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FORMULA=BREAST MILK?!

DO YOU REALLY BELIEVE IT?

A *CRUCIAL* QUESTION

- **IS INFANT FORMULA REALLY VERY NEAR TO, OR ALMOST LIKE BREASTMILK?**
- **NO!**
- **EVEN NOW, FORMULA IS ONLY SUPERFICIALLY SIMILAR TO BREASTMILK**
- ***THERE IS NO QUESTION ABOUT THIS*!**

IS FORMULA ALMOST LIKE BREAST MILK?

- **HOW CAN IT POSSIBLY BE?**
- **WE DON'T REALLY KNOW WHAT IS IN BREASTMILK**
- **THERE IS NO SUCH THING AS A *STANDARD* BREASTMILK**
- **EVEN THE FORMULA COMPANIES ADMIT THAT NOT ALL BABIES NEED EXACTLY THE SAME STUFF AND, OF COURSE, WILL USE THIS NOTION TO MARKET THEIR FORMULAS (SPECIAL FORMULAS FOR SPECIAL BABIES)**
- **AT THE SAME TIME CONVINCING US THAT THEIR FORMULA IS *VIRTUALLY THE SAME AS BREASTMILK***
- **BUT *DIFFERENT* AND BETTER THAN THE FORMULAS OF THEIR COMPETITORS, WHICH ARE ALSO VIRTUALLY THE SAME AS BREASTMILK**

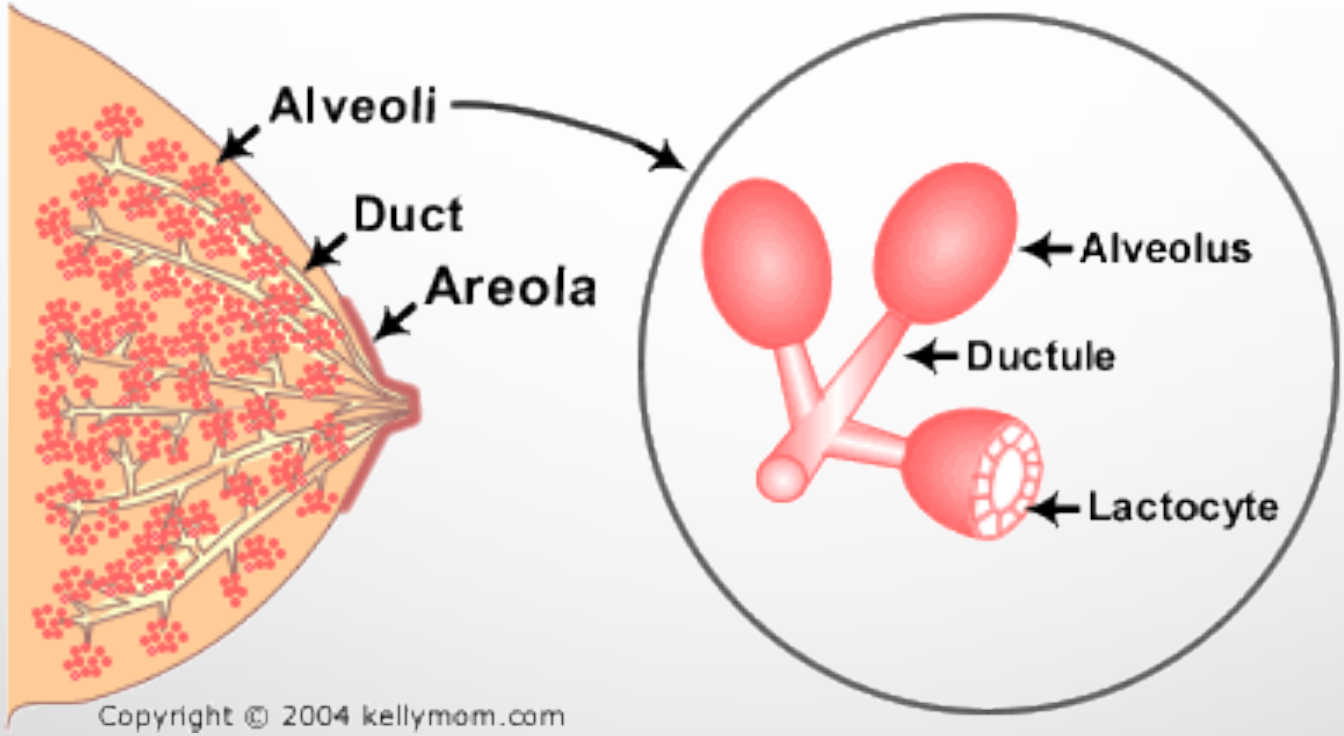
BREAST MILK VARIES

1. FROM WOMAN TO WOMAN
2. DEPENDING ON THE BABY'S GESTATIONAL AGE
3. WITH THE MOTHER'S DIET
4. WITH THE TIME OF DAY
5. WITH THE LENGTH OF TIME AFTER BIRTH
6. DURING A SINGLE FEEDING
7. WITH WHICH BREAST IS OFFERED FIRST
8. WITH THE TIME OF THE MOTHER'S MENSTRUAL CYCLE
9. WITH THE NUMBER OF PREVIOUS PREGNANCIES
10. DEPENDING ON HOW THE MILK IS OBTAINED

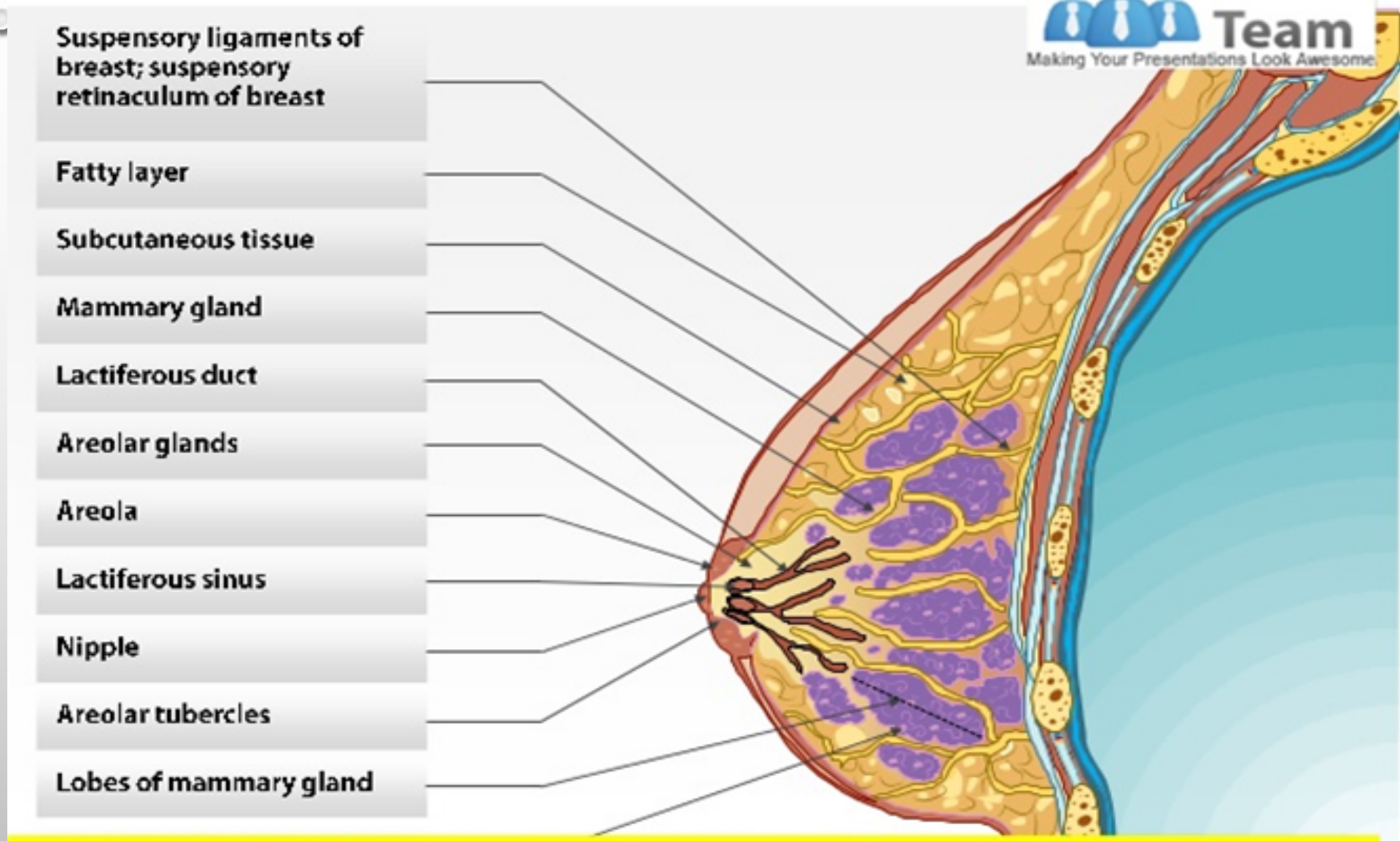
HUMAN MILK

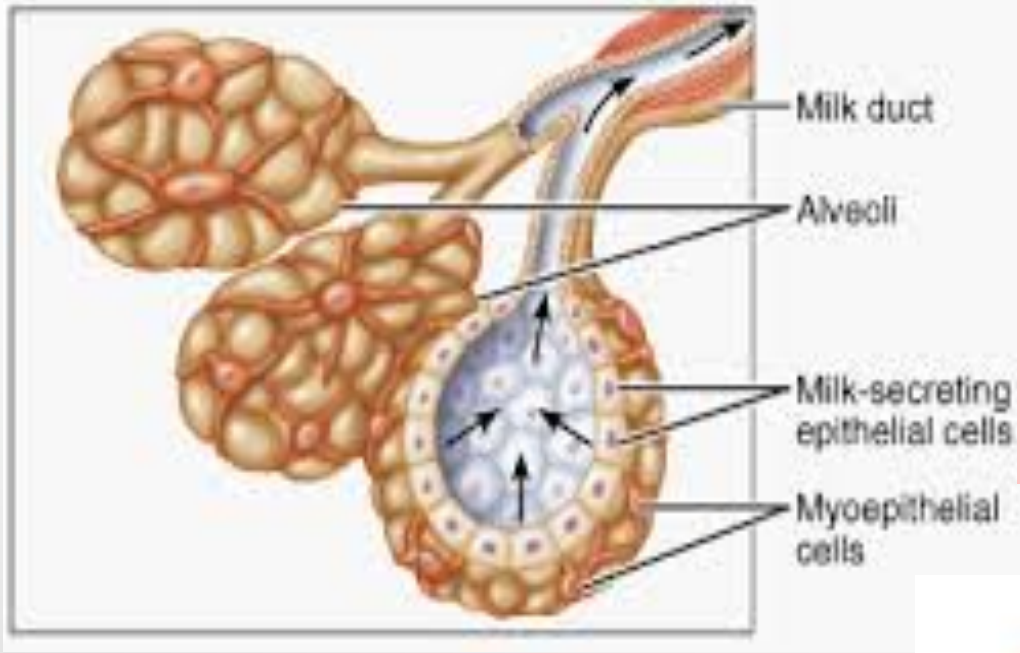
- THE DEFINING CHARACTERISTIC OF THE CLASS MAMMALIA IS THE ABILITY TO PRODUCE MILK, AN EXTERNALLY SECRETED FLUID DESIGNED SPECIFICALLY TO NOURISH THE YOUNG.
- IT IS A **UNIQUE COMPLEX LIVING FLUID** WITH A COMPOSITION THAT IS **SPECIES SPECIFIC.**
- IT IS THE MOST APPROPRIATE SOURCE OF NUTRITION FOR THE INFANT UP TO THE AGE OF 6 MONTHS.
- IT IS RICH IN NUTRIENTS NEEDED FOR THE **GROWTH** OF THE NEWBORN, AND IN **NON-NUTRITIONAL BIOACTIVE COMPONENTS** SUCH AS THE MATERNAL ANTIBODIES, CHEMICAL MEDIATORS, VITAMINS, ENZYMES AND SOME TYPES OF WHITE BLOOD CELLS IN BREAST MILK (PARTICULARLY IN COLOSTRUM) AUGMENT THE ACTION OF THE BABY'S IMMUNE SYSTEM.
- THIS UNIQUE FLUID EVOLVES TO MEET THE CHANGING NEEDS OF THE BABY DURING GROWTH AND MATURATION.

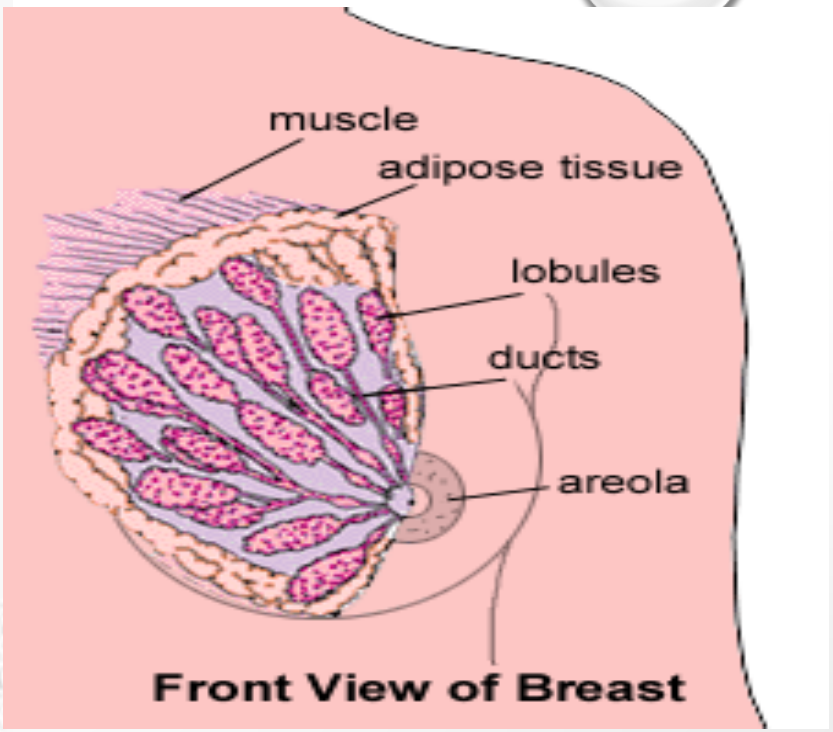
BREAST ANATOMY



Anatomy of Thoracic wall and Breast




Milk duct
Alveoli
Milk-secreting epithelial cells
Myoepithelial cells


muscle
adipose tissue
lobules
ducts
areola
Front View of Breast

TYPES OF BREAST MILK

THERE ARE BROADLY THREE TYPES OF BREAST MILK :

1- COLOSTRUM;

- IT IS THE FIRST STAGE OF BREAST MILK THAT IS PRODUCED AFTER BIRTH AND LASTS FOR SEVERAL DAY AFTER CHILD BIRTH.
- IT HAS A YELLOWISH TO CREAM COLORED THICK APPEARANCE.
- IT IS HIGH IN PROTEIN ESPECIALLY ANTIBODIES(THAT PROVIDE PROTECTION TO THE NEWBORN AGAINST INFECTION) , VITAMINS(ESPECIALLY FAT SOLUBLE VITAMINS) , MINERALS BUT VERY LOW IN FAT COMPARED TO MATURE BREAST MILK .

2- TRANSITIONAL MILK;

- IT OCCURS AFTER COLOSTRUM STAGE AND LASTS FOR APPROXIMATELY TWO WEEKS UNTIL IT IS REPLACED BY MATURE MILK.
- THE TRANSITIONAL MILK CONTAINS HIGH LEVELS OF FAT, LACTOSE, AND VITAMINS TO HELP THE BABY REGAIN ANY WEIGHT LOST AFTER BIRTH .

- IT CONTAINS MORE FAT AND LACTOSE THAN COLOSTRUM AND HAS WATER-SOLUBLE VITAMINS.

3- MATURE MILK ; - IT IS THE FINAL MILK THAT IS PRODUCED AND LASTS THROUGHOUT LACTATION.

-NINETY PERCENT IS WATER, WHICH IS NECESSARY TO MAINTAIN HYDRATION OF THE INFANT. THE OTHER 10% IS MADE UP OF CARBOHYDRATES, PROTEINS, AND FATS, WHICH ARE NECESSARY FOR BOTH GROWTH AND ENERGY.

-THERE ARE TWO TYPES OF MATURE MILK: FOREMILK AND HIND MILK.

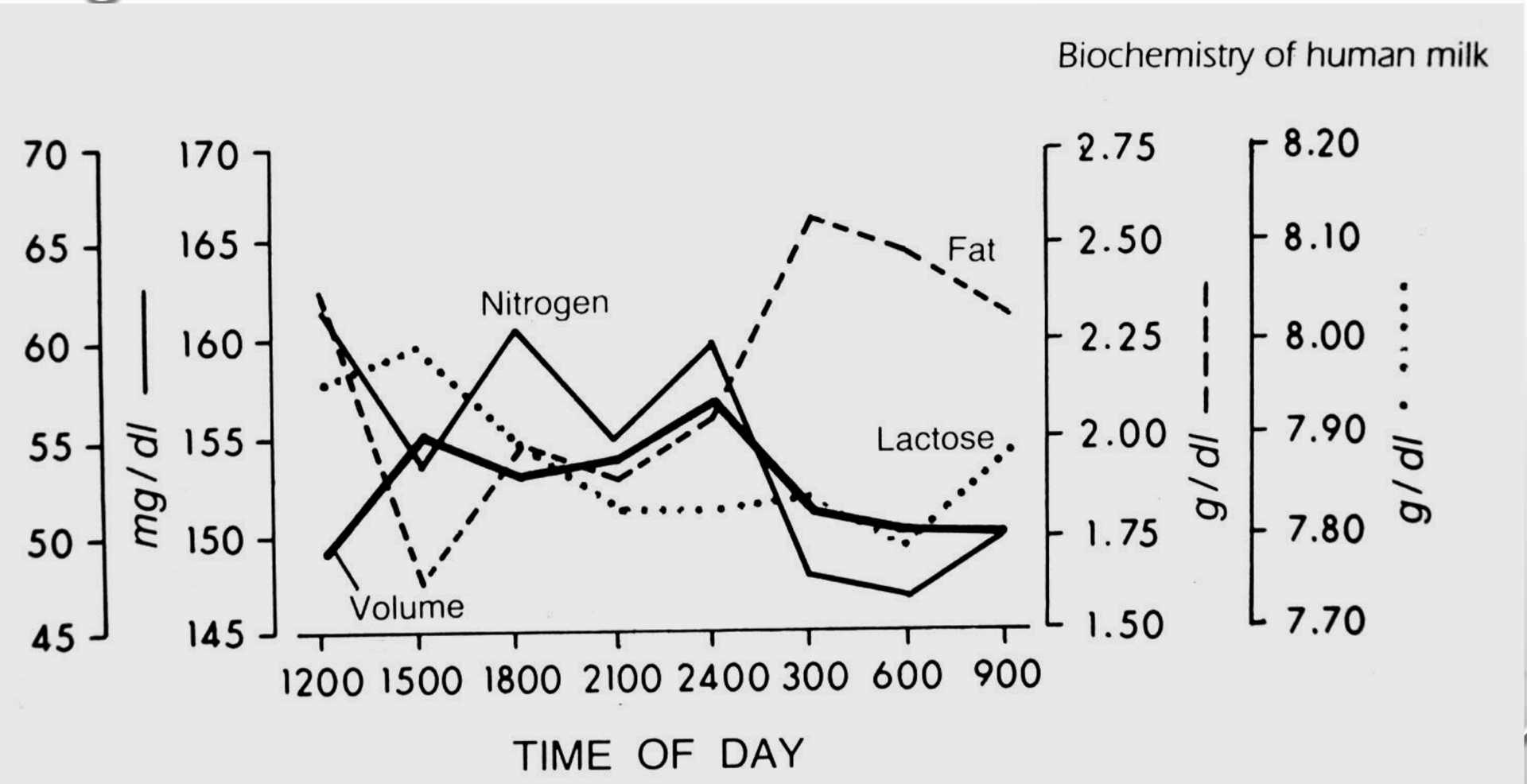
TYPES OF MATURE BREAST MILK

DURING EACH BREASTFEEDING SESSION, THE BABY SHOULD RECEIVE TWO TYPES OF MATURE MILK, THE FOREMILK AND THE HIND MILK TO ENSURE THAT THE BABY IS RECEIVING ADEQUATE NUTRITION TO GROW AND DEVELOP PROPERLY.

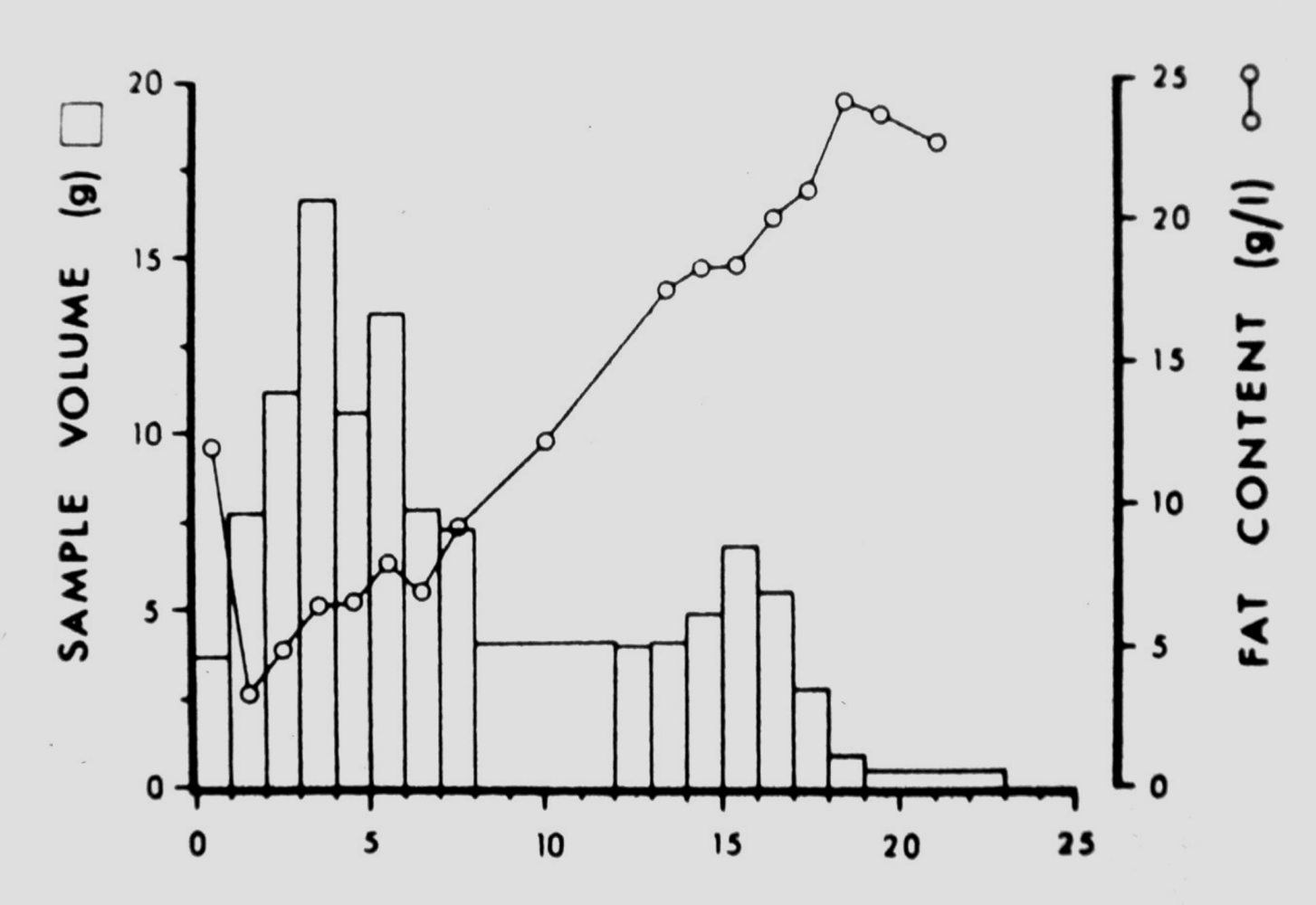
THE FOREMILK (THE MILK "IN FRONT"); IS PRODUCED AT THE BEGINNING OF EACH FEEDING. IT CONTAINS WATER, VITAMINS, AND PROTEIN.

THE HIND MILK ; IS PUSHED OUT LATTER , IT IS HEAVIER , RICHER IN LIPID AND CHO.

DIURNAL VARIATION OF BREAST MILK



VARIATION IN FAT CONTENT DURING A SINGLE FEEDING



COMPOSITION OF MATURE MILK

- MATURE MILK CONTAINS ON AVERAGE:
- ENERGY; (670-750 KCAL / LITER) .
- LIPIDS (38 G / LITER) - THE MAIN LIPIDS FOUND IN HUMAN BREAST MILK ARE THE TRIACYL-GLYCEROLS, PHOSPHOLIPIDS, AND FATTY ACIDS INCLUDING ESSENTIAL FATTY ACIDS. MATERNAL DIET DOES NOT AFFECT THE AMOUNT OF FAT IN MILK BUT DOES AFFECT THE TYPES OF FAT. CHOLESTEROL IS PRESENT IN BREAST MILK BUT NOT OR VERY LOW IN FORMULAS.
- CASEIN (2.5 G / LITER) - PROTEIN - CASEIN OR CURDS ARE PROTEINS WITH LOW SOLUBILITY WHICH COMPLEX WITH CALCIUM. THESE ARE PRESENT IN BREAST MILK IN MUCH LOWER CONCENTRATION THAN IN COW'S MILK.
- WHEY (0.64 G / LITER) - PROTEIN - THE WHEY PROTEINS ARE LOCATED IN THE CLEAR LIQUID LEFT BEHIND WHEN CLOTTED MILK STANDS. THE LARGEST COMPONENTS ARE ALPHA-LACTALBUMEN , LACTOFERRIN, LYZOZYME, ALBUMEN AND IMMUNOGLOBULINS.
-

CONT.

- **NONPROTEIN NITROGEN** IS USED IN AMINO ACID SYNTHESIS AND INCLUDES THE NITROGEN IN UREA, CREATINE, CREATININE, URIC ACID AND AMMONIA. PEPTIDES, SUCH AS EPIDERMAL GROWTH FACTOR, SOMATOMEDIN - C AND INSULIN ARE ALSO PRESENT IN THIS FRACTION. NUCLEOTIDES SUCH AS CYTIDINE MONOPHOSPHATE ARE DERIVED FROM NUCLEIC ACIDS AND PLAY AN IMPORTANT ROLE IN THE IMMUNE SYSTEM AND PROTEIN SYNTHESIS.

CONT.

- IN ADDITION,
- **LACTALBUMIN** IS PART OF AN ENZYME COMPLEX THAT:
- 1-**SYNTHESIZES LACTOSE**, AND
- 2- UPON MODIFICATION SEEMS TO CONTRIBUTE TO THE **APOPTOSIS OF MALIGNANT CELLS**.

COMPOSITION OF MATURE MILK

Table 6.4 Compositions of 100 mL colostrum (days 1–5 postpartum) and mature milk (day 15 postpartum)

Contents	Colostrum	Mature Milk
Calories (kcal)	55	67
Fat (g)	2.9	4.2
Lactose (g)	5.3	7.0
Total protein (g)	2.0	1.1
Secretory IgA	0.5[a]	0.1
Lactoferrin	0.5	0.2
Casein	0.5	0.4
Calcium (mg)	28	30
Sodium (mg)	48	15
Vitamin A (μg retinol equivalents)	151	75
Vitamin B_1 (μg)	2	14
Vitamin B_2 (μg)	30	40
Vitamin C (μg)	6	5

[a]Concentration is considerably higher at 1–3 days postpartum than at days 4 and 5.

THE IMMUNOLOGIC COMPONENTS OF MATURE MILK

WHILE AWAITING ENDOGENOUS MATURATION OF THE BABY'S OWN IMMUNOLOGIC SYSTEMS, VARIOUS IMMUNOLOGIC AND BIOACTIVE MILK COMPONENTS ACT SYNERGISTICALLY TO PROVIDE A PASSIVE IMMUNOLOGIC SUPPORT SYSTEM FROM THE MOTHER TO HER INFANT IN THE FIRST DAYS TO MONTHS AFTER BIRTH.

THE IMMUNOLOGIC COMPONENTS INCLUDE ;

- **IMMUNOGLOBULINS ;** HUMAN MILK **CONTAINS ALL OF THE DIFFERENT ANTIBODIES** (M, A, D, G, E), BUT SECRETORY IMMUNOGLOBULIN A (SIGA) IS THE MOST ABUNDANT .
- **LACTOFERRIN**,; WHICH BINDS TO IRON, THUS MAKING IT UNAVAILABLE TO PATHOGENIC BACTERIA;
- **LYSOZYME** , WHICH ENHANCES S IGA BACTERICIDAL ACTIVITY AGAINST GRAM-NEGATIVE ORGANISMS;
- **MUCINS** ADHERE TO BACTERIA AND VIRUSES AND HELP ELIMINATE THEM FROM THE BODY.
- **LEUKOCYTES**; WITH THE TRANSITION FROM COLOSTRUM TO MATURE MILK, THE PERCENTAGE OF MACROPHAGES INCREASES FROM 40-60% OF THE CELLS TO 80-90% .
- **CASEIN :** INHIBIT THE ADHESION OF VARIOUS BACTERIA AT DIFFERENT EPITHELIAL SITES
- **OLIGOSACCHARIDES:** PREVENT BINDING OF PATHOGENIC MICROORGANISMS TO GUT, WHICH PREVENTS INFECTION & DIARRHEA.

ENZYMES IN MATURE MILK

- HUMAN MILK CONTAINS VARIOUS ENZYMES ;

- - SOME ARE SPECIFIC FOR THE **BIOSYNTHESIS** OF MILK IN THE MAMMARY GLAND (EG, LACTOSE SYNTHETASE, FATTY ACID SYNTHETASE, THIOESTERASE),

- OTHERS ARE SPECIFIC FOR THE **DIGESTION** OF PROTEINS, FATS, AND CARBOHYDRATES THAT **FACILITATE THE INFANT'S ABILITY TO BREAK DOWN FOOD AND TO ABSORB HUMAN MILK (SUCH AS LIPASE, AND PROTEASE, AMYLASE)**

- CERTAIN ENZYMES ALSO SERVE AS **TRANSPORT MOIETIES FOR OTHER SUBSTANCES**, **SUCH AS ZINC, SELENIUM, AND MAGNESIUM.**

- SOME HAVE **ANTIMICROBIAL ACTIVITY** SUCH **AS LYSOZYME**.
- **THE ENZYME LYSOZYME WHICH INHIBITS THE GROWTH OF MANY BACTERIAL SPECIES** BY
- **DISRUPTING THE BACTERIAL CELL WALL,** MORE SPECIFICALLY, THE PROTEOGLYCAN LAYER

VITAMINS & MINERALS

- **FAT SOLUBLE** VITAMIN A, D, E & K
- **WATER SOLUBLE** VITAMINS IN GENERAL ARE PRESENT ,THEIR

  CONTENT **REFLECTIVE OF THE MOTHER'S DIET .**

  – **LOW VITAMIN B_{12} IS SEEN IN** WOMEN WHO ARE VEGETARIANS, MALNOURISHED OR HAVE HAD GASTRIC BYPASS .

- **MINERALS** ; THE MOST IMPORTANT SALTS ARE CALCIUM, SODIUM, POTASSIUM AND MAGNESIUM, REPRESENTING THE PREDOMINATING MINERAL.

MILK CARBOHYDRATES

- **LACTOSE (70 G / LITER) CARBOHYDRATE - LACTOSE IS THE MAJOR CARBOHYDRATE IN BREAST MILK. IT IS COMPOSED OF GALACTOSE AND GLUCOSE. LACTOSE CONCENTRATION IN BREAST MILK INCREASES OVER THE DURATION OF BREASTFEEDING.**

- **OLIGOSACCHARIDES;**
  - SECOND DOMINANT CHO

LIPID

- MORE THAN **98%** OF THE FAT IN BREASTMILK IS IN THE FORM OF **TRIGLYCERIDES.**
- SHORT-CHAIN FATTY ACIDS (CARBON CHAIN LENGTH ☐ 8) ARE ONLY PRESENT IN TRACE AMOUNTS.
- OLEIC ACID (18:1) AND PALMITIC ACID (16:0) ARE THE MOST ABUNDANT FATTY ACIDS IN BREASTMILK .
- CHOLESTEROL

(LCP) FATTY ACIDS(18- TO 22-CARBON LENGTH) **ARE NEEDED FOR BRAIN AND RETINAL DEVELOPMENT OF THE INFANT.**

CONT.

- **TRIGLYCERIDES**
- TRIGLYCERIDES ARE FAT. THEY ARE THE MAIN LIPID FOUND IN BREAST MILK, AND THEY MAKE UP 98% OF BREAST MILK FAT. TRIGLYCERIDES ARE RESPONSIBLE FOR THE STORAGE OF ENERGY. THE BONDS THAT HOLD THE TRIGLYCERIDE MOLECULES TOGETHER CONTAIN THE ENERGY. WHEN THE TRIGLYCERIDES ARE BROKEN DOWN, THE BONDS BREAK AND RELEASE THE ENERGY.

CONT.

- **CHOLESTEROL**
- CHOLESTEROL IS A STEROID, AND IT'S ESSENTIAL FOR BRAIN AND NERVE DEVELOPMENT. CHOLESTEROL IS ALSO NEEDED TO MAKE HORMONES WHICH REGULATE THE FUNCTIONS OF THE BODY. STUDIES SHOW THAT CHILDREN EXPOSED TO CHOLESTEROL IN BREAST MILK APPEAR TO HAVE BETTER HEART HEALTH AS THEY GROW. IT SEEMS THAT ADULTS WHO WERE BREASTFED AS CHILDREN HAVE LOWER LEVELS OF BAD (LDL) CHOLESTEROL AND A LOWER RISK OF HEART DISEASE
- HUMAN MILK CONTAINS 90 TO 150 MG/L CHOLESTEROL [8], IN CONTRAST TO
- NO APPRECIABLE CHOLESTEROL CONTENT IN VEGETABLE OIL–BASED INFANT FORMULAE AND
- TO APPROXIMATELY 40 MG/L IN DAIRY FAT–BASED INFANT FORMULAE.

PUFA

- **DOCOSAHEXAENOIC ACID (DHA)**
- DHA IS AN ESSENTIAL FATTY ACID THAT CONTRIBUTES TO THE DEVELOPMENT OF THE CENTRAL NERVOUS SYSTEM AND THE BRAIN. IT'S ALSO IMPORTANT FOR VISION AND THE DEVELOPMENT OF THE EYES, ESPECIALLY FOR PREMATURE INFANTS. **ROLE OF DHA**
- **ARACHIDONIC ACID (ARA)**
- THE IMPORTANCE OF THE ESSENTIAL FATTY ACID ARA IN BREAST MILK IS NOT ENTIRELY UNDERSTOOD. IT MAY PLAY A ROLE IN INFANT GROWTH, OR IT MAY BE NECESSARY TO BALANCE THE DHA.

CONT.

- **COMPLEX LIPIDS**
- COMPLEX LIPIDS ARE BELIEVED TO BE IMPORTANT FOR THE BRAIN, STOMACH, INTESTINES, AND SKIN. THEY ARE **FOUND IN A BABY'S BRAIN, THEY HELP TO FIGHT INFECTION, AND THEY ARE BELIEVED TO HELP REDUCE INFLAMMATION IN THE INTESTINES TO PROTECT A BABY AGAINST A SERIOUS INTESTINAL CONDITION CALLED NECROTIZING ENTEROCOLITIS (NEC).**

AMOUNT OF FAT IN BREAST MILK

- THE AMOUNT OF FAT IN BREAST MILK IS NOT CONSTANT.
- IT CHANGES THROUGHOUT THE DAY AND OVER TIME AS YOUR BABY GROWS. IT EVEN CHANGES DURING EACH FEEDING. THE ***LONGER*** YOUR BABY BREASTFEEDS ON THE SAME BREAST AND THE CLOSER SHE GETS TO EMPTYING THAT BREAST, **THE MORE FAT** SHE WILL RECEIVE.
- BREAST MILK PRODUCED FOR **PREMATURE INFANTS** IS ALSO VERY HIGH IN FAT. IT HAS ABOUT 30% MORE FAT THAN THE BREAST MILK THAT'S MADE FOR FULL-TERM BABIES.

MOTHER'S DIET, FAT IN BREAST MILK

- THE LEVELS OF DHA ARE VERY DIFFERENT AMONG DIFFERENT POPULATIONS OF WOMEN DEPENDING ON THEIR DIET AND WHERE THEY LIVE.
- EXAMPLES OF HOW DIET CAN INFLUENCE LIPIDS, ESPECIALLY DHA IN BREAST MILK:
- **SUPPLEMENTS DURING PREGNANCY:** WHEN PREGNANT WOMEN TAKE OMEGA-3 SUPPLEMENTS, THEY HAVE HIGHER LEVELS OF DHA, IGA, AND OTHER IMMUNE PROPERTIES IN THEIR EARLY BREAST MILK.

CONT.

- **VEGETARIAN AND VEGAN DIETS**: SINCE VEGETARIANS DO NOT GET DIETARY FAT FROM ANIMAL PRODUCTS, THE LEVEL OF DHA IN THEIR BREAST MILK IS LOWER. BUT, THEY TEND TO HAVE VERY HIGH LEVELS OF LINOLEIC ACID, A PLANT-BASED FATTY ACID. **DHA SUPPLEMENTS** MAY BE NECESSARY FOR THOSE WHO FOLLOW A STRICT VEGETARIAN OR VEGAN DIET.
- **DIETS HIGH IN CARBOHYDRATES:** WHEN WOMEN HAVE DIETS HIGH IN CARBOHYDRATES WITH LITTLE OR NO FAT, THEIR BREAST MILK HAS HIGHER LEVELS OF MEDIUM-CHAIN FATTY ACIDS SUCH AS LAURIC ACID AND LINOLEIC ACID.
- **COASTAL FISH EATING DIETS:** WOMEN WHO LIVE IN AREAS WHERE SEAFOOD IS ABUNDANT AND A LARGE PART OF THEIR DIET, HAVE HIGHER LEVELS OF DHA IN THEIR BREAST MILK.

CONT.

- STUDIES INDICATE THAT THE MAJOR PORTION OF MILK PUFA IS NOT DERIVED DIRECTLY FROM THE MATERNAL DIET, BUT STEMS FROM ENDOGENOUS BODY STORES. THUS, **NOT ONLY THE WOMAN'S CURRENT BUT ALSO HER LONG-TERM DIETARY INTAKE IS OF MARKED RELEVANCE FOR MILK FAT COMPOSITION.**
- BREASTFEEDING PROVIDING DHA AND ARA IMPROVES COGNITIVE DEVELOPMENT AND REDUCES ASTHMA RISK AT SCHOOL AGE PARTICULARLY IN THOSE CHILDREN WITH A GENETICALLY DETERMINED LOWER ACTIVITY OF DHA AND ARA

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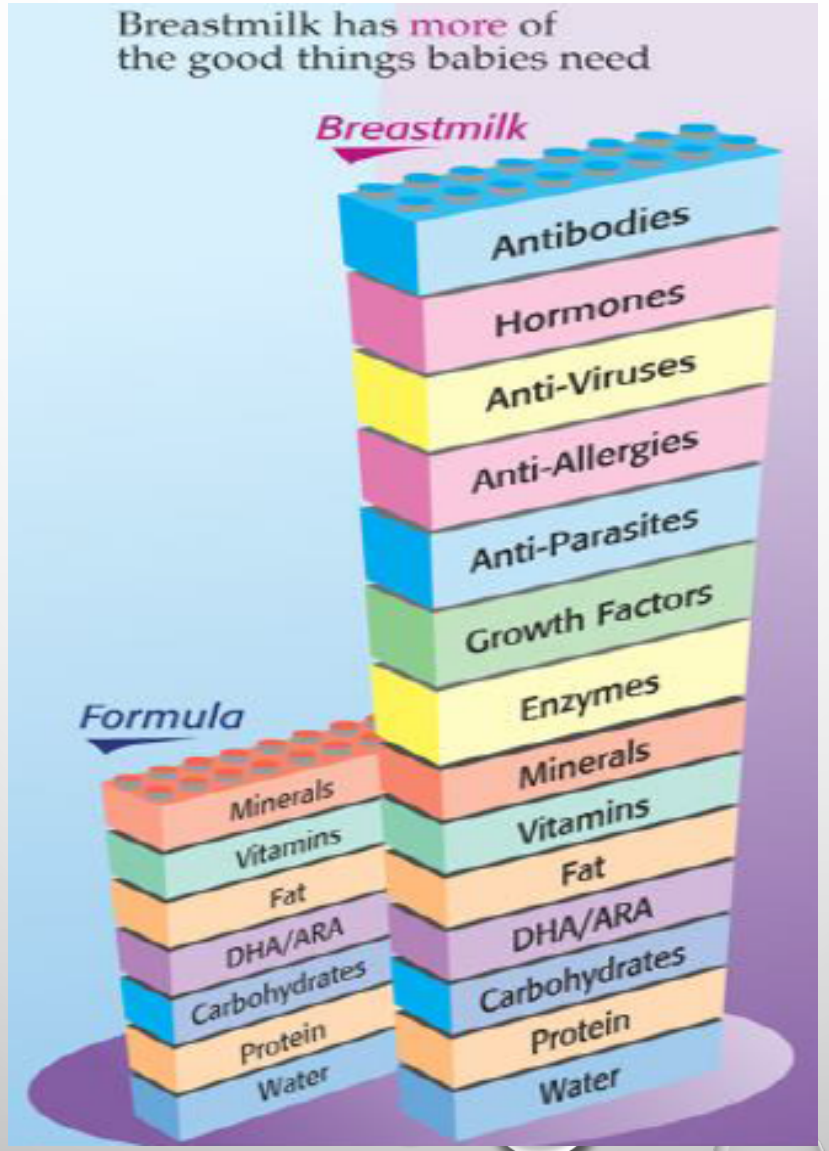

Breastmilk has more of
the good things babies need
Breastmilk
Antibodies
Hormones
Anti-Viruses
Anti-Allergies
Anti-Parasites
Growth Factors
Enzymes
Minerals
Vitamins
Fat
DHA/ARA
Carbohydrates
Protein
Water
Formula
Minerals
Vitamins
Fat
DHA/ARA
Carbohydrates
Protein
Water

COLOSTRUM IS A WONDERFUL FLUID

- MORE NA, K, CL, PROTEIN, FAT-SOLUBLE VITAMINS
- MORE MINERALS
- RICH IN IMMUNOGLOBULINS, ESPECIALLY SIGA
- RICH IN CELLS (100,000-5,000,000 LEUKOCYTES PER ML)
- HIGHER PERCENTAGE OF FAT IS DOCOSAHEXAENOIC (DHA), ARACHIDONIC AND LINOLENIC ACIDS


Y 4
OSTRUM

IN ADDITION, COLOSTRUM…

1. FACILITATES ESTABLISHMENT OF L. BIFIDUS FLORA IN GI TRACT
2. FACILITATES EXPULSION OF MECONIUM
3. IS THE BEST "TREATMENT" FOR PREVENTING AND TREATING HYPOGLYCAEMIA AND HYPERBILIRUBINAEMIA

WHAT'S MISSING IN BREASTMILK?

1. IRON?

- NO, THERE IS JUST THE RIGHT AMOUNT OF IRON IN BREASTMILK
- TOGETHER WITH THE STORES THE BABY GETS DURING PREGNANCY, AT BIRTH ESPECIALLY WITH DELAYED CLAMPING OF THE CORD, PROBABLY THERE IS ENOUGH TO KEEP THE BABY IRON SUFFICIENT FOR UP TO 6 TO 9 MONTHS
- BEAN COUNTERS, BE CAREFUL (AMOUNTS OF BREASTMILK BABIES GET, THE AMOUNT OF PROTEIN, IRON ETC)

2. VITAMIN D?

- BREASTMILK DOES NOT NEED TO SUPPLY VITAMIN D

WHAT ABOUT IRON?

- THE FOLLOWING IS THE ABSTRACT OF AN ARTICLE THAT WAS PUBLISHED IN THE *AMERICAN JOURNAL OF HUMAN BIOLOGY* 2014:26;10-17
- IT QUESTIONS THE BASIC ASSUMPTION THAT WHAT MIGHT BE "NORMAL" FOR THE ARTIFICIALLY FED BABY SHOULD BE CONSIDERED NORMAL FOR THE BREASTFED BABY

HERE IS THE ABSTRACT

- RECENTLY, THERE HAS BEEN CONSIDERABLE DEBATE REGARDING THE APPROPRIATE AMOUNT OF IRON FORTIFICATION FOR COMMERCIAL INFANT FORMULA. GLOBALLY, THERE IS CONSIDERABLE VARIATION IN FORMULA IRON CONTENT, FROM 4 TO 12 MG IRON/L. HOWEVER, HOW MUCH FORTIFICATION IS NECESSARY IS UNCLEAR. HUMAN MILK IS LOW IN IRON (0.2–0.5 MG/L), WITH THE MAJORITY OF INFANT IRON STORES ACCUMULATED DURING GESTATION. OVER THE FIRST FEW MONTHS OF LIFE, THESE STORES ARE DEPLETED IN BREASTFEEDING INFANTS.

HERE IS THE ABSTRACT (CONTINUED)

- THIS DECLINE HAS BEEN PREVIOUSLY LARGELY PERCEIVED AS PATHOLOGICAL; IT MAY BE INSTEAD AN ADAPTIVE MECHANISM TO MINIMIZE IRON AVAILABILITY TO PATHOGENS COINCIDING WITH COMPLEMENTARY FEEDING. MANY OF THE PATHOGENS INVOLVED IN INFANTILE ILLNESSES REQUIRE IRON FOR GROWTH AND REPLICATION. BY REDUCING INFANT IRON STORES AT THE ONSET OF COMPLEMENTARY FEEDING, INFANT PHYSIOLOGY MAY LIMIT ITS AVAILABILITY TO THESE PATHOGENS, DECREASING FREQUENCY AND SEVERITY OF INFECTION.

- *ALL* BABIES NEED VITAMIN D. ARTIFICIALLY FED BABIES HAVE VITAMIN D ALREADY ADDED ARTIFICIALLY TO THE MILK AT THE FACTORY. BREASTFED BABIES UNABLE TO GET ADEQUATE SUNSHINE EXPOSURE SHOULD RECEIVE SUPPLEMENTATION

WHAT'S MISSING FROM FORMULA?

- WHAT ABOUT COLOSTRUM?
- WHERE DO I BUY SIMILOSTRUM?
- ENFALOSTRUM?
- GOOD STARTOSTRUM?

WHICH FORMULA IS CLOSEST TO WHICH COLOSTRUM?

Table 1. Biochemically active substances in human milk.

Hormones		Cytokines	
Hypothalamic	GRH	Interleukins	IL-1α/β
	Somatostatin		IL-2
	TSH		IL-4
	Dopamine		IL-6
Pituitary	Growth hormone		IL-8
	ACTH		IL-10
	TSH	Other cytokines	TNF-α
	FSH/LH		IFN-γ
	Prolactin		TGF-β
Thyroid	Triiodothyronin		RANTES
	Thyroxin		GROα
	Calcitonin		MCP-1
Parathyroid	PTH and PTH related peptides		MIP-1α
Adrenal	Cortisol	Colony stimulating factors	
	Progesterone		GM-CSF
	Estradiol/Estriol		G-CSF
	Testosterone		M-CSF
Gastrointestinal	Gastrin	Nutrients	
	Cholecystokinin		Nucleotides
	GIP		Glutamine
	VIP		Lactoferrin
	Peptide YY		
	Erythropoietin (EPO)		
Growth factors			
	IGF		
	EGF		
	NGF		
	MGF		
	bFGF		

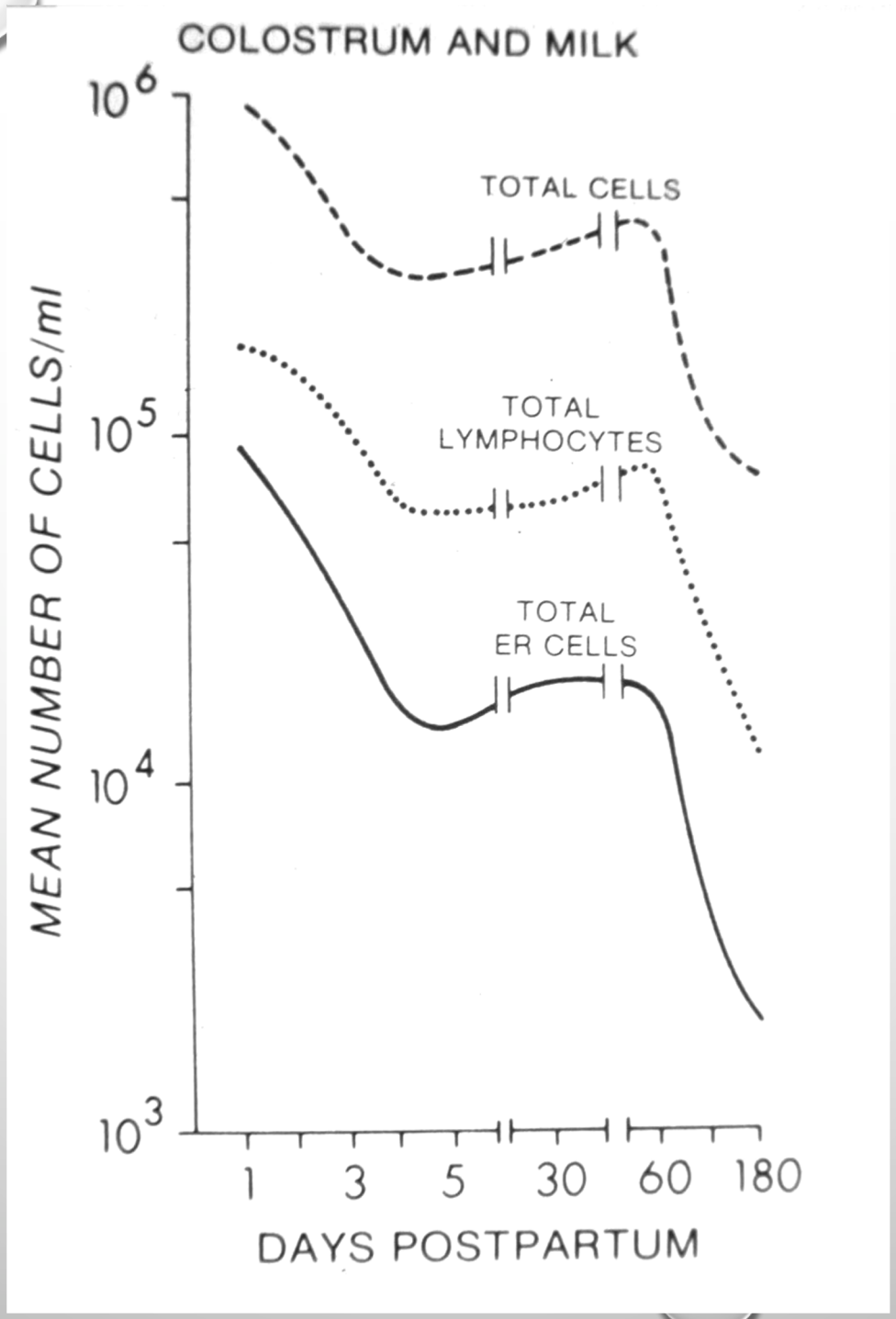

COLOSTRUM AND MILK
MEAN NUMBER OF CELLS/ml
10^6
10^5
10^4
10^3
TOTAL CELLS
TOTAL LYMPHOCYTES
TOTAL ER CELLS
1
3
5
30
60
180
DAYS POSTPARTUM

Table 2. Cellular composition of human breast milk

Cell type	Percentage*
Cell number/mL	10^5–10^7 (colostrum), 0·5 × 10^6 (mature milk)
Polymorphonuclear cells	Approximately 80%
Macrophages	Approximately 15%
Lymphocytes	4% (1–15)
T lymphocytes	80% of lymphocytes (65–83)
CD4+ T	45% of lymphocytes (10–83)
CD8+ T	35% of lymphocytes (11–78)
HLA-DR+	80% of T lymphocytes (56–98)
CD45 RO+	>95% of T lymphocytes
CD103+	70% of T lymphocytes (61–98)
CD49f+	50% of T lymphocytes (32–65)
γδ lymphocytes	11% of lymphocytes (6–26)
B lymphocytes	<2% of lymphocytes
Natural killer cells	3–4% of lymphocytes
Eosinophils	<3%
Epithelial cells (and fragments)	Present in mature milk

*Percentages represent the means (range of the results of several different studies).[56–71]

IMMUNE FACTORS IN BREASTMILK

Compounds with immunological properties in human milk

- Anti-microbial compounds
  - Immunoglobulins: sIgA, SIgG, SIgM
  - Lactoferrin, lactoferricin B and H
  - Lysozyme
  - Lactoperoxidase
  - Nucleotide-hydrolyzing antibodies
  - κ-Casein and α-lactalbumin
  - Haptocorrin
  - Mucins
  - Lactadherin
  - Free secretatory component
  - Oligosaccharides and pre-biotics
  - Fatty acids
  - Maternal leukocytes and cytokines
  - sCD14
  - Complement and complement receptors
  - β-Defensin-1
  - Toll-like receptors
  - Bifidus factor
- Tolerance/priming compounds
  - Cytokines: IL-10 and TGFβ
  - Anti-idiotypic antibodies
- Immune development compounds
  - Macrophages
  - Neutrophils
  - Lymphocytes
  - Cytokines
  - Growth factors
  - Hormones
  - Milk peptides
  - Long-chain polyunsaturated fatty acids
  - Nucleotides
  - Adhesion molecules
- Anti-inflammatory compounds
  - Cytokines: IL-10 and TGFβ
  - IL-1 receptor antagonist
  - TNFα and IL-6 receptors
  - sCD14
  - Adhesion molecules
  - Long-chain polyunsaturated fatty acids
  - Hormones and growth factors
  - Osteoprotegerin
  - Lactoferrin
  - Long-chain polyunsaturated
  - Hormones and growth factors
    fatty acids

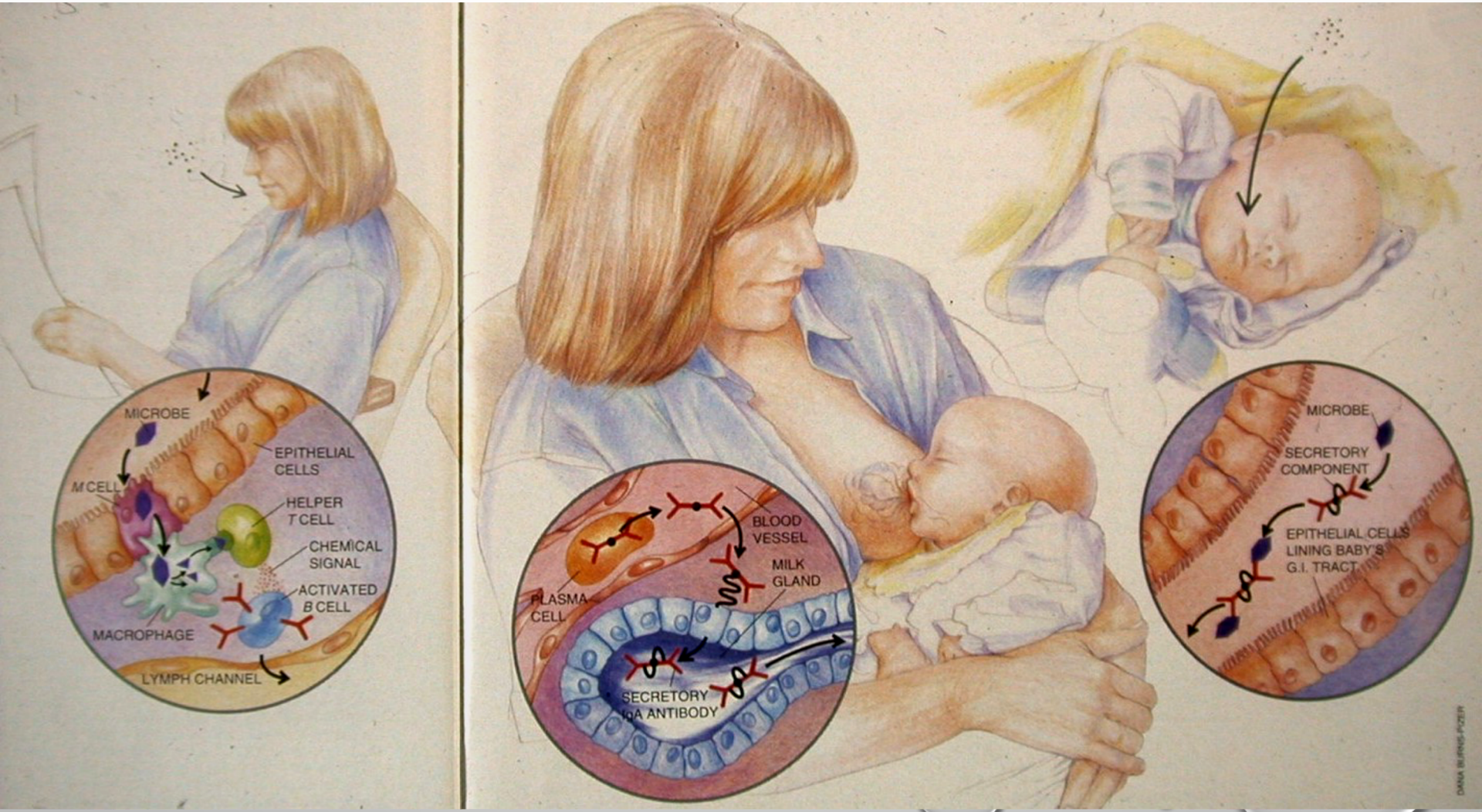
AND THESE ARE NOT EVEN ALL OF THE IMMUNE FACTORS WHICH ARE PRESENT IN BREASTMILK, BUT ABSENT FROM FORMULAS

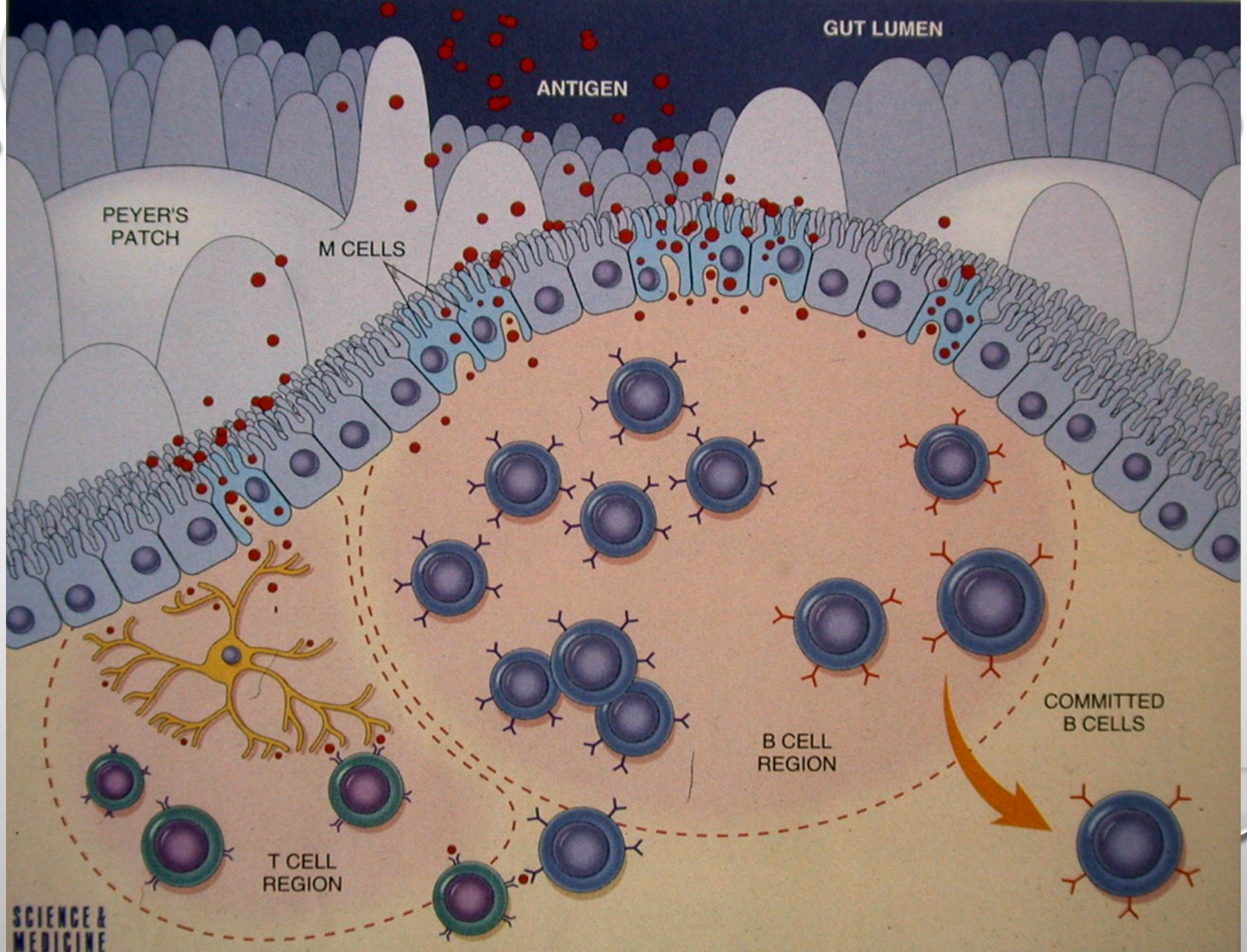
STEM CELLS.

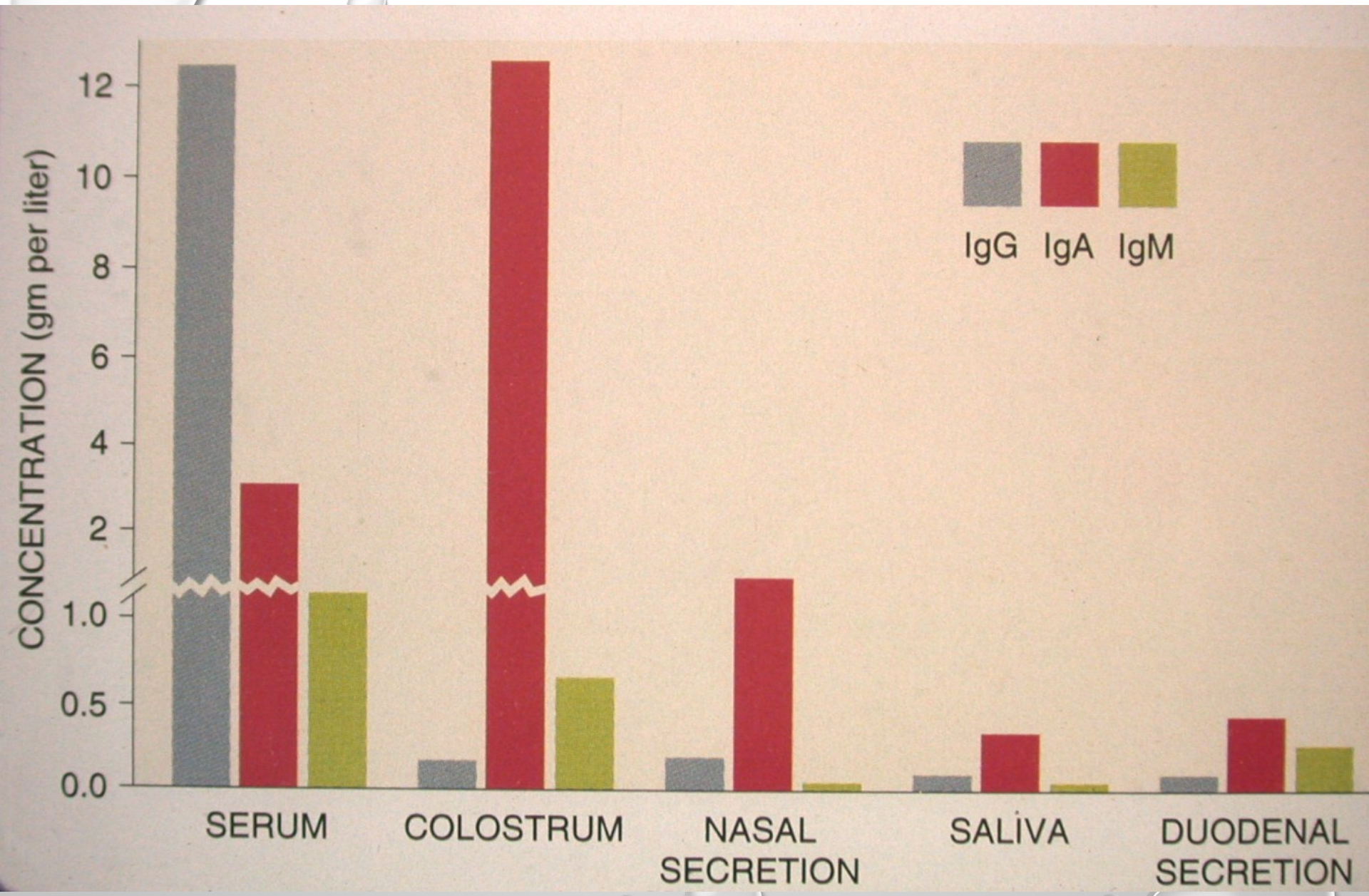
It was discovered seven years ago that human breast milk also contains a kind of stem cell. The question was whether The above now demonstrate that as in humans, mouse milk contains cells that express stem cell markers. These studies in mice provide the first evidence of migration and integration of breastmilk stem cells to organs of the neonate.

April 2014 The FASEB Journal vol. 28 no. 1 Supplement 216.4

BREASTMILK MADE TO MEASURE

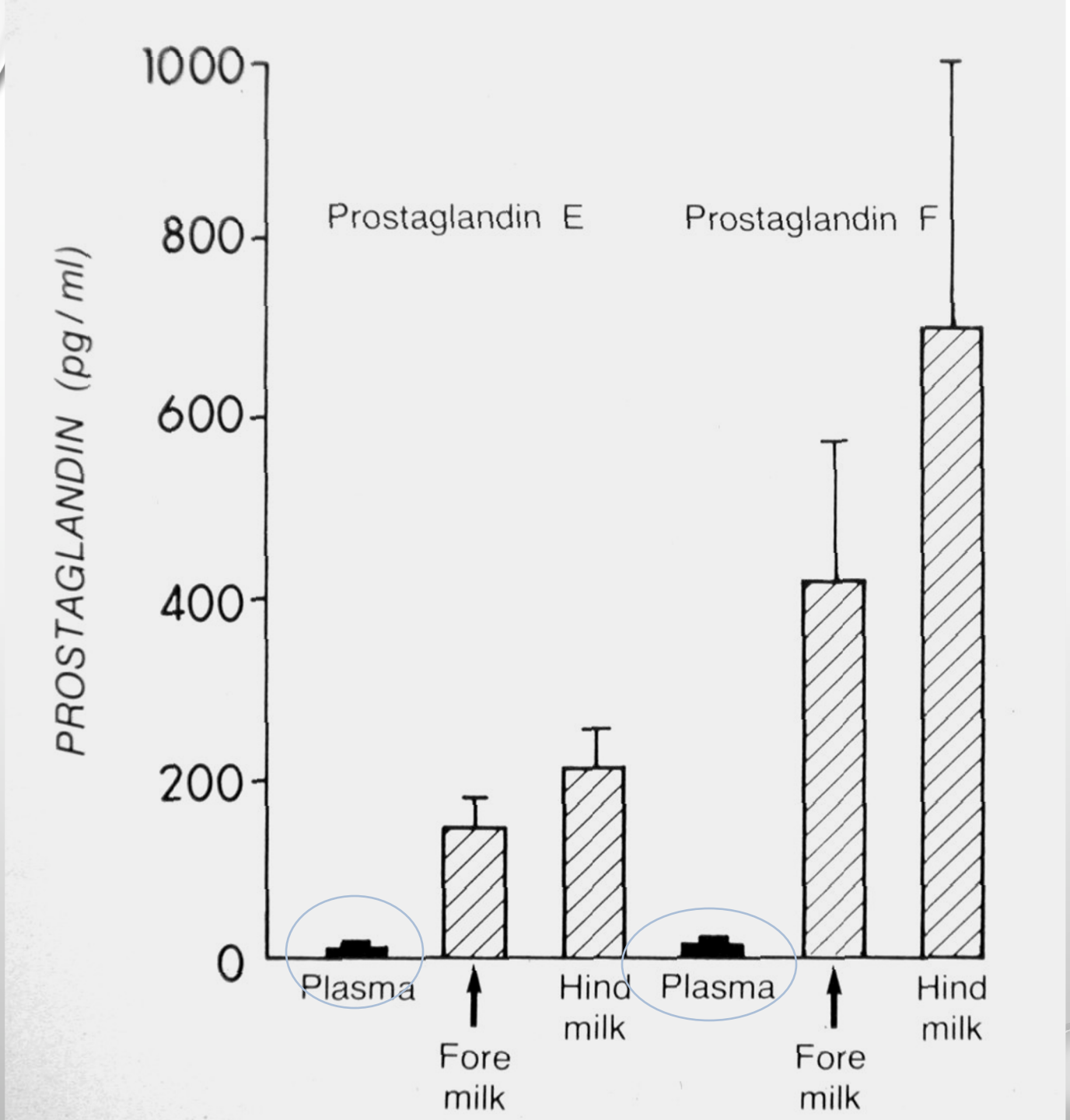



GUT LUMEN
ANTIGEN
PEYER'S PATCH
M CELLS
B CELL REGION
COMMITTED B CELLS
T CELL REGION
SCIENCE & MEDICINE

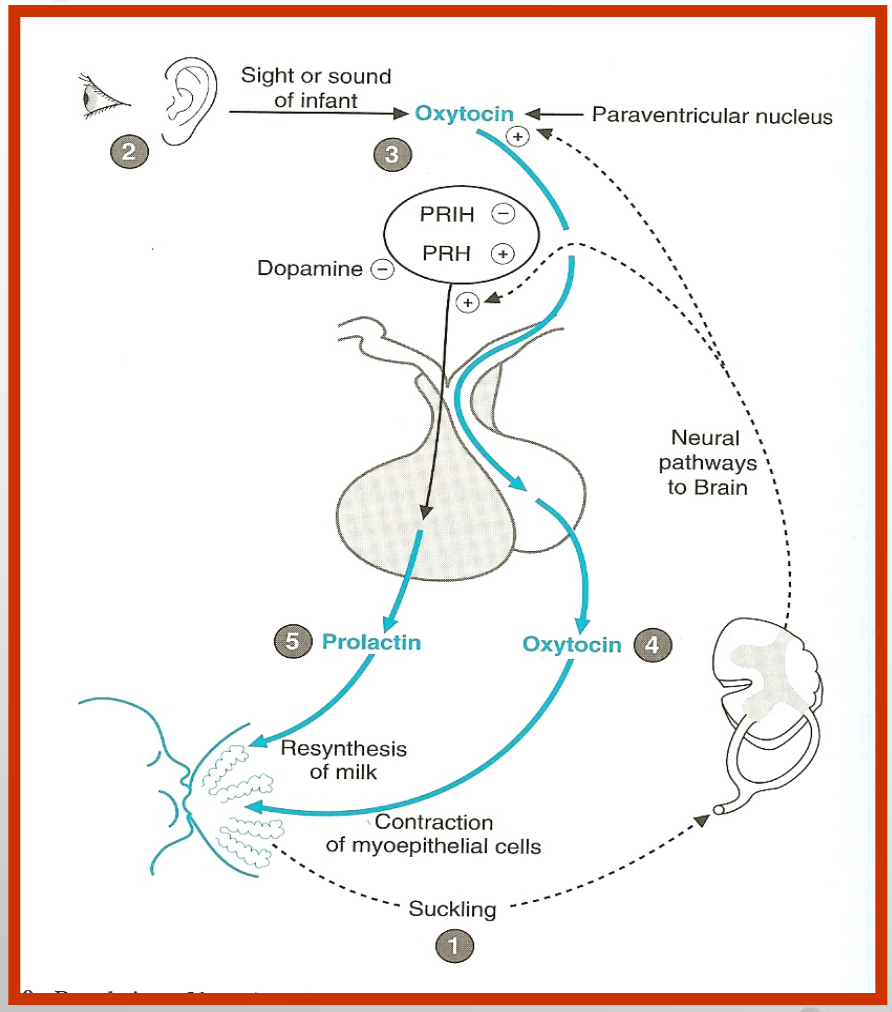

CONCENTRATION (gm per liter)
12
10
8
6
4
2
1.0
0.5
0.0
IgG
IgA
IgM
SERUM
COLOSTRUM
NASAL SECRETION
SALİVA
DUODENAL SECRETION

DO MATERNAL ANTIBODIES PASS ON AUTO-IMMUNE DISEASE TO THE BABY?

1. THE PREDOMINANT IMMUNOGLOBULIN IN HUMAN MILK IS SECRETORY IGA, BUT THERE IS NO EVIDENCE THAT SECRETORY IGA IS A PATHOGENIC ANTIBODY IN AUTOIMMUNE DISEASE
2. IN ANY CASE, SECRETORY IGA IS NOT ABSORBED VIA THE GASTROINTESTINAL TRACT
3. THERE IS NO EVIDENCE THAT IGG IN HUMAN MILK IS ABSORBED INTO THE CIRCULATION OF THE INFANT
4. IGM IS ALSO EXCLUDED FROM THE INFANT'S CIRCULATORY SYSTEM


PROSTAGLANDIN (pg/ml)
1000
800
600
400
200
0
Prostaglandin E
Prostaglandin F
Plasma
Fore milk
Hind milk
Plasma
Fore milk
Hind milk

STIMULATION OF MILK PRODUCTION



MILK EJECTION IS PROMOTED BY ;

1-NEUROGENIC STIMULANT (STIMULATED BY SUCKLING)

2-HORMONAL REFLEX (OXYTOCIN)

PHYSIOLOGY OF LACTATION

During suckling, a conditioned reflex is set up:

Ascending impulses from the nipple and areola

↓ thoracic sensory (4, 5 and 6) afferent neural arc

paraventricular and supra optic nuclei of the hypothalamus

↓

Oxytocin from the posterior pituitary produces contraction of the myoepithelial cells of the alveoli and the ducts containing milk. **("milk ejection"** or **"milk let down" reflex)**

↓

Milk is forced down into the ampulla of lactiferous ducts, wherefrom it can be expressed by the mother or sucked by The baby.

FORMULA CONTAINS THE SAME AMOUNT OF PROTEIN AS BREASTMILK, REALLY?

- BREASTMILK CONTAINS AT ABOUT 3 MONTHS AFTER BIRTH, 8 TO 10 G/L OF PROTEIN
  - THIS IS SOMEWHAT LESS THAN MOST FORMULAS (MOST CONTAIN 12-15 G/L OR *MORE*)
- BUT:
  - UP TO 60-65% (ABOUT 5 G/L) OF THE PROTEIN IN BREASTMILK IS LACTOFERRIN, WHICH IS NOT ABSORBED FROM THE GUT!
  - ABOUT 6% (0.5 G/L) OF THE PROTEIN IS IMMUNOGLOBULIN, WHICH IS ALSO NOT ABSORBED FROM THE GUT!
  - SO ONLY *AT MOST*, 4.5 G/L OF PROTEIN

→BABIES CAN'T GROW ON THIS AMOUNT, *BUT THEY DO!*

→FORMULA CONTAINS WAY TOO MUCH PROTEIN (3.5X MORE)

WHAT ABOUT S100B PROTEIN?

- **S100B IS AN ACIDIC CALCIUM-BINDING PROTEIN OF THE EF-HAND FAMILY, CHARACTERIZED BY THE MOST COMMON CALCIUM BINDING MOTIF OF A HELIX-LOOP-HELIX STRUCTURE**
- THE PROTEIN ENCODED BY THIS GENE IS A MEMBER OF THE S100 FAMILY OF PROTEINS CONTAINING 2 EF-HAND CALCIUM-BINDING MOTIFS. S100 PROTEINS ARE LOCALIZED IN THE CYTOPLASM AND/OR NUCLEUS OF A WIDE RANGE OF CELLS, AND INVOLVED IN THE REGULATION OF A NUMBER OF CELLULAR PROCESSES SUCH AS CELL CYCLE PROGRESSION AND DIFFERENTIATION. **IT MAY BE IMPORTANT TO BRAIN DEVELOPMENT**

- altered expression of this gene have been implicated in several neurological, neoplastic, and other types of diseases, including Alzheimer's disease, Down's syndrome, epilepsy, amyotrophic lateral sclerosis, melanoma, and type I diabetes. [provided by RefSeq, Jul 2008]
- Present in much higher concentrations in breastmilk than in formula (and higher in mature breastmilk than in colostrum)

STEM CELLS IN BREASTMILK

- **SEE:**

- **CREGAN MD, FAN Y, APPLEBEE, A, *ET AL*. IDENTIFICATION OF NESTIN-POSITIVE PUTATIVE MAMMARY STEM CELLS IN HUMAN BREASTMILK *CELL TISSUE RES* (2007) 329:129–136**

IS IT GOOD OR BAD?

- BREASTMILK IS FULL OF IMMUNE FACTORS
- IMMUNE FACTORS IN BREASTMILK WORK BY LINING THE MUCOUS MEMBRANES OF THE BABY'S BODY AND PREVENT PATHOLOGIC BACTERIA FROM ENTERING THE BABY'S BODY
- WHEN THE BABY SPITS UP, IMMUNE FACTORS LINE THE BABIES UPPER RESPIRATORY TRACT AND UPPER GUT TWICE, ONCE ON THE WAY DOWN, AGAIN ON THE WAY UP
- SO IF THE BABY ASPIRATES BREASTMILK?
- FORMULA=BREASTMILK?

ALL THIS IS VERY NICE, BUT DOES IT MAKE A DIFFERENCE TO THE BABY?

- YOU BET IT DOES!
- THE STUDIES ARE ALL THERE, BUT SO MANY PEOPLE PREFER NOT TO BELIEVE THEM BECAUSE THEY DON'T WANT TO BELIEVE THEM (MY BABY WAS FORMULA FED AND HE'S A PHD)
- AS SOON AS *ONE* STUDY COMES OUT DOUBTING THE RESULTS OF *MANY* STUDIES, WE HEAR "YOU SEE? FORMULA IS JUST AS GOOD!"
- STUDIES SHOWING RISKS OF FORMULA ARE NEVER AS WELL DONE AS STUDIES SHOWING NO RISK…
- REMEMBER, IF STUDIES SHOWING RISKS OF FORMULA FEEDING ARE NOT PERFECT, THE BURDEN OF PROOF THAT THERE IS NO RISK TO FORMULA IS ON THOSE WHO SAY IT'S OKAY

FORMULA: A HEAVY METAL COCKTAIL

TOO MUCH…

- TOO MUCH ALUMINUM
  - COW MILK FORMULA 100X
  - SOY FORMULA UP TO 2000X
- TOO MUCH MANGANESE
- TOO MUCH LEAD
- TOO MUCH CADMIUM
- TOO MUCH IRON

ERRORS IN INFANT FORMULAS

RECALLS OF INFANT FORMULAS

- **1978**
  - **ENFAMIL CONTAMINATED WITH *E. COLI***
- **1979**
  - **SMA RECALLED (IMPROPER HOMOGENIZATION)**
  - **NEOMULSOY AND CHO FREE CAUSED HYPOCHLOREMIC ALKALOSIS**
- **1980**
  - **SOYALAC CONTAINED TOO MUCH VITAMIN D**
  - **ENFAMIL RECALLED (SOUR, GREEN, CURDLED)**

JUST ONE STUDY

- **CONCLUSIONS: BREASTFEEDING IS PROTECTIVE AGAINST SIDS, AND THIS EFFECT IS STRONGER WHEN BREASTFEEDING IS EXCLUSIVE. THE RECOMMENDATION TO BREASTFEED INFANTS SHOULD BE INCLUDED WITH OTHER SIDS RISK-REDUCTION MESSAGES TO BOTH REDUCE THE RISK OF SIDS AND PROMOTE BREASTFEEDING FOR ITS MANY OTHER INFANT AND MATERNAL HEALTH BENEFITS. *PEDIATRICS* 2011;128:103–110**
- **A STUDY COMPLETELY IGNORED IT SEEMS**

IN FACT…

- NO EVIDENCE THAT SIMPLY ADDING DHA AND ARA TO FORMULA GIVES THE BENEFIT IT'S SUPPOSED TO
- THESE PUFA'S NEED TO BE ADDED IN CORRECT PROPORTIONS, AND THEY ARE NOT ABSORBED FROM FORMULA IN THE SAME WAY AS THEY ARE FROM BREASTMILK
- STUDIES DO NOT SUPPORT ANY BENEFIT WHEN ADDED TO FORMULA
- SEE HTTP://CORNUCOPIA.ORG/DHA/DHA_FULLREPORT.PDF

AN IMPORTANT MESSAGE FROM NESTLÉ CANADA

Dear Parents,

By now you may have heard about the recall of some of our liquid concentrate infant formula. At Nestlé we hold ourselves to high internal standards of quality to ensure your continued trust and satisfaction in our brands and our company. As President and CEO of Nestlé Canada, I made this decision as a responsible measure.

We apologize for the worry and inconvenience this has undoubtedly caused. **The extensive inspection and quality testing of these voluntarily recalled batches support our belief that these products are safe.**

Unfortunately, an incorrect thermocouple was installed in the sealing area resulting in an inaccurate temperature reading of the area around the can during the final stages of canning for these nine date codes. Nestlé's stringent quality assurance procedures detected the variance and we took action to rectify the situation. We notified the government and with their agreement on the approach, we decided to take this precautionary measure.

FDA ALERTS PUBLIC REGARDING RECALL OF POWDERED INFANT FORMULA (NOVEMBER 1, 2002): SEE HTTP://WWW.FDA.GOV/BBS/TOPICS/NEWS/2002/NEW00849.HTML

ASIDE FROM MANY RECALLS OF FORMULAS OVER THE YEARS…

- FOR THOSE WHO ARE FOND OF EXOTIC FOODS…
- INTERESTING FOOD THAT HAS BEEN FOUND IN INFANT FORMULAS:
  - RAT HAIR
  - BEETLE PARTS AND BEETLE LARVAE
  - PIECES OF GLASS
  - MELAMINE—DUE TO ADULTERATION OF MILK BY GREEDY PEOPLE

RISKS FOR THE MOTHER

- OVARIAN CANCER
- ENDOMETRIAL CANCER
- BREAST CANCER
- OSTEOPOROSIS
- IRON DEFICIENCY
- DELAYED INVOLUTION OF THE UTERUS

BREAST CANCER

- WOMEN WHO BREASTFEED ARE LESS LIKELY TO DEVELOP BREAST CANCER
- COLLABORATIVE GROUP ON HORMONAL FACTORS IN BREAST CANCER. BREAST CANCER AND BREASTFEEDING: COLLABORATIVE REANALYSIS OF INDIVIDUAL DATA FROM 47 EPIDEMIOLOGICAL STUDIES IN 30 COUNTRIES, INCLUDING 50,302 WOMEN WITH BREAST CANCER AND 96, 973 WOMEN WITHOUT THE DISEASE *LANCET* 2002;360:187-195
- THIS STUDY BRINGS TOGETHER >80% OF THE WORLDWIDE EPIDEMIOLOGICAL DATA ON BREAST CANCER AND BREASTFEEDING

MORE MATERNAL RISKS

- DIFFICULTY WITH WEIGHT LOSS
- DISEMPOWERMENT
- INCREASED DIFFICULTY IN ATTACHMENT WITH BABY
- COST

TYPE 2 DIABETES

- STUEBE AM, RICH-EDWARDS JW, WILLETT WC, *ET AL*. DURATION OF LACTATION AND INCIDENCE OF TYPE 2 DIABETES *J AM MED ASSOC* 2005;294:2601-2610
- "LONGER DURATION OF BREASTFEEDING WAS ASSOCIATED WITH REDUCED INCIDENCE OF TYPE 2 DIABETES IN 2 LARGE COHORTS OF WOMEN"

METABOLIC SYNDROME

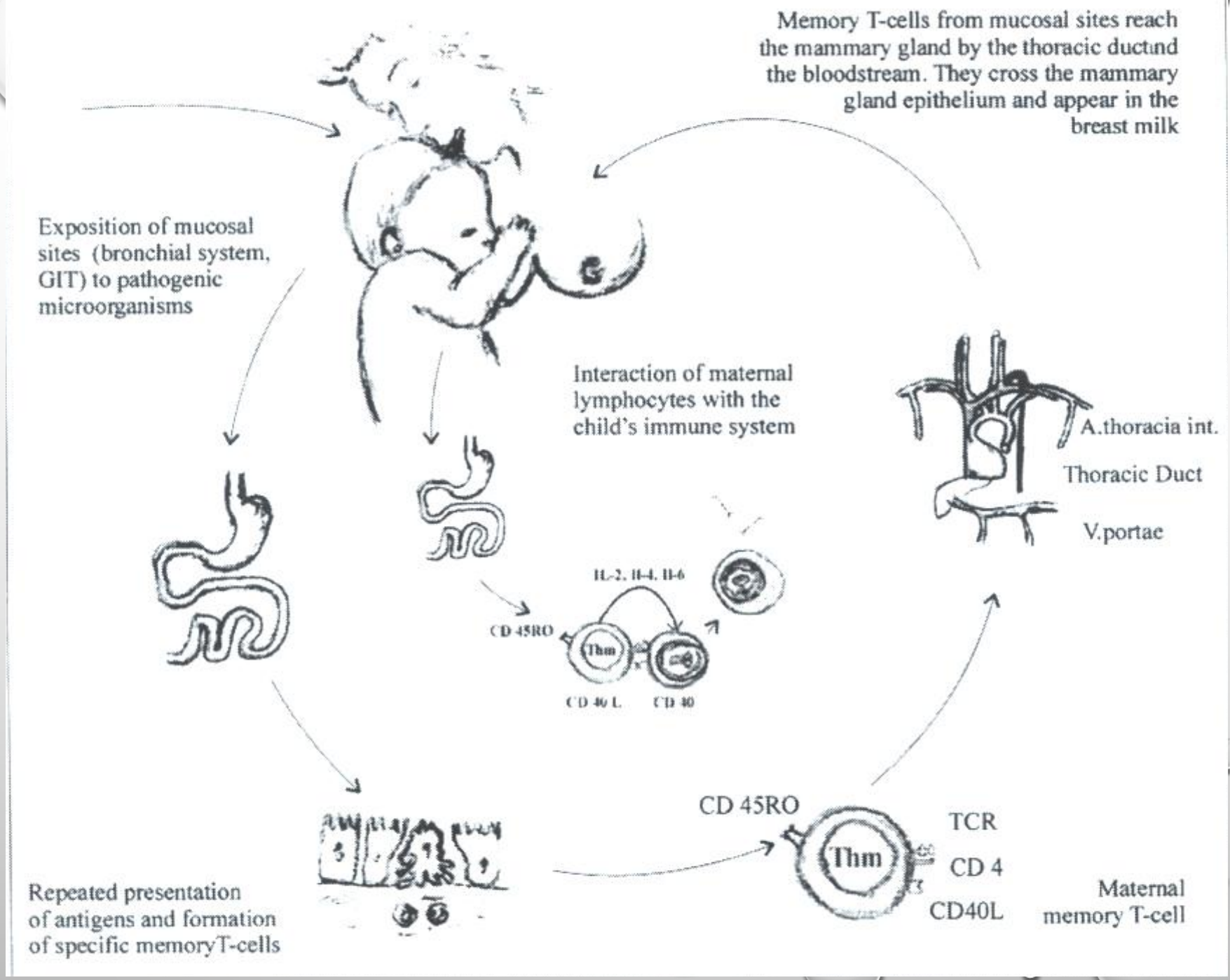
- RAM K, BOBBY P, HAILPERN S, ET AL. DURATION OF LACTATION IS ASSOCIATED WITH LOWER PREVALENCE OF THE METABOLIC SYNDROME IN MIDLIFE—SWAN, THE STUDY OF WOMEN'S HEALTH ACROSS THE NATION *AM J OBSTET GYNECOL* 2008;198:268.E1-268.E6
- "DURATION OF LACTATION IS ASSOCIATED WITH LOWER PREVALENCE OF METSYN IN A DOSE-RESPONSE MANNER IN MIDLIFE, PAROUS WOMEN"

WHAT IS METABOLIC SYNDROME?

- THE METABOLIC SYNDROME IS A CLUSTERING OF THE METABOLIC ABNORMALITIES:
  - INSULIN RESISTANCE, DYSLIPIDEMIA, HYPERTENSION, AND OBESITY
  - WOMEN WITH METABOLIC SYNDROME ARE AT INCREASED RISK OF DIABETES MELLITUS, MAJOR CARDIOVASCULAR EVENTS, AND INCREASED ALL-CAUSE MORTALITY

RISKS TO SOCIETY

1. FORMULA AS AN ENVIRONMENTAL HAZARD
2. LOSS OF CONTRACEPTIVE EFFECT
3. LOSS OF SECURITY, STABLE BEGINNING FOR THE CHILD


Memory T-cells from mucosal sites reach the mammary gland by the thoracic ductand the bloodstream. They cross the mammary gland epithelium and appear in the breast milk
Exposition of mucosal sites (bronchial system, GIT) to pathogenic microorganisms
Interaction of maternal lymphocytes with the child's immune system
A.thoracia int.
Thoracic Duct
V.portae
IL-2, Il-4, Il-6
CD 45RO
Thm
CD 40 L
CD 40
CD 45RO
Thm
TCR
CD 4
CD40L
Maternal memory T-cell
Repeated presentation of antigens and formation of specific memoryT-cells

Manganese	25	mcg	Chloride	62	mg

INGREDIENTS: 42.6% CORN SYRUP SOLIDS, 14.7% SOY PROTEIN ISOLATE, 11.5% HIGH OLEIC SAFFLOWER OIL, 10.1% SUGAR (SUCROSE), 8.4% SOY OIL, 7.8% COCONUT OIL, 2.4% CALCIUM PHOSPHATE; LESS THAN 2.0% OF: C. COHNII OIL†, M. ALPINA OIL‡, POTASSIUM CITRATE, SODIUM CHLORIDE, MAGNESIUM CHLORIDE, ASCORBIC ACID, L-METHIONINE, POTASSIUM CHLORIDE, CHOLINE CHLORIDE, TAURINE, FERROUS SULFATE, ASCORBYL PALMITATE, m-INOSITOL, ZINC SULFATE, MIXED TOCOPHEROLS, L-CARNITINE, NIACINAMIDE, d-ALPHA-TOCOPHERYL ACETATE, CALCIUM PANTOTHENATE, CUPRIC SULFATE, THIAMINE CHLORIDE HYDROCHLORIDE, VITAMIN A PALMITATE, RIBOFLAVIN, PYRIDOXINE HYDROCHLORIDE, BETA-CAROTENE, FOLIC ACID, POTASSIUM IODIDE, POTASSIUM HYDROXIDE, PHYLLOQUINONE, BIOTIN, SODIUM SELENATE, VITAMIN D_3 AND CYANOCOBALAMIN.
CONTAINS SOY INGREDIENTS.

*Ⓤ **Contains no dairy ingredients. Manufactured on dairy equipment.**
†SOURCE OF DOCOSAHEXAENOIC ACID (DHA) ‡SOURCE OF ARACHIDONIC ACID (ARA)

ROSS PRODUCTS DIVISION
ABBOTT LABORATORIES
COLUMBUS, OHIO 43215-1724 USA

إلى متى المتاجرة بأرواح أطفالنا؟؟