授課講師學經歷

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課程名稱（主題）	~~肥胖基因改造之減肥效應探討~~
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授課內容摘要

母體攝取的營養素會影響母乳品質與分泌量，母乳中的某些營養素含量，會因母親在飲食中增加攝取而增加，像是如蛋白質、維生素A、維生素B1、B2、B6、B12、維生素E、菸鹼素、錳、碘、鎂等，哺乳期間母親的營養狀態會影響母乳品質，進而影響餵補母乳寶寶的營養狀態。雞精為一種傳統高蛋白補充品，由於其所含蛋白質分子量較小，因此較易被人體吸收。本研究目的探討懷孕後期(37週)至產後3天補充雞精對哺乳婦女乳汁蛋白組成的影響。於臺北醫學大學附設醫院婦產科門診篩選，並經婦產科主治醫師確定為健康產婦共30位。依其接受雞精意願分為控制組(n=15)和雞精組(n=15)。實驗期間，雞精組利用每週回診產檢時給予一星期的鷄精，並要求受試者每天分別於早、中，及晚餐後30分鐘內飲用一瓶雞精(70 mL/瓶)，每日3瓶，且不定時以電話追蹤飲用情形。雞精組平均補充雞精為18 ± 5天。控制組於研究進行期間，則限制其高蛋白飲食攝取。所有受試者均維持平日正常飲食，並於懷孕37週和產後3天分別記錄3天飲食攝取，並記錄母親和嬰兒的基本資料。收集產後3天初乳分析總蛋白、酪蛋白(casein)、乳白蛋白(lactalbumin)、乳鐵蛋白(lactoferrin)、上皮生長因子(epidermal growth factor)，及轉形生長因子-β2 (transforming growth factor-β2; TGF-β2)含量。雞精組初乳中乳鐵蛋白、上皮生長因子、轉形生長因子-β2含量分別顯著較控制組高34%、62%，及196%（$p<0.05$）。但雞精組初乳中總蛋白、酪蛋白，及乳白蛋白含量與控制組相較則無差異。綜合上述，補充雞精可提高哺乳婦女乳汁中乳鐵蛋白、上皮生長因子，及轉形生長因子-β2 含量，可能對胎兒改善免疫功能和刺激生長發育有所助益。

影響母乳品質的營養因素

趙振瑞 教授
臺北醫學大學保健營養學系

Content

1

- Lactation
- Human milk
- Nutritional factors affecting milk proteins
- Chicken extract
- Effects of chicken extract on milk proteins
- Conclusions

Lactogenesis

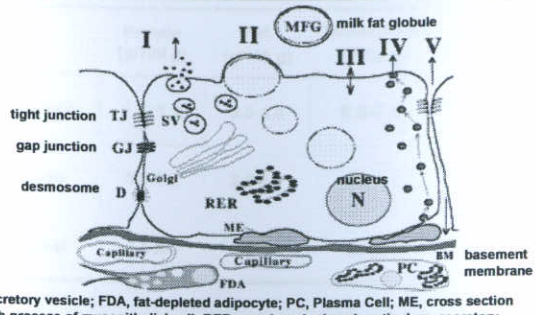
2

- colostrum 初乳
  6-12 h~2-3 d postpartum
- transitional milk 過渡乳
  1-2 wk postpartum
- mature milk
  > 3 wk postpartum

可以收集120C.C.

Milk Synthesis and Secretion

3



SV, secretory vesicle; FDA, fat-depleted adipocyte; PC, Plasma Cell; ME, cross section through process of myoepithelial cell; RER, rough endoplasmic reticulum. secretory pathways I (exocytosis), II (lipid), III (apical transport), IV (transcytosis) and V (paracellular pathway).

http://mammary.nih.gov/Reviews/lactation/Neville001/index.html#lactogenesis

Human Milk Composition

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- Immunoglobulins
- lactoferrin
- proline-rich polypeptide
- growth factors
- growth hormone
- leukocytes
- enzymes
- cytokines and lymphokines
- glycoproteins
- carbohydrate, fat, vitamins, and minerals

Human Milk Composition

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Table I Chemical composition of human milk compared with milk from various species (values per 100 ml)

Constituents	Human milk	Cow milk	Buffalo milk
Protein (g)	1.2	3.3	3.8
Casein (g)	0.4	2.8	3.0
Lactalbumin (g)	0.3	0.4	0.4
Lactoglobulin (g)	0.2	0.2	0.2
Fat (g)	3.8	3.7	7.5
Lactose (g)	7.0	4.8	4.4
Calorie (Kcal)	71	69	100
Mineral matter (g)	0.21	0.72	0.80
Calcium (mg)	33	125	210
Phosphorus (mg)	15	96	130
Chlorine (mg)	43	103	112
Magnesium (mg)	4	12	15
Potassium (mg)	55	138	142
Sodium (mg)	15	58	65
Iron (mg)	0.15	0.10	0.20
Copper (mg)	0.04	0.03	0.02
Magnesium (mg)	0.7	2.0	–
Zinc (mg)	0.53	0.38	–
Iodine (mg)	0.007	0.021	0.004
Vitamin A (IU)	160	158	200
Vitamin D (IU)	1.4	2.0	–
Thiamine (mg)	0.017	0.04	0.05
Riboflavin (mg)	0.04	0.18	0.10
Nicotinic acid (mg)	0.17	0.08	0.28
Pantothenic acid (mg)	0.20	0.35	–
Vitamin B_6 (mg)	0.001	0.035	–
Folic acid (μg)	1.3	5.6	3.3
Biotin (μg)	0.4	2.0	–
Vitamin B_{12}(μg)	0.05	0.50	0.30
Vitamin C(mg)	4.0	2.0	2.5

Source: Swaminathan (1998)

Various Milk Compositions

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	Protein (g/100 g)	Fat (g/100 g)	Carbohydrate (g/100 g)	Energy (kcal/100 g)
Human	1.1-1.2	3.8-4.5	6.8-7.0	66-73
Cow	3.1-3.9	3.5-4.9	4.6-5.1	62-80
Goat	2.9-3.4	3.5-4.1	4.6-4.7	62-69

Webb *et al.* 1974, Jensen 1995

Various Milk Compositions

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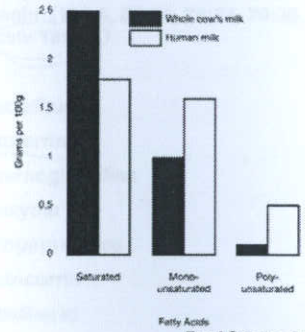

Food Science Association, 2002

Changes in Human Milk Composition

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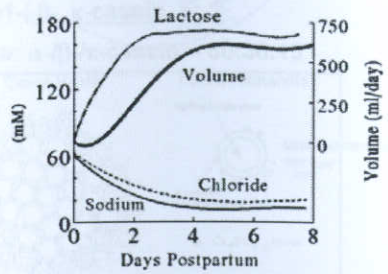

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Changes in Human Milk Composition

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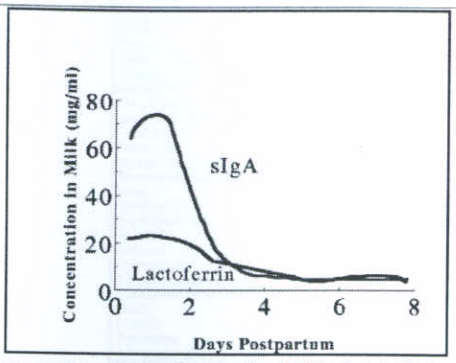

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Proteins in Human Milk

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- whey/casein (100:0, 86:14, 76:24, 70:30, 65:35, 60:40, 50:50 vs cow 18:82)
- whey
  - α-lactalbumin
  - lactoferrin
  - immunoglobulins
  - lysozyme
  - lactoperoxidase
  - haptocorrin
  - lactadherin
  - bile salt-dependent lipase

Proteins in Human Milk

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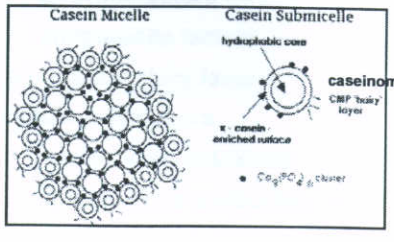
- casein (~30% of protein fraction)
  - α s1-, β-, κ-casein
  - cow: α-/β-/κ-casein = 50:36:13



Hormones in Human Milk

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Table 1. Some hormones and their concentrations found in human milk.[a]

Hormone	Concentration
Pituitary	
Prolactin	20–90 ng/mL
Growth hormone	5–30 μU/mL
Thyroid-stimulating hormone	2.7–5.0 μU/mL
Hypothalamus	
Thyroid-releasing hormone	0.025–1.5 ng/mL
Luteinizing hormone–releasing hormone	Not available
Somatostatin	23–113 pg/mL
Gonadotropin-releasing hormone	0.1–4.0 ng/mL
Growth hormone–releasing hormone	23–430 pg/mL
Thyroid	
Thyroxine (T_4)	0.3–12 ng/mL
Triiodothyronine (T_3)	0.2–0.4 ng/mL
Reverse T_3	0.008–0.15 ng/mL
Parathyroid	
Parathormone	15 pg/mL
Parathormone-related peptide	30–50 ng/mL
Calcitonin/calstonin inhibiting protein	0–5 ng/mL
Steroid	
Estrogen	15–840 ng/mL
Progesterone	10–40 ng/mL
Adrenal steroids	0.2–32 ng/mL

[a]Data from Hamosh (2001).

Growth Factors in Human Milk

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- insulin-like growth factor (IGF)-I, -II
- epidermal growth factor (EGF)
- nerve growth factor (NGF)
- transforming growth factors (TGF-α, -β1, -β2)
- platelet-derived growth factor (PDGF)
- hepatocyte growth factor (HGF)
- colony-stimulating growth factor (CSGF)
- vascular endothelial growth factor (VEGF)

Factors in Human Milk

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- antimicrobial factors
  - antibacterial factors
  - antiviral factors
  - antiparasite factors
- anti-inflammatory factors
- immunomodulators
  - nucleotides, cytokines
  - anti-idiotypic antibodies, lactoferrin

Antibacterial Factors in Human Milk

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- secretory IgA, IgG, IgM, IgD
- analogues of epithelial cell receptors (oligosaccharides and sialylated oligosaccharides)
- *Bifidobacterium bifidum* growth factors (oligosaccharides, glycopeptides)
- other bifidobacteria growth factors (α-lactoglobulin, lactoferrin, sialyllactose)
- carbohydrate

Antibacterial Factors in Human Milk

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- cathelicidin
- casein, κ-casein, phosphorylated β-casein
- complement C1-C9 (mainly C3 and C4)
- α-, β-defensins
- factor binding proteins (zinc, vitamin B_{12}, folate)
- ganglioside
- glycolipid Gb3
- glycoproteins
- α-lactalbumin

Antibacterial Factors in Human Milk

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- lactoferrin
- lactoperoxidase
- lipids
- lysozyme
- milk cells (80% macrophages, 15% neutrophils, 0.3% B and 4% T lymphocytes)
- mucin
- phosphatidylethanolamine
- sialyllactose

Antibacterial Factors in Human Milk

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- sialyloligosaccharides on sIgA
- CD14
- sulphatide (sulphogalactosylceramide)
- xanthine oxidase
- secretory leukocyte protease inhibitor
- heparin

Antiviral Factors in Human Milk

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- secretory IgA, IgG, IgM
- *Bifidobacterium bifidum*
- chondroitin sulphate
- α-, β-defensins
- haemagglutinin inhibitors
- lactadherin (mucin-associated glycoprotein)
- histo-blood group carbohydrates
- lactoferrin

Antiviral Factors in Human Milk

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- lipid (unsaturated fatty acids and monoglycerides)
- lysozyme
- α2-macroglobulin
- milk cells
- neutrophil-derived α-defensin-1
- ribonuclease
- secretory leukocyte protease inhibitor
- sialic acid-glycoproteins

Antiviral Factors in Human Milk

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- soluble intracellular adhesion molecule 1 (sICAM-1)
- soluble vascular cell adhesion molecule 1 (sVCAM-1)
- sulphatide (sulphogalactosylceramide)
- vitamin A
- prostaglandins E1, E2, F2α
- gangliosides
- glycolipid Gb4
- heparin

Antiparasite Factors in Human Milk

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- secretory IgA, IgG
- gangliosides
- lipid (free fatty acids and monoglycerides)
- lactoferrin
- macrophages

Anti-inflammatory Factors in Human Milk

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- secretory IgA
- lactoferrin
- lysozyme
- κ-casein
- antioxidants (β-carotene, α-tocopherol, ascorbate, uric acid)
- EGF
- platelet activating factor-acetylhydrolase
- antiproteases (α1-antichymotrypsin, α2-trypsin)
- prostaglandins

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Nutritional Factors Affecting Milk Proteins

Weight loss
2303 kcal → ↓ 538 kcal
↓ 4.8 ± 1.2 kg
In 10 weeks

↓ Milk quantity and quality

Dusdieker *et al.* 1994

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Nutritional Factors Affecting Milk Proteins

Moderately undernourished mother
caloric supplement
500 kcal/d *vs* 140 kcal/d

↑ secretory IgA ↓ lactoferrin

Herias *et al.* 1993

热量个.(蛋白质的)可以增加 sIgA.

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Nutritional Factors Affecting Milk Proteins

↓ meat, egg,dairy products, food prepared with oil

↑ rice, vegetables, beans, seaweed

↓ total protein at 2-5 mo postpartum

Yoneyama *et al.* 1994

来自于动物之蛋白质是必要的

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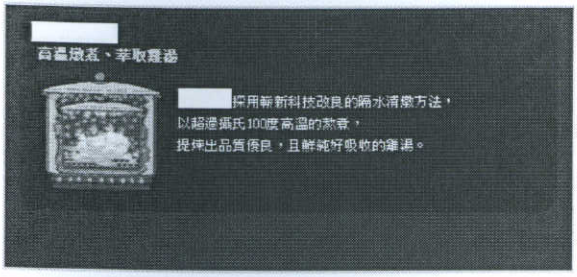
Manufacture of Chicken Extract



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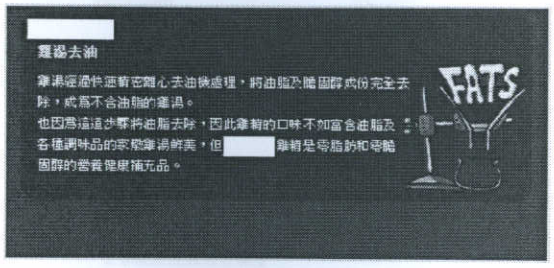
Manufacture of Chicken Extract



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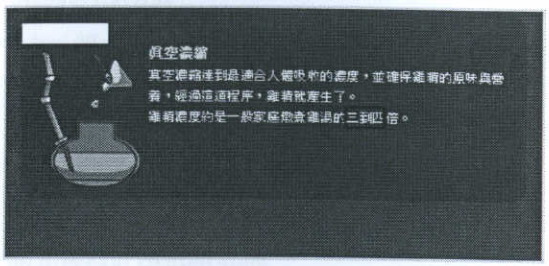
Manufacture of Chicken Extract



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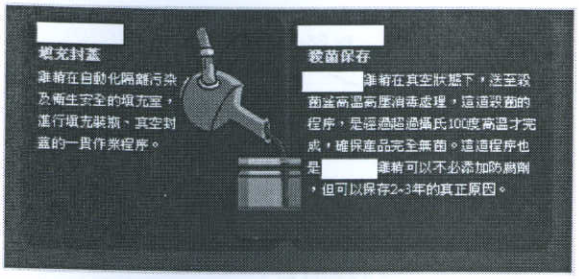
Manufacture of Chicken Extract



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Chicken Extract Composition

Ingredient	Amount
	weight/70 g (1 bottle)
Protein	5.4 g
Purine	63 mg 中普林
Minerals	
Sodium	63 mg 低鈉
Potassium	155 mg 半根香蕉
Chloride	92 mg
Phosphorus	52 mg
Calcium	2.4 mg

普林：Japan Food Research Laboratories －
日本政府授權之實驗室
蛋白質及礦物質：新竹食品工業研究所

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Subject Inclusion Criteria

- non-vegetarians
- below 40 years old
- gravidity less than 3
- gestational age more than 37 weeks
- natural delivery of single birth
- free of any disease
- no pregnant complication
- without a history of smoking, alcohol, and drug abuse during the pregnancy

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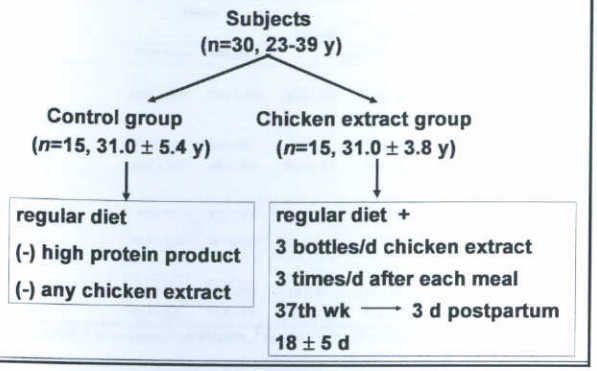
Experimental Designs



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Human Milk Collection

- no breastfeeding 1 h before milk collection
- twice a day
- the interval at least 4 h
- electronic suction pump
- 15-min suction of each breast
- from 1 to 3 d postpartum
- 5-10 mL for protein analyses

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Demographic and Clinical Characteristics

	Control	Chicken extract
Gestational weight gain, kg	16.4 ± 5.2	15.8 ± 4.9
Gestational age, weeks	38.9 ± 1.0	38.9 ± 0.9
Parity, n	1.4 ± 0.5	1.1 ± 0.4
Primiparous, n	9 (60.0%)	13 (86.7%)
Infant sex	9M, 6F	6M, 9F
Infant birth length, cm	51.3 ± 2.5	54.4 ± 2.3
Infant birth weight, g	3438 ± 205	3250 ± 397
Infant birth head circumference, cm	33.7 ± 0.9	33.4 ± 1.1

Chao *et al.* 2004

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Daily Dietary Intake

	Control		Chicken extract			
			Exclude	Include	Exclude	Include
	Pregnancy	Postpartum	Pregnancy		Postpartum	
Energy						
kcal/d	1986 ± 293‡	2081 ± 373	2097 ± 449	2168 ± 449	1923 ± 206#	1994 ± 206
Carbohydrate						
g/d	257 ± 63	257 ± 78	246 ± 77	246 ± 77	228 ± 52	228 ± 52
% energy	51.5 ± 8.1‡	49.0 ± 9.9	46.4 ± 9.0*	44.8 ± 8.8	47.5 ± 9.9	45.8 ± 9.6
Protein						
g/d	82 ± 18‡	101 ± 18‡#	91 ± 20	109 ± 20†	107 ± 30#	125 ± 30†
% energy	16.7 ± 3.4‡	20.1 ± 5.7‡#	17.7 ± 4.3	20.6 ± 4.6†	22.4 ± 6.4#	25.2 ± 6.3
Fat						
g/d	71 ± 16‡	73 ± 25‡	85 ± 24*	85 ± 24	61 ± 17*#	61 ± 17
% energy	32.4 ± 6.8	31.3 ± 7.7	36.3 ± 7.0*	35.0 ± 6.8	28.3 ± 7.1#	27.3 ± 6.8

* *vs* control, † *vs* exclude, ‡ *vs* include, # *vs* pregnancy ($P<0.05$)

Chao *et al.* 2004

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Milk Protein Concentrations

	Control	Chicken extract
Total protein, g/L	64.9 ± 26.1	75.6 ± 47.5
Lactoferrin, g/L	7.3 ± 3.0	9.8 ± 3.5* ↑ 34%
Epidermal growth factor, μg/L	146.8 ± 73.5	237.6 ± 144.6* ↑ 62%
Transforming growth factor-β2, μg/L	7.8 ± 5.8	23.1 ± 17.4* ↑ 196%
Secretory immunoglobulin A, g/L	4.1 ± 1.3	4.8 ± 1.5

* *vs* control ($P<0.05$)

Chao *et al.* 2004

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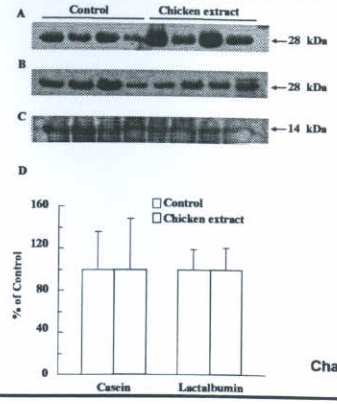
Milk Casein and Lactalbumin



Chao *et al.* 2004

Conclusion

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Protein compositions of human milk can be altered by diet. Supplementation with chicken extract increases colostrum levels of lactoferrin, EGF, and TGF-β2, which are important for the growth and immune functions of the infants, in lactating women.