

Lactose intolerance: From the origin to treatment

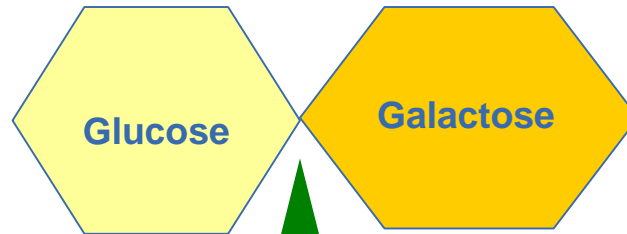
**Valio Ltd R&D
Tuula Tuure**

What is lactose intolerance?

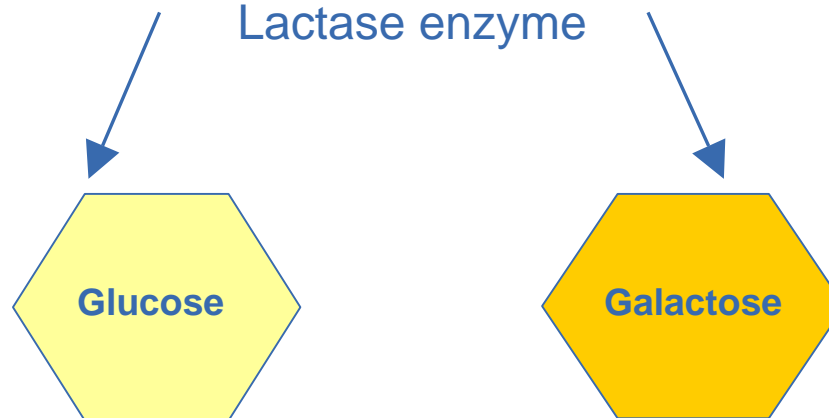
- Symptoms caused by maldigestion of lactose
 - Lactose is the carbohydrate (sugar) of milk
- Hypolactasia = Deficiency of lactase
 - Lactase splits lactose in the intestine



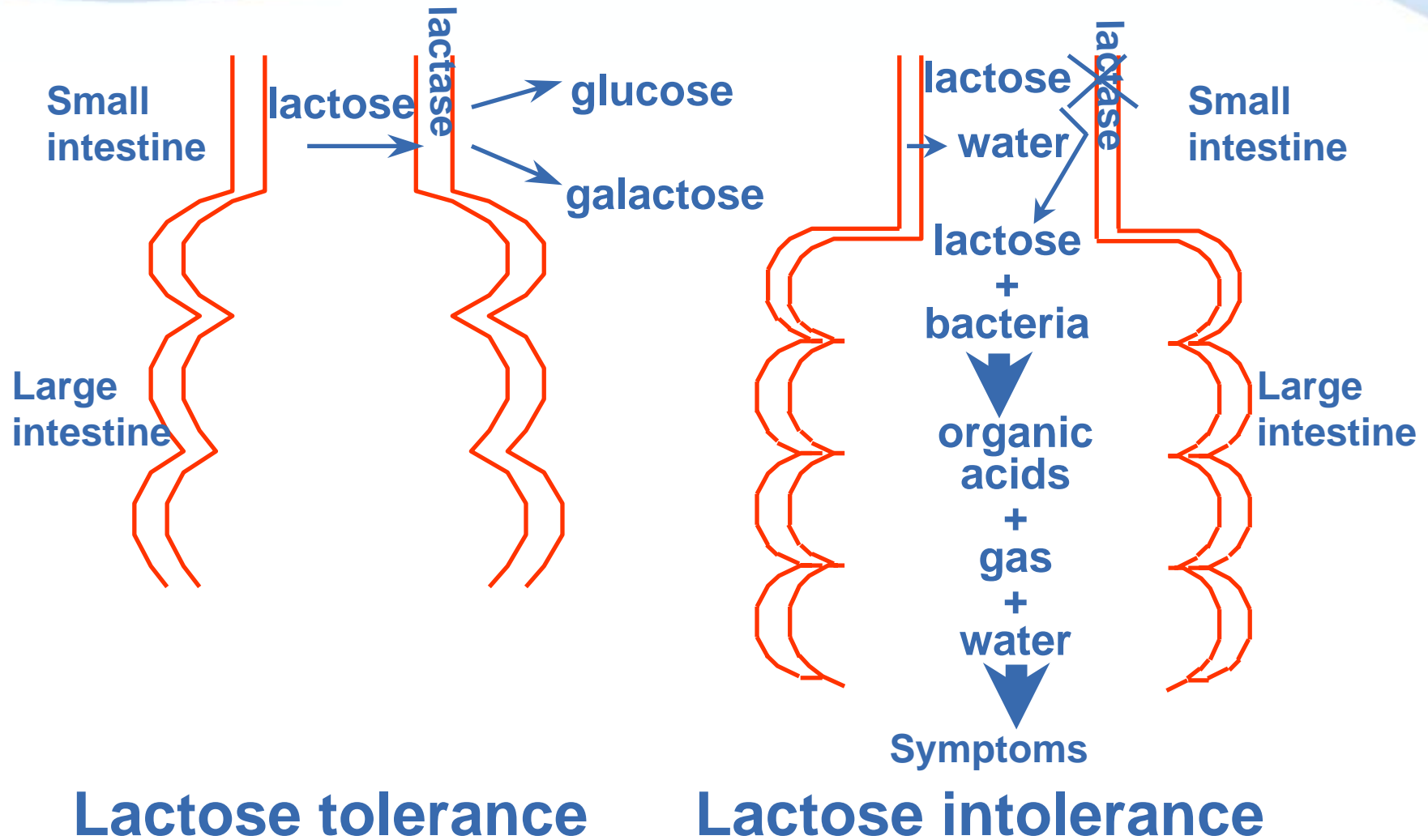
Lactose



Lactase enzyme



Lactose in the intestine



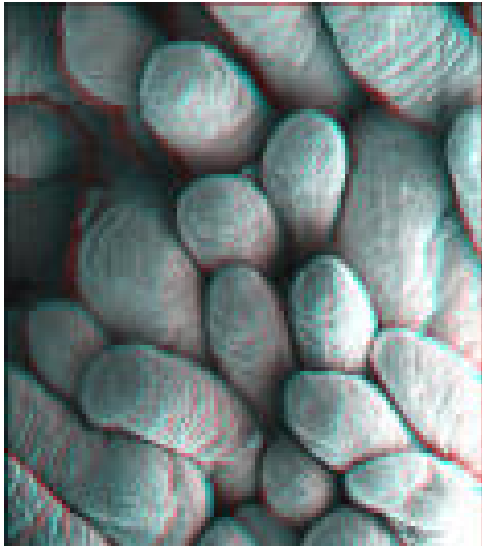
Lactose tolerance

Lactose intolerance

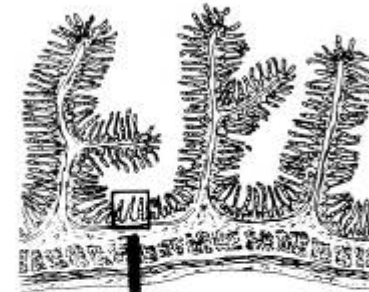
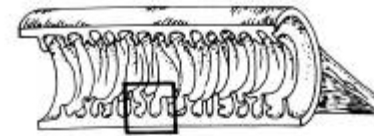
What causes hypolactasia?

- Genetic lactase deficiency
(Inborn lactase deficiency extremely rare)
- Intestinal diseases
 - Damage of the intestinal villi
 - Secondary lactase deficiency
- Lactase deficiency in premature infants

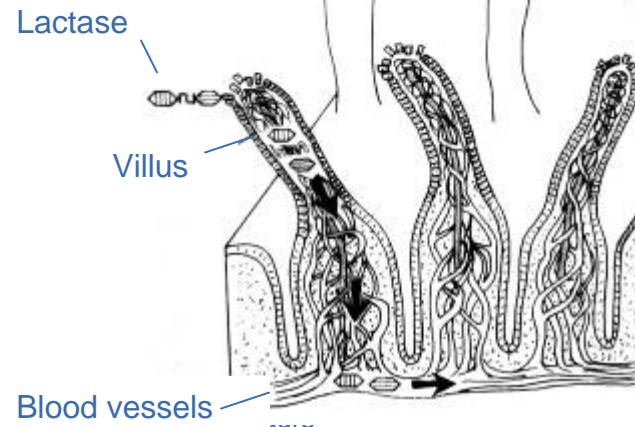
Lactase is found on the top of the intestinal villi



Courtesy of Dr Wagner, University of Delaware.



0,5 – 1 mm



Terms

Hypolactasia



+ lactose

Lactose maldigestion



Lactose-intolerance

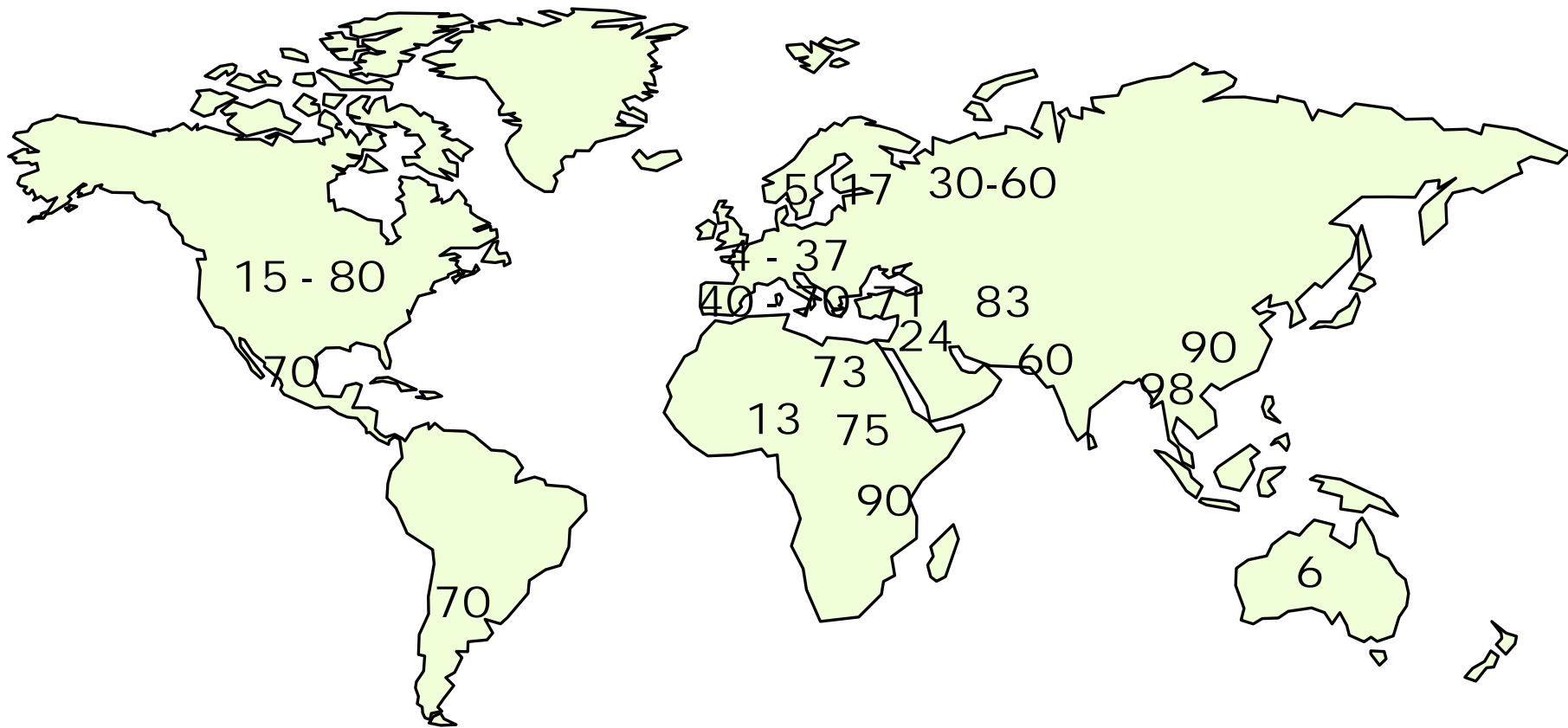
Symptoms

- Loose stools
- Abdominal bloating and pain
- Gas problems

Genetics of hypolactasia

- Mutation in the DNA found by a Finnish group of scientists
(Enattah et al. Nature Genetics 2002;30:233-)
- C/T₋₁₃₉₁₀ and T/T₋₁₃₉₁₀ genotypes associated with normolactasia
- C/C₋₁₃₉₁₀ genotype is strongly associated with hypolactasia

Prevalence of primary lactose maldigestion



Recent study carried out in Russia on prevalences of hypolactasia

ИЗВЕСТИЯ РАССКАЗЫВАЮТ О НАС

ПРОФИЛЬ ПРОИЗВОДИТЕЛЯ ПРОДУКЦИИ
ПРОДУКЦИИ РАССКАЗЫВАЮТ О НАС

697107

ИЗВЕСТИЯ РАССКАЗЫВАЮТ О НАС
ПРОФИЛЬ ПРОИЗВОДИТЕЛЯ ПРОДУКЦИИ
ПРОДУКЦИИ РАССКАЗЫВАЮТ О НАС

ИЗВЕСТИЯ РАССКАЗЫВАЮТ О НАС

© 2006, С.А. Смирнов¹, Д.В. Петров², В.В. Ковалев³, И.В. Ковалев⁴,
С.А. Смирнов⁵, Д.В. Петров⁶, В.В. Ковалев⁷, И.В. Ковалев⁸,
И.В. Ковалев⁹, Д.В. Петров¹⁰, С.А. Смирнов¹¹, В.В. Ковалев¹²,
С.А. Смирнов¹³, Д.В. Петров¹⁴, И.В. Ковалев¹⁵, И.В. Ковалев¹⁶

Prevalences of hypolactasia in Russia

Таблица 1. Частоты генотипов и аллелей полиморфного маркера C/T_{-13910}

Популяция	Численность выборки	Число индивидов (частота генотипа, %)		
		CC	CT	TT
Украинцы*	122	51 (41.8)	54 (44.3)	17 (13.9)
Белорусы*	101	40 (39.6)	45 (44.6)	16 (15.8)
Русские (Кострома)*	102	37 (36.2)	46 (45.1)	19 (18.6)
Русские (Курск)	112	60 (53.6)	43 (38.4)	9 (8)
Русские (Ростов)	114	61 (53.5)	46 (40.4)	7 (6.1)
Русские (Чукотка)	26	12 (46.2)	10 (38.5)	4 (15.4)
Чукчи	35	31 (88.6)	4 (11.4)	0 (0)
Удмурты	94	52 (55.3)	36 (38.3)	6 (6.4)
Коми-пермяки	69	29 (42.0)	30 (43.5)	10 (14.5)
Горцы (Памир)	34	30 (88.2)	3 (8.8)	1 (2.9)

* Данные приведены по [13].

Diagnostic methods

- **H₂ Breath Test:** bacteria in the bowel use lactose generating hydrogen (H₂) → detection of H₂ in the exhaled air
- **Lactose Tolerance Test:** Lactose ingestion → detection of reduced or missing rise in blood glucose
- **New tests**
- Detection of the hereditary primary hypolactasia with genetic test system from blood or saliva

Diagnostic methods: Pros and cons

Method	Advantage	Disadvantage
Lactose tolerance test	Indication of intolerance Readily available	Exaggerates symptoms Not reliable in diabetes
H2-test	Good indication of intolerance	Possibility for false negative results in certain cases
Gene test	No need for fasting From saliva: no need for blood sample Reliable for primary hypolactasia	No indication of intolerance Secondary hypol. not detected

Lactose intolerance is not milk allergy

Differences of lactose intolerance and milk allergy

	Lactose intolerance	Milk allergy
Origin of the ailment	Enzymatic deficiency	Immunologic reaction
Cause	Lactose (carbohydrate)	Milk protein
Symptoms	Flatulence, bloating, diarrhoea, abdominal pain	Exzema, nausea, diarrhoea, colic, respiratory dys- function, anaphylaxis
Occurrence	Mainly in adults	Almost exclusively in infants and small children
Dietary treatment	Reduction of lactose	Replacement of milk by special formulae

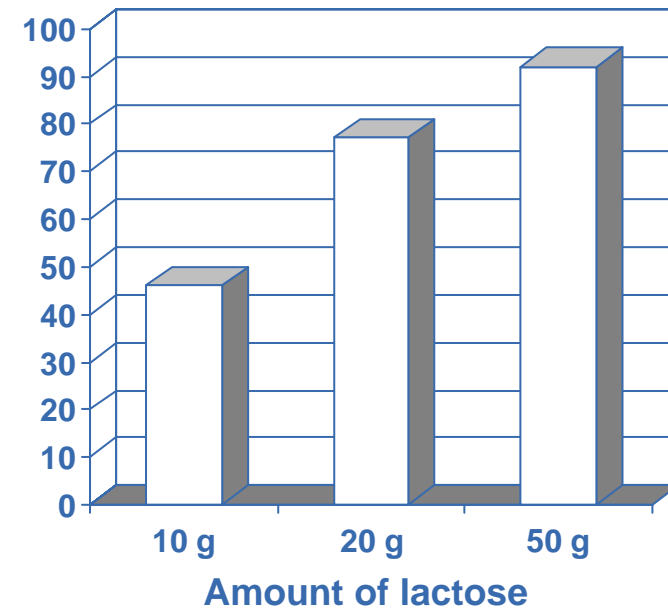
At what age does lactose maldigestion appear?

- High lactase activity after weaning
 - Exception: congenital lactose maldigestion – very rare
- In lactose maldigesters lactase activity drops to 1/10 by age 20 y
- Occasionally the manifestation may continue after age 20
- Sometimes symptoms appear only at later age
 - Weakened adaptive mechanisms of the intestines?

Factors influencing the symptoms

- Amount of lactose
- Other indigestible carboh.
- Other food
- Gastric emptying and gastrointestinal transit time
- Intestinal, colonic microflora
- Acidity of the intestine
- Intestinal sensitivity

Persons with symptoms (%)



(Sahi et al. 1983)

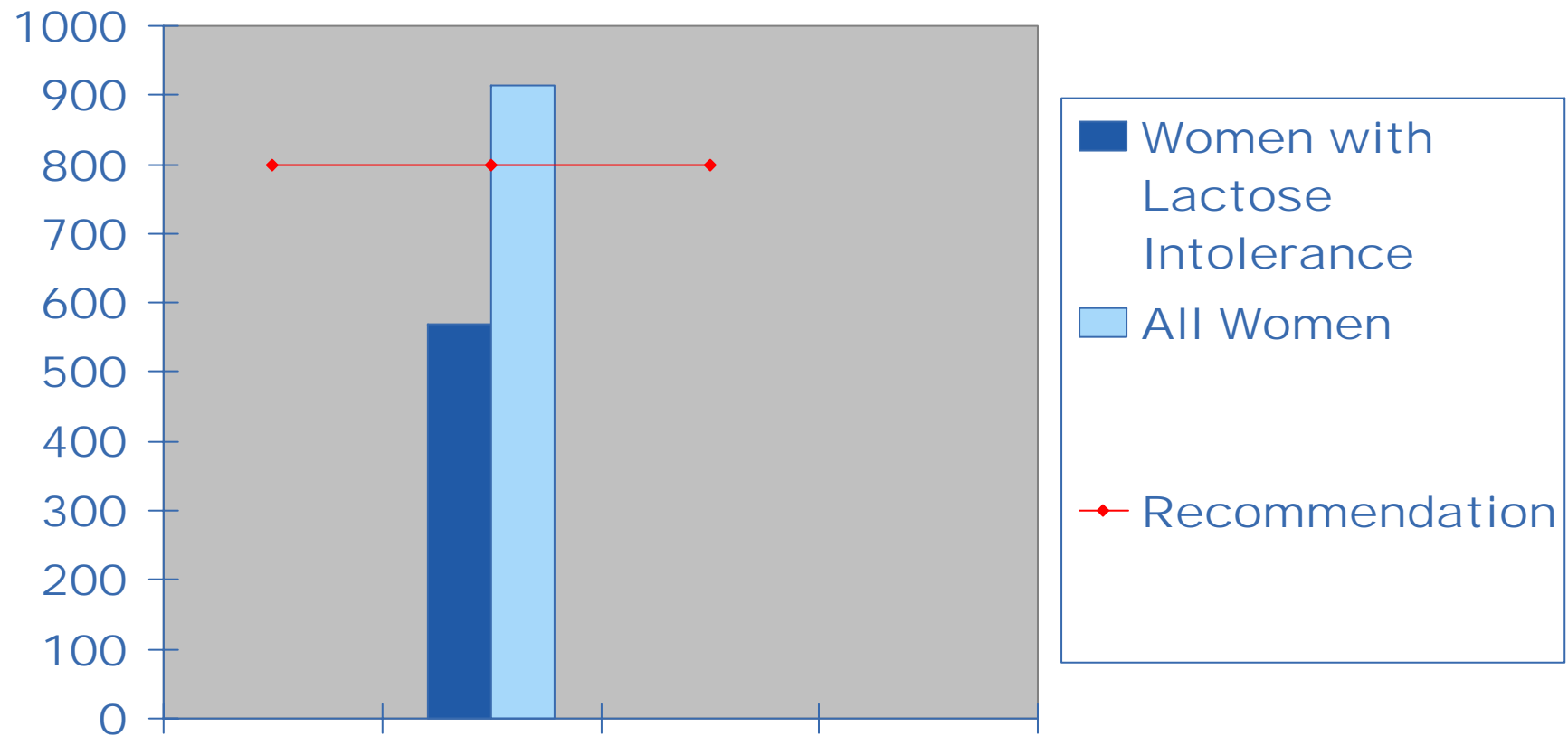
Average content of lactose in different dairy products

Product	Lactose g/100 g	Lactose g/ 2 dl (portion)
Milk	5	10
Yoghurt	3.5	7
Hard cheese	0	0
Low lactose milk and yoghurt	< 1	< 2
Lactose-free milk and yoghurt	< 0.01	< 0.02

Treatment of lactose intolerance

Treatment	Possible problems
Less dairy products	Poorer diet Deficiency of calcium
Low-lactose products <ul style="list-style-type: none"> • Fermented • Lactose hydrolysed 	Some lactose left Sweet taste in some products
Lactose-free products <ul style="list-style-type: none"> • Matured cheese • Removed lactose 	- Methods not readily available
Lactase preparations <ul style="list-style-type: none"> • Added in the product • Consumed with the product 	Sweet taste in some products, expensive Not efficient in all individuals, expensive

Calcium Intake of Lactose Intolerant Finnish Women (mg/d)





Lactose-free products from Valio Ltd



Set-type fermented dairy
Quark, Creme fraiche



Yoghurts



Milks and sour milks



Creams



Feta type cheeses

What is lactose-free?

- No common definition
- Lactose content may vary from 0,00 – 0,1 %
- Sugar-free: < 0,5 %
 - Lactose is a sugar → lactose-free: < 0,5 % ???
- Best definition: < 0,01 %

Low-lactose or lactose-free?

Lactose-free milk by Valio

- **no lactose**
→ suitable for the most sensible lactose intolerant
- 40% less carbohydrates
→ lower calory content
- **original, fresh milk taste**

Low-lactose milk

- lactose content <1%
→ may cause symptoms in some individuals
- Normal carbohydrate and calory content
- **sweet taste**

Lactose residue < 1% in hydrolysed low-lactose products

Lactose residue < 0,01% in lactose-free milk

Conclusions

- **70 % of the world adult population have hypolactasia**
- **Feasible diagnostic methods are available**
- **The majority tolerate small amounts of lactose**
- **The most sensitive need lactose-free products**
- **Savory low-lactose and lactose-free liquid dairy products increase dairy consumption**