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INFANT FORMULA CONTAINING FULL CREAM MILK FATS: LATEST INNOVATIONS

The benefits of breastfeeding are well established, with exclusive breastfeeding recommended for up to six months of age. Presently, in Great Britain, less than 17% of women comply with these guidelines and manage to breastfeed 'exclusively' for the full six months.

In circumstances where breastfeeding may not be possible, solely adequate, or suitable, closely matched alternatives are needed. This article aims to discuss the nutritional profile of infant formula that uses full-cream milk fats (whole cows' milk) and explains how these products are evolving and integrating the latest science.

It is widely acknowledged that breastfeeding is best, having many short and long-term benefits for both mother and child.¹ The World Health Organisation (WHO) advises that '*exclusive breastfeeding is recommended for up to six months of age, with continued breastfeeding along with appropriate complementary foods up to two years of age or beyond*'.² The colostrum in particular (the yellowish sticky fluid produced after birth) is regarded as the perfect food for the newborn and should be introduced within the first hour after birth.²

Unfortunately, through no fault of their own, many women are not able

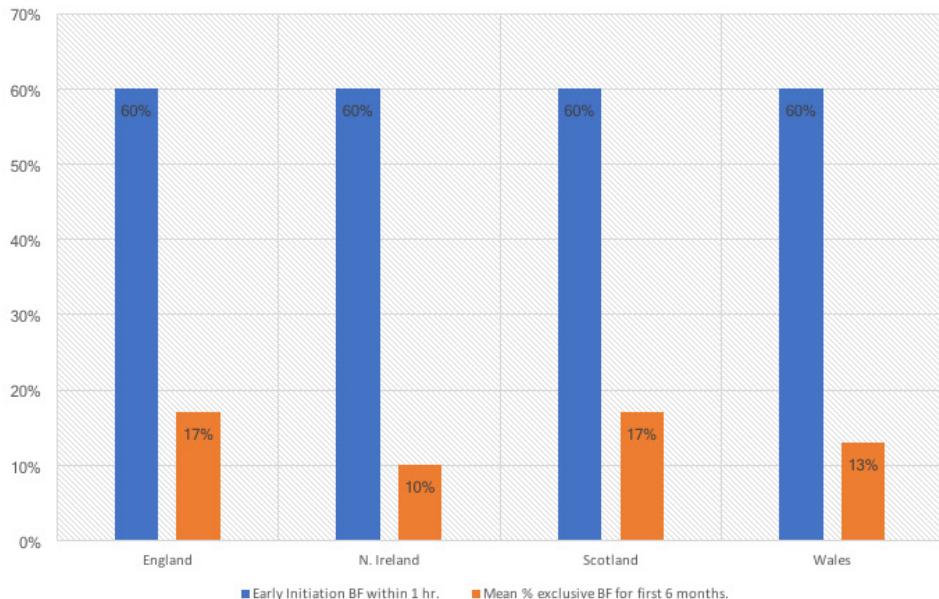
to breastfeed. There is evidence that long labours, maternal exhaustion and stress due to traumatic deliveries can all lead to delayed lactogenesis.³ Other work has shown that women delivering by emergency C-section have a higher proportion of breastfeeding difficulties (41%) compared to those delivering vaginally (29%).⁴ Medical conditions, such as tongue tie (ankyloglossia), can also affect an infant's ability to latch on, leading to breastfeeding problems.⁵ A summary of studies investigating obstacles to breastfeeding is shown in Table 1.

The World Breastfeeding Trends Initiative (WBFTI), supported by the Lactation Consultants of Great Britain, provides useful insights into patterns of infant feeding.⁶ As shown in Figure 1 overleaf, patterns of breastfeeding vary across Great Britain. Data from the WBFTI (2016) shows that three out of five women (60%) initially breastfeed within one hour of giving birth. However, by six months less than two out of 10

Table 1: Key obstacles to breastfeeding

Obstacle
Emergency C-section
Employment and early return to work
Infant tongue tie (ankyloglossia)
Long labours, maternal exhaustion and stress
Pain, difficulty latching on, relentlessness of early infant feeding
Maternal obesity and related difficulties
Sibling jealousy

Figure 1: Initiation and rates of exclusive breastfeeding for six months (% of women)



(17%) women in England breastfeed exclusively, with lower rates of 10 and 13% in Northern Ireland and Wales, respectively. Furthermore, the median duration of breastfeeding is three months in England, five days in Northern Ireland, six weeks in Scotland and just over two weeks in Wales (Figure 2).

In instances where breastfeeding may not be possible, adequate or suitable, other options are needed.⁷ Infant formula that mimics the nutritional composition of breastmilk, particularly its fat composition, may be the next best alternative to provide nutrition and nurture to the infant.⁸ A recent study showed that of 81%

Figure 2: Median duration of breastfeeding (months)

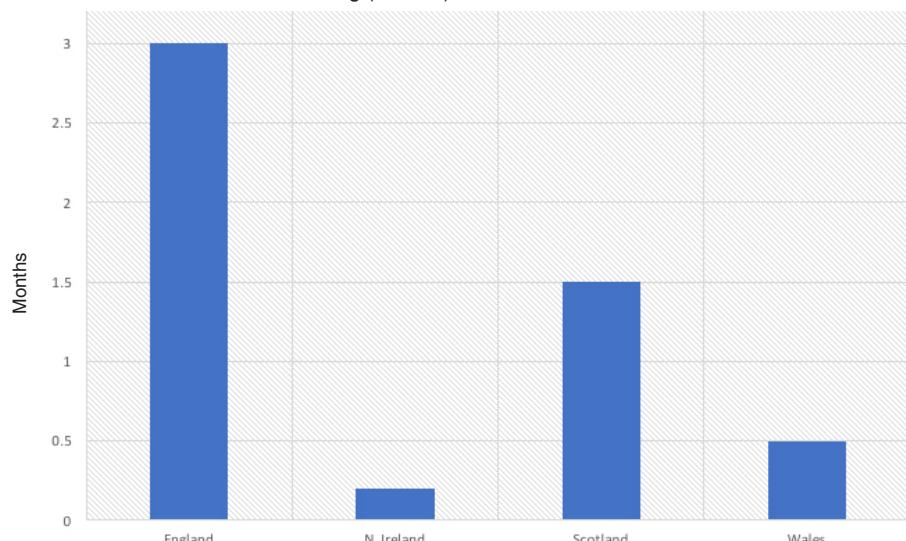


Table 2: Nutritional profile of milks (per 100ml)

	Milk, whole, pasteurised, average	Milk, semi-skimmed, pasteurised, average	Human milk, mature
Water g	87.6	89.4	87.1
Energy Kcal	63	46	69
Fat g	3.6	1.7	4.1
Saturated fat g	2.3	1.1	1.9
Carbohydrate g	4.6	4.7	7.2
Protein g	3.4	3.5	1.3
Vitamins			
Biotin mcg	2.5	3	0.7
Folate mcg	8	9	5
Niacin mg	0.2	0.1	0.2
Retinol mcg	36	19	58
Vitamin B1 mg	0.03	0.03	0.02
Vitamin B12 mcg	0.9	0.9	Tr
Vitamin B2 mg	0.23	0.24	0.03
Vitamin B6 mg	0.06	0.06	0.01
Vitamin C mg	2	2	4
Vitamin E mg	0.06	0.04	0.34
Vitamin K mcg	0.6	NR	NR
Inorganics			
Calcium mg	120	125	34
Chloride mg	89	87	42
Copper mg	Tr	Tr	0.04
Iodine mcg	31	30	7
Iron mg	0.02	0.03	0.07
Magnesium mg	10	10	3
Phosphorous mg	96	96	15
Potassium mg	157	162	58
Selenium mcg	1	1	1
Sodium mg	42	44	15
Zinc mg	0.5	0.5	0.3

Source: CoFID (2015)

of mothers using infant formula, 69% chose to feed their infants cows' milk formula.⁹

WHOLE COWS' MILK

As shown in Table 2, the fat content of whole cows' milk is closely aligned with that of human milk. Studies show that milk fat contains around 400 different fatty acids, making it the most complex of all natural fats.^{10,11} Due to the natural presence of fats in whole cows' milk, fewer manufactured vegetable oils need to be added to infant formulas using this as a base. Recently, the use of vegetable oils in formulas has been questioned, as these can influence

the balance of palmitic acid (16:0) which is an essential component of infant tissue lipids.¹² It has also been associated with reduced fat and calcium absorption and harder stools when used in infant formulas,¹³ and its use is questionably ethical, namely due to wide scale deforestation.¹⁴ Whole cows' milk is also a good provider of B vitamins, including B2 (riboflavin) and B12 and the minerals iodine, potassium and phosphorous (Table 2). Research has shown that the bioavailability of vitamin B12 in cows' milk is substantially higher than equivalent amounts of cyanocobalamin, the synthetic form of this vitamin.¹⁵ Milk is also an important source of

choline, an essential nutrient that contributes to the growth and development of newborns.¹⁶ Cows' milk also contains more L-carnitine than human milk which plays a central role in energy production, alongside being concentrated in tissues such as skeletal and cardiac muscle.¹⁷

Taken together, the range of nutrients present in whole cows' milk provides a good base for infant formulas, though iron levels are lower than needed. At this point it should be considered that infant formulas are different to liquid cows' milk in that they are fortified with iron and other nutrients, including vitamin D. The shortfalls in iron are partly why liquid cows' milk is not advised for the first 12 months of life.¹⁸

Cows' milk, however, tends to be associated with cows' milk allergy (CMA). Findings from the latest EUROPREVALL Study (The prevalence, cost and basis of food allergy across Europe) found that <1% of children up to the age of two years had confirmed CMA. The diagnosis of CMA in this important study was tested using gold standard diagnostic procedures.¹⁹

MILK FATS

Human milk fat naturally contains palmitic acid that is esterified to the beta-position of triglycerides (an sn-2 bond), with evidence that this form favourably influences fatty acid metabolism and calcium absorption and improves bone matrix, stool consistency and the gut microbiome.²⁰ The sn-2 bond is also regarded as being particularly important in the regulation of fat digestion and absorption.²¹ Presently, most supplemental formulas using vegetable oils as a main fat source contain palmitic acid with sn-1 and sn-3 bonds located at the external or alpha-position, which may impact on intestinal fat absorption.^{22,23} Formulas using dairy fat tend to contain more palmitic acid that is esterified in the sn2 position.²⁴

Since the middle of the 20th century, cows' milk fat has progressively been removed from infant formulas and replaced with vegetable oils.²⁴ Latest evidence, however, indicates that dairy fat blended with a lower level of vegetable oils may be the best way to mimic the composition, structure and physiological properties of human breast milk oils.²⁴ The

combined use of different lipid sources also helps to balance out proportions of fatty acids, especially lauric, myristic and palmitic acid,²⁵ as well as providing palmitic acid mainly in the esterified sn2 position of triglycerides.²⁴

Whole cows' milk fat also provides a range of lipophilic microconstituents. These include the vitamins A, D, E and K, carotenoids and phytosterols.²⁶ A spectrum of bioactive components are also present in milk fat, including lipophilic antioxidants such as conjugated linoleic acid (CLA), coenzyme Q10 and phospholipids, with milk fat being regarded at the most easily digested fat in the human diet.¹¹ CLA, in particular, has drawn particular attention for its biological activities, including its ability to modulate immune and inflammatory responses.²⁷

It has recently been proposed that an ideal docosahexaenoic acid (DHA) target should be established for breast milk, with the view that this should be 0.3% or 1.0% of milk fatty acids.²⁸ Koletzko and colleagues²⁹ have also recommended that, when breastfeeding is not possible, infant formulas should provide DHA between 0.2 and 0.5 weight percent of total fat, with the minimum amount of Arachidonic Acid (ARA) equivalent to the contents of DHA being used. Recently, it has been put forward that both DHA and ARA should be included in infant formula, as breastfed infants obtain both of these fatty acids.³⁰ With regard to trans fats, these are naturally present in whole cows' milk but also present in breast milk via dietary transfer.^{31,32}

Current opinion suggests that adding complex lipids and milk fat globule (MFG) membranes to vegetable oil-based infant formula could help to enhance infant development and reduce infections.³³ For example, human fat contains an array of lipid component present as MFG, with a core containing triglycerides (98% of total lipids), surrounded by a MFG.²⁴ Consequently, cows' whole milk formulas have the advantage over those using semi-skimmed milk in that cows' milk already contains complex natural fats and around 400 different fatty acids.¹⁰ This means that fewer processed vegetable-oils or other complex lipids need to be added.



Breastfeeding support and interventions should continue to be provided, especially as levels of 'exclusive' breastfeeding are so low.

IRON

There have been concerns about the low iron content of cows' milk, with particular reference to iron deficiency (ID) risk in infants and toddlers.³⁴ However, the iron content of human milk is also typically low, with the theory that an infant's iron stores should be accumulated in pregnancy.³⁵ Whilst iron is needed for infant neurodevelopment,³⁶ excess iron may promote the growth of pathogenic iron requiring bacteria,³⁵ indicating the importance of balance. The Global Standard for the composition of infant formula advises that the iron content of formula based on cows' milk protein and protein hydrolysate should be a minimum of 0.3mg per 100kcal and maximum of 1.3mg per 100kcal.³⁷

Revised guidelines relating to iron intakes in babies and children up to three years of age, have been issued in compliance with article 14 of the European Commission Regulation. This ensures that infant formula and follow-on formulae contain sufficient levels of iron, ranging from 0.6mg/100kcals to 2.00mg/100kcals, to support the formation of haemoglobin and red blood cells and a normal functioning immune system.^{38,39,40}

VITAMIN D

Cows obtain vitamin D from both their diet and skin UVB exposure, with the vitamin D status of the cow impacting on the vitamin D content of milk produced in much the same way as human breast milk.⁴¹ Whilst there is great potential to further optimise the vitamin D content of cows' milk, cows' milk formulas are fortified to ensure that infants obtain suitable levels of vitamin D. The global standard for the composition of infant formula advised that infant formula contained a minimum of 1 μ g and maximum of 2.5 μ g vitamin D per 100kcal.³⁷

Health claims relating to the contribution of vitamin D to normal development of teeth and bones, have been formally approved and considered appropriate for infants and young children from birth to three years.⁴² Recently, the UK Scientific Advisory Committee on Nutrition report on vitamin D advised a safe daily intake of between 8.5-10 μ g/day for ages 0 up to one year (including exclusively breastfed and partially breastfed infants, from birth); and 10 μ g/day for ages one up to four years, although data was not sufficient to set Reference Nutrient Intakes.⁴³ Amongst a sample of Dutch infants, median vitamin D intakes were 16-22 μ g/day for infants aged 0 to six months (increasing with age) and 13-21 μ g/day for infants aged seven to 19months (decreasing with age), indicating that a combination of infant formula, (fortified) foods and supplements was successful in achieving suitable intakes of vitamin D.⁴⁴

DISCUSSION

Taking the latest evidence on board, breastfeeding is the gold standard when it comes to infant feeding and should be undertaken for at least six months exclusively.² However, in reality, for physiological or other reasons, these guidelines are not being followed. In fact, latest data across Great Britain shows that less than one in five (20%) of women feed their infants exclusively for the first six months.⁶ Whilst interventions can clearly be put into place to improve rates of breastfeeding, other options also need to be provided.

Whole cows' milk is a good provider of nutrients, especially B2 (riboflavin), B12, iodine, potassium and phosphorous,⁴⁵ along with choline¹⁶ and L-carnitine.¹⁷ Milk lipids in general are attracting much interest at present, due to the presence of bioactive compounds in the lipid fraction - this includes omega-3 and 6

Polyunsaturated fatty acids, conjugated linoleic acid, short chain fatty acids, gangliosides and phospholipids.⁴⁶ Furthermore, it is coming to light that cows' milk lipids and milk fat membrane extracts better mimic human milk structure and composition, yet few infant formulas use these, as they are more expensive than vegetable lipids.⁴⁷ Subsequently, more recent evidence suggests that adding complex lipids and milk fat globules to vegetable-oil based infant formulas could help to support infant development and reduce infection risk.³³

Animal studies indicate that grass-fed cows produce milk with an improved fatty acid profile. For example, a recent study has found that Holstein cows fed on cool-season pastures produce whole milk with a higher omega-3 and CLA content than those fed on pearl millet.⁴⁸ Other work has also shown that pasture-fed cows, i.e. fed outdoors on grass and clover, produce milk containing significantly higher levels of saturated and unsaturated fatty acids, with more than a two-fold increase in CLA compared with milk produced from cattle fed indoors on a total mixed ration diet.⁴⁹ Augmenting milk microconstituents by means of animal nutrition, rather than milk fortification, also helps to safeguard animal health.²⁶

Formulas using whole cows' milk also have potential to support the British dairy industry.

The British dairy industry is under pressure, with many dairy farmers expected to leave the industry, as they cannot continue to produce milk at a loss. This is largely due to increasing UK and EU supplies coupled with a stagnant global market.⁵⁰ In New Zealand, infant formula is regarded as an 'export superstar' and has played a significant role in supporting the dairy industry which has now become a great success.⁵¹ Whilst breastfeeding should continue to be supported first and foremost, it should also be considered that alternatives are needed and the British dairy industry can play a role in providing these.

CONCLUSIONS

In summary, whilst breastfeeding is regarded as the best way to feed infants, this is not always possible for a host of different reasons. Breastfeeding support and interventions should continue to be provided, especially as levels of 'exclusive' breastfeeding are so low. However, whilst the benefits of breastfeeding are well recognised, it should also be appreciated that other options are needed for women who cannot breastfeed through no fault of their own. In these instances, British full cream formulas provide an alternative option. These provide a good nutrient base, meaning that only subtle levels of fortification and fewer manufactured vegetable oils are needed.

Key points

- Exclusive breastfeeding is recommended for up to six months of age, as advised by the World Health Organisation (WHO).
- Presently, less than 17% of women in Great Britain feed infants exclusively for the recommended six-month duration.
- Cessation of breastfeeding appears to be attributed to a host of different reasons, including physiological and medical reasons.
- In cases where breastfeeding is not possible, solely adequate, or suitable, closely matched alternatives are needed.
- Full-cream milk fat infant formula provides an excellent nutrient base and spectrum of fatty acids.
- There is growing evidence that lipid sources need to be carefully selected to better mimic breast milk, which includes the potential use of dairy fat.

Conflict of Interest

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The article was written independently and its content reflects the opinion of the author only.