B1 (µg)	100	100	66	83	80
Vitamin B2 (µg)	180	160	100	109	230
Vitamin B6 (mcg)	80	140	58	83	100
Vitamin B12 (µg)	0.15	0.15	0.13	0.25	0.30
Vitamin C (mg)	8	5	11	17	8.2
Fiber (g)	0.1	0.6		0.0	0
GOS					

(Table 2). Continued.

Formula number	**9 °**	**9 A**	**9 B^**
Amount of ingredient/ 100 ml			
Calories (kcal)	67	67	71
Protein (g)	1.5	1.5	2.5
Whey/casein ratio (%)	0.6/0.9	0.45/1.05	
Lipids (g)	3.0	2.8	3.5
Saturates	0.8	0.3	0.4
Monounsaturates	1.7	1.7	2.1
Polyunsaturates	0.5	0.8	1.0
LA/ALA	421/74	664/123	812/172
DHA (mg)			
AA (mg)			
Carbohydrates (g)	8.5	8.5	7.5
Lactose (g)	6.0	5.9	
Sodium (mg)	26	26	38
Potassium (mg)	75	81	61
Chlorine (mg)	41	41	10
Iron (mg)	1.2	1.2	1.3
Zinc (mg)	0.90	0.90	0.62
Calcium (mg)	86	84	105
Phosphorus (mg)	47	50	71
Vitamin A (µg -RE)	65	65	81
Vitamin D (µg)	1.7	1.7	1.3
Vitamin B1 (µg)	50	50	40
Vitamin B2 (µg)	136	110	200
Vitamin B6 (µg)	40	40	40
Vitamin B12 (µg)	0.14	0.18	0.39
Vitamin C (mg)	15	14	8
Fiber (g)	1.2	0.8	
GOS			

Explanation of terms and formulae used in Table **1**, which describes the compositon of different toddler formula milks available in Italy.
*Enriched with Streptococcus thermophilus and Bifidobacterium lactis.
§Ingredients from biological agriculture.
°100 ml at 15.1%.
^whole proteic amount derives from soy.
LA, linoleic acid; ALA, a-linolenic acid; AA, arachidonic acid; DHA, docosahexaenoic acid; GOS, galacto-oligosaccharides.
Formula 1: Latte David con latte intero (Plasmon), Formula 1A: Plasmon David Biscotto (Plasmon), Formula 1B: Plasmon David Cereali e Miele (Plasmon), Formula 1C: Plasmon David con latte scremato (Plasmon), Formula 2: Nidina 3 Crescita (Nestlè), Formula 2 A: Latte Mio (Nestlè), Formula 2 B: Latte Mio 5 Cereali (Nestlè), Formula 2 C. Latte Mio Biscotto (Nestlè), Formula 3: Humana 3 (Humana), Formula 3 A: Humana latte di crescita junior drink (Humana), Formula 4: Hipp 3 Bio (Hipp), Formula 5: Latte Prima Crescita Parmalat (Parmalat), Formula 6: Scuolabus (Milte), Formula 7: Nutribén Crescita, Formula 8: Mellin latte di crescita (Mellin), Formula 9: Aptamil 3 polvere (Milupa), Formula 9 A: Aptamil 3 liquido (Milupa), Formula 9B: Aptamil Latte di Crescita Soya (Milupa).

particularly in Europe, however their benefits are still a matter of debate. This controversy arose because the expected benefits from the use toddler milks with respect to the cow's milk develops from the nutritional composition more than from a clear demonstration and evidence derived from randomized clinical trials, except for protein and iron intake. A recent study presented the breastfeeding practices and use of nonhuman milk in Italy [51]. Exclusive breastfeeding is recommended by more than 80% of paediatricians for 4–5 months. More than 95% of paediatricians suggest to introduce cow's milk at 12 months or later (21.8% at or after 36 months of age). More than 95% of paediatricians suggest use of formula milk in infants having breastfeeding stopped within the first year of age and about 85% successive use of toddler milk [51]. In conclusion in Italy most of pediatricians paediatricians reported positive disposition towards the use of toddler milk.

Table **2** lists the compositions of different toddler milks currently available in Italy. Some comments about the use of certain nutrients are given below.

PROTEINS

Quantity and Quality

According to some recent observations, the proteins in cow's milk could be associated with the subsequent development of overweight and obesity. Some technical innovations have been proposed in order to reduce the protein content with values around 1.5-1.9 g/dl in most of toddler milks available in Italy.

LIPIDS

Quality

At present, all the commercially available infant formulae contain LA and ALA at a ratio that has been modified to be less than 10:1. In a toddler milk (Formula 2), amounts of AA and DHA have been added. Actually the role of LCPUFA supplementation in toddler milks has not been adequately investigated.

CARBOHYDRATES

From data available lactose is the only carbohydrate present in a toddler milk (Formula 4), although it is associated with greater fermentability. In all other infant formulae, maltodextrins and polysaccharides (both digestible and indigestible) have been added to lactose.

Indigestible polysaccharides (bifidogenic effect; prebiotics) are present in Formula 3 (galactooligosaccharides [GOS] only). Randomized controlled trials are needed to evaluate the effects of additional supplementation with prebiotics in toddler milks.

This study showed that infant formula closer resembling human milk was more bifidogenic than the control formula and led to a microbiota profile similar to that for breast-fed infants.

PROBIOTICS

Formula 2 is enriched with Streptococcus thermophilus and Bifidobacterium lactis. Probiotic supplementation in formulas is generally considered safe and a recent review has evaluated the effects of probiotics on health [52]. In particular a recent review [52] showed that supplementation of infant formula with *Bifidobacterium lactis* (alone or combined with other probiotics) is associated with a reduced risk of gastrointestinal infections in children and that Supplementation of infant formula with *Bifidobacterium lactis*, combined with *Streptococcus thermophilus* or *Lactobacillus reuteri* is associated with a reduced use of antibiotics. However studies evaluating the effect of probiotic supplementation in toddler milks are lacking.

CONCLUSIONS

Toddler milk is an effective food which may assure a balanced diet for children and supports growth and development while respecting their nutritional requirements. Toddler milks are formulated depending on the diversified dietary requirements of children between 12 and 36 months of age. The choice of a toddler milk may be functional to the needs of individual children, taking into account that the use of this milk instead of cow's milk allows:

- A low intake of protein avoiding nutritional excesses, even if the effects of early protein intake with regard to obesity development is actually discussed.
- An adequate consumption of iron and vitamin C having a protective effect against the development of iron deficiency anemia.
- A supplementation with micronutrients (iron and zinc) important for the correct functioning of natural defense mechanisms, for the development-activity of immune system cells and for a adequate neurological development.

- A supplementation with vitamins and essential fatty acids for an appropriate growth and development.

However other alternatives, such as the use of non-dairy whole food, could be considered to solve the problem overeating protein and prevention of iron and zinc deficiency in young children.

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