Effect of a new prebiotic supplemented formula on growth parameters & stool microbiology of term infants

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By
Nesreen Nagy Hassan
M.B.B.Ch.
Faculty of Medicine - Ain shams university (2005)

Supervised by

Prof. Dr. Adham Mohamed Hegazy

Professor of Pediatrics
Faculty of Medicine - Ain shams university

Prof. Dr. Ghada Abdelwahed Ismail

Professor of Clinical Pathology
Faculty of Medicine - Ain shams university

Dr. Marwa Talaat El Deeb

Lecturer of Pediatrics
Faculty of Medicine - Ain shams university

Faculty of Medicine
Ain Shams university
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كلية الطب جامعة عين شمس

تحت إشراف

الأستاذة الدكتور / أدهم محمد الطاهرى

أستاذ طب الأطفال
كلية الطب –جامعة عين شمس

الأستاذة الدكتورة /غادة عبدالواحد اسماعيل

استاذ الباثولوجيا الأكلينيكيه
كلية الطب – جامعة عين شمس

الدكتورة / مروه طلعت الديب

مدرس طب الأطفال
كلية الطب -جامعة عين شمس

كلية الطب
جامعة عين شمس
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LIST OF ABBREVIATIONS

AAP	American Academy of Pediatrics
FDA	American Food and Drug Administration
ARA	arachidonic acid
ADHD	Attention deficient hyperactive disease
CD	celiac disease
CD	Cluster of differentiation
CpG	Coupled protein G
DP	Degree of polymerization
DHA	docosahexaenoic acid
FAE	Follicle associated epithelium
FOS	Fructo-oligosaccharide
GOS	Galacto-oligosaccharide
GRAS	Generally Recognized As Safe
GALT	Gut associated lymphoid tissue
HSP_S	heat shock proteins
HMO	Human milk oligosaccharide
IL	Interleukin
INF-	Interferon
IEL	Intraepithelial lymphocytes
LP	Lamina propria
LPS	Lipopolysaccharides
NF-κB	Nuclear factor κB

LIST OF ABBREVIATIONS (CONT.)

NOD	Nucleotide oligomerization domain
NEC	Necrotizing enterocolitis
NLR	NLR, NOD-like receptor;
OME	Otitis media with effusion
PP	Payer's Patches
PAMP	Pathogen-associated molecular patterns
PRR	Pattern recognition receptors
SCFA	Short chain fatty acids
TLR	Toll-like receptor
SIDS	sudden infant death syndrome
TNF-α	Tumor necrosis factor-alpha
WHO	World Health Organization

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INTRODUCTION

Bacterial colonization of the sterile neonatal gut starts soon after birth and consists predominantly of bifidobacteria and lactobacilli. These pioneer bacteria modulate gene expression in host epithelial cells, create a favorable permanent habitat for themselves, and prevent growth of harmful bacteria. Early colonization is thus a critical determinant of the permanent gut flora that may beneficially affect the individual's health throughout life by preventing conditions such as colon cancer, inflammatory bowel disease, allergic diseases, diabetes, and obesity ***(Neu et al., 2007)***.

Human milk contains various "oligosaccharide prebiotics" that promote the beneficial gut flora, making breastfeeding very important especially in the first month of life ***(Lara-Villoslada et al., 2007)***. However, breastfeeding may not be possible for various reasons. Formula feeding at such a critical stage of development may result in failure to develop normal gut flora and colonization with potential pathogens such as staphylococci and *Escherichia coli* ***(Harmsen et al., 2000)***. Supplementation of formula milk with prebiotic oligosaccharides such as galactose oligosaccharide (GOS) and fructose oligosaccharide (FOS) is therefore being explored to overcome this problem ***(Roberfroid et al., 2007)***.

Prebiotic oligosaccharides are short-chain carbohydrates with a degree of polymerization between 2 and 60 and are nondigestible by human or animal digestive systems. The defining property of prebiotics is their ability to selectively stimulate the growth of bifidobacteria and lactobacilli in the large intestine ***(Cummings et al., 2002)***. The prebiotic oligosaccharides in turn are fermented by the gut flora, resulting in the release of hydrogen and carbon dioxide gas and short-chain fatty acids such as butyrate. The short-chain fatty acids reduce the pH of the stools, resulting in more acidic

stools, which in turn leads to a mild laxative effect with softening and increased frequency of stools. This could be beneficial in preventing the constipation that is frequently observed in formula-fed infants. In addition, the acidic pH prevents growth of pathogens, promotes further growth of healthy organisms, and promotes integrity of colonic epithelial cells ***(Shripada Rao et al., 2009)***.

AIM OF THE WORK

The aim of our study is to evaluate the effect of a new infant formula supplemented with (o.8 g/100 ml) prebiotics (galacto-oligosaccharide & fructo-oligosaccharide in a ratio 9:1) on intestinal micro-flora (Bifidobacteria, Lactobacilli) &it's subsequent effect on term infant's growth & imunity compared with human Milk and a standard infant formula without prebiotics.

Chapter I
BREASTFEEDING

Breastfeeding is the feeding of an infant or young child with breast milk directly from human breasts rather than from a baby bottle or other container. Babies have a sucking reflex that enables them to suck and swallow milk. Most mothers can breastfeed for six months or more, without the addition of infant formula or solid food.

Human breast milk is the most healthful form of milk for human babies ***(Picciano, 2001).*** There are a few exceptions, such as when the mother is taking certain drugs or is infected with tuberculosis or HIV. Breastfeeding promotes health, helps to prevent disease and reduces health care and feeding costs ***(Yeo et al., 2005).*** In both developing and developed countries, artificial feeding is associated with more deaths from diarrhea in infants ***(Horton et al., 2000).*** Experts agree that breastfeeding is beneficial, but may disagree about the length of breastfeeding that is most beneficial, and about the risks of using artificial formulas ***(Baker, 2003).***

Both the World Health Organization (WHO) and the American Academy of Pediatrics (AAP) recommend exclusive breastfeeding for the first six months of life and then supplemented breastfeeding for up to one (AAP) or two years or more (WHO). Exclusive breastfeeding for the first six months of life "provides continuing protection against diarrhea and respiratory tract infection" that are more common in babies fed formula. The WHO and AAP both stress the value of breastfeeding for mothers and children ***(Gartner LM,2005)***. While recognizing the superiority of breastfeeding, regulating authorities also work to minimize the risks of artificial feeding ***(Baker, 2003).***