Role of dietary fibre in rabbit nutrition and digestive troubles prevention

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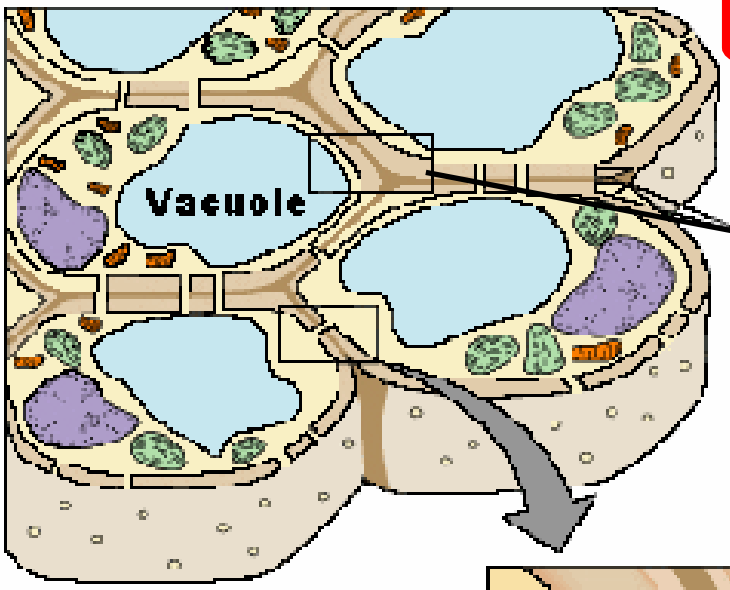
Dietary fibre origin

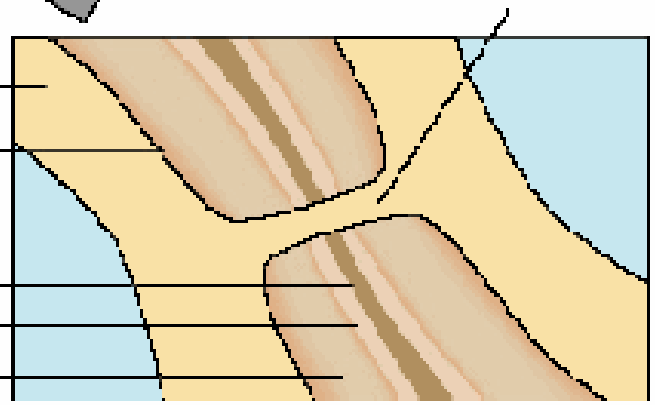
Fibre Sources ?

Origin of the different types of fibre

Standard Plant Cell



Plant Cell Walls



Plant cell wall layers :

- Middle Lamella
- Primary Wall
- Secondary Wall

Fibre Source

:

MIDDLE LAMELLA

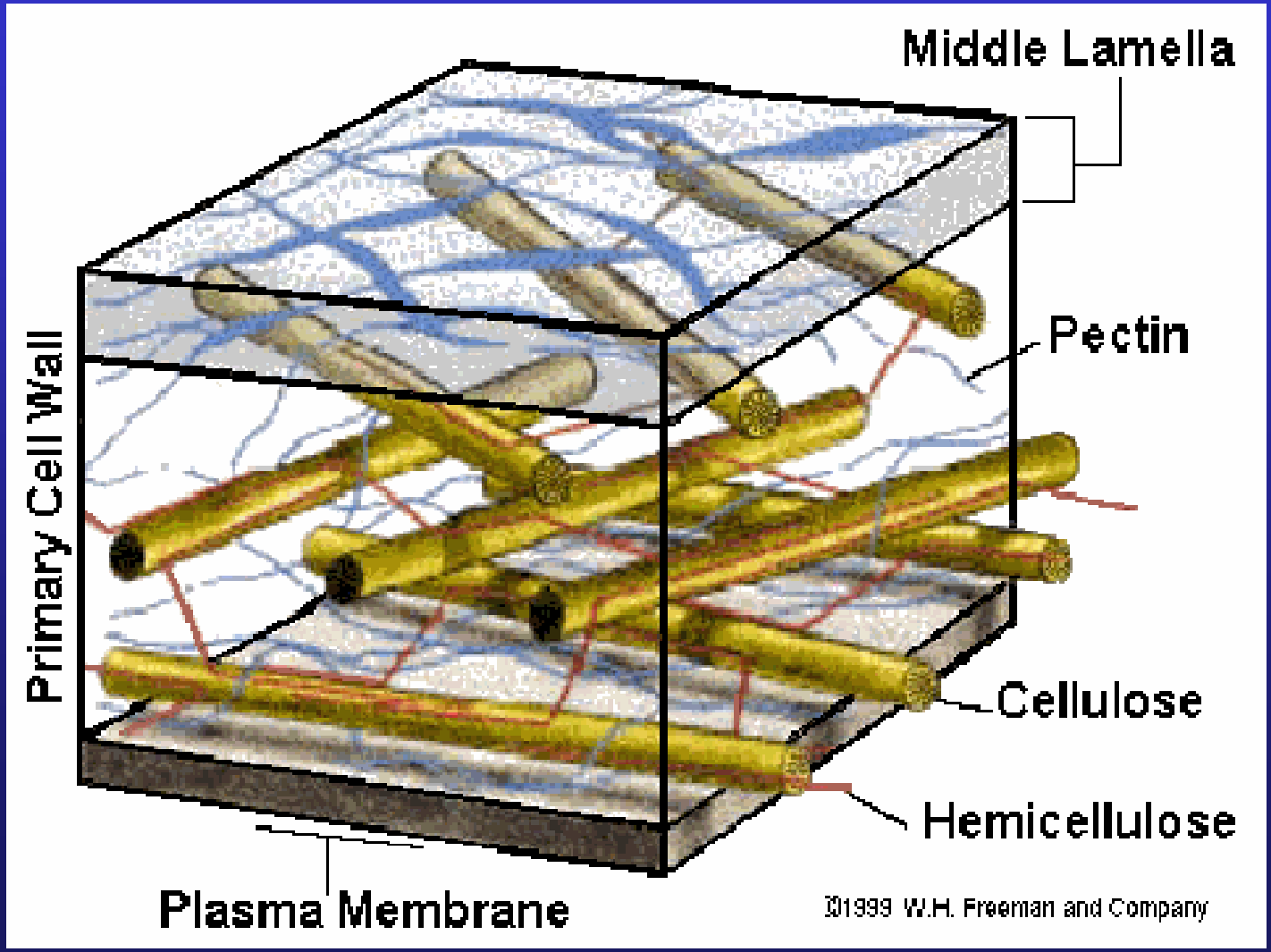
is a flexible pectic region that fill gap between two adjacent cells. It may content lignin

PRIMARY CELL WALL

consist of cellulose macrofibrils , extremely strong. The macrofibrils are complexed with hemicellulose, hydrogen bounded to adjacent cellulose fibrils

Primary cell wall contents also pectins and small quantities of glycoproteins and of lignins

Schematic representation of the primary cell wall



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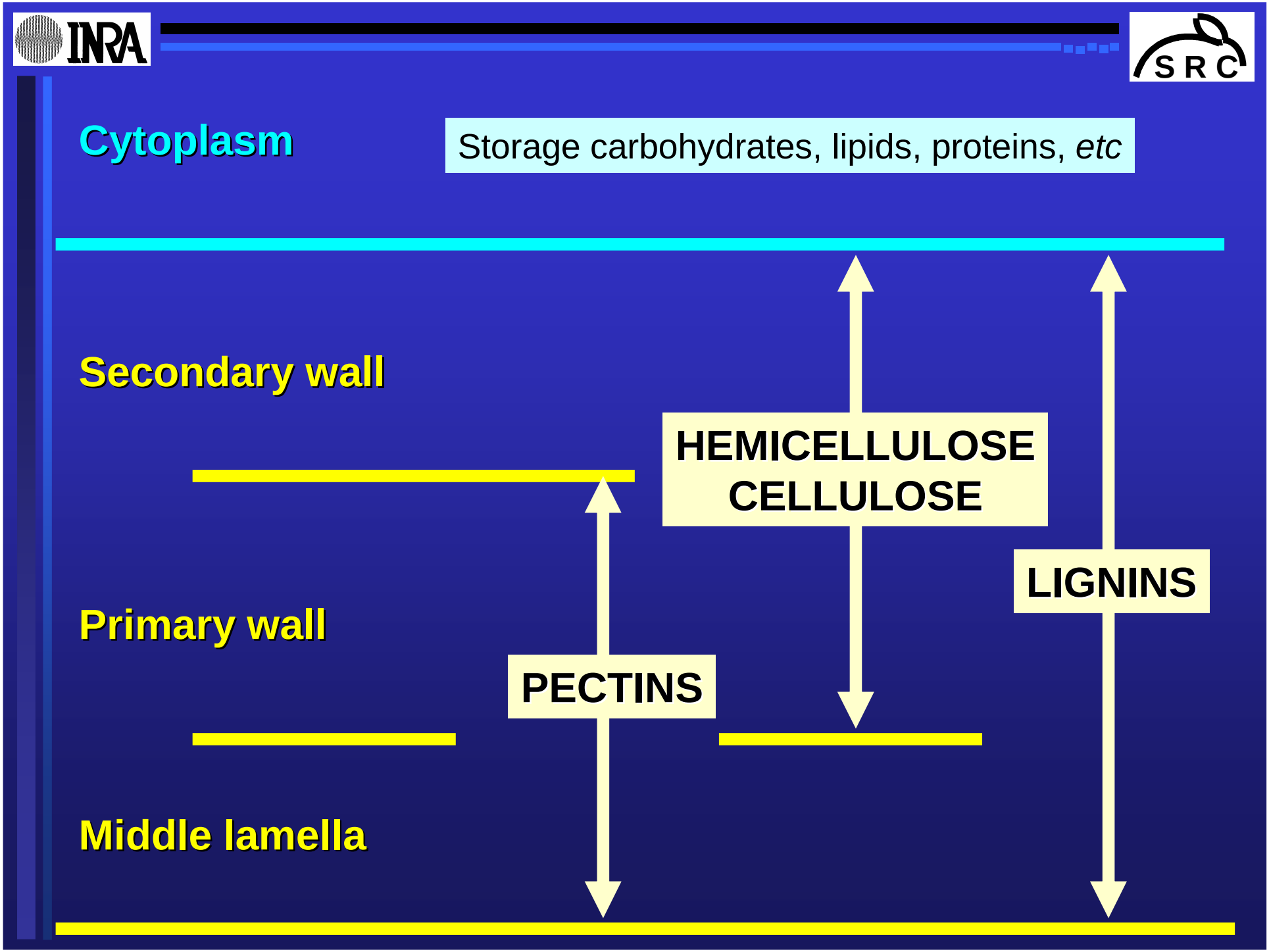
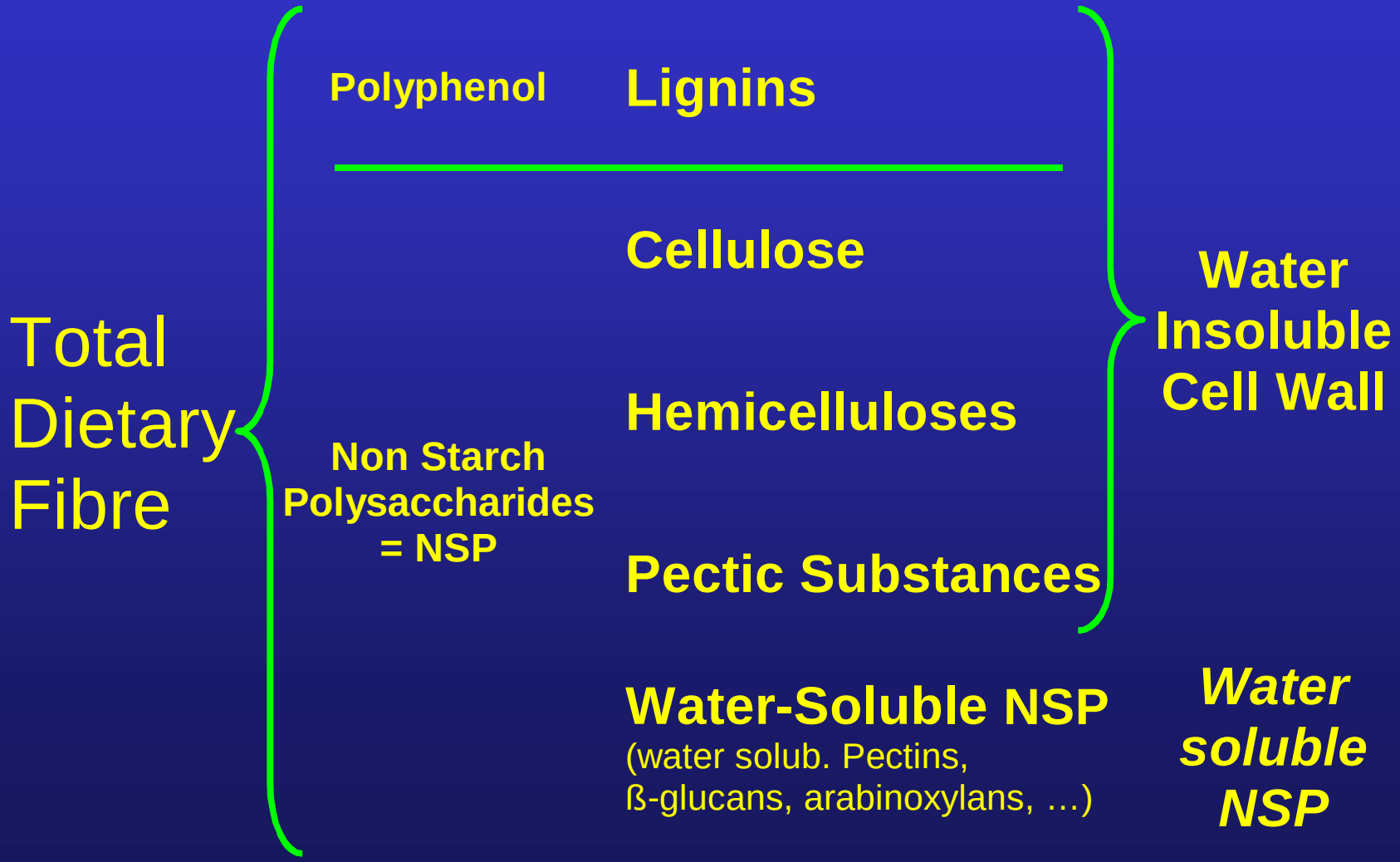
SECONDARY CELL WALL

Main advantage is increased strength
From INSIDE primary wall, between cell membrane and primary wall. Contains NO PECTIN, but mainly cellulose and usually lignin


INRA
SRC
Cytoplasm
Storage carbohydrates, lipids, proteins, *etc*
Secondary wall
HEMICELLULOSE
CELLULOSE
LIGNINS
Primary wall
PECTINS
Middle lamella

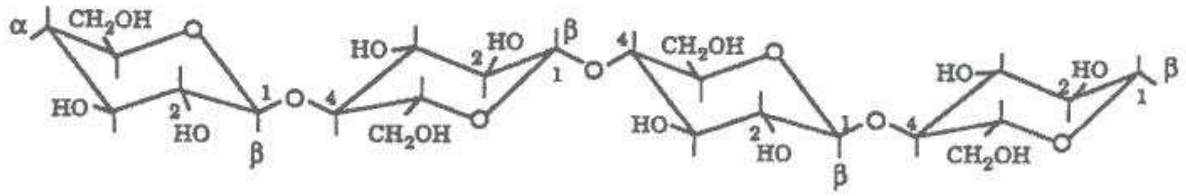
CLASSIFICATION OF DIETARY FIBRE



CHEMICAL COMPOSITION OF DIETARY FIBRE COMPONENTS

Lignins : non saccharide polymer. Built up from 3 phenyl-propane units (conferilic, coumarilic & sinapilic acids) very branched and complex network Resistant to most chemical and enzymatic agents, those of bacteria included

Cellulose : the major structural polysaccharide. Homopolymer formed from linear chains of ß (1-4) linked D-glucose units (starch is is a polymer of the same units but α (1-4) linked). Degree of polymerization is usually 8 000 to 10 000. Soluble only in strong acid solutions.



Cellulose

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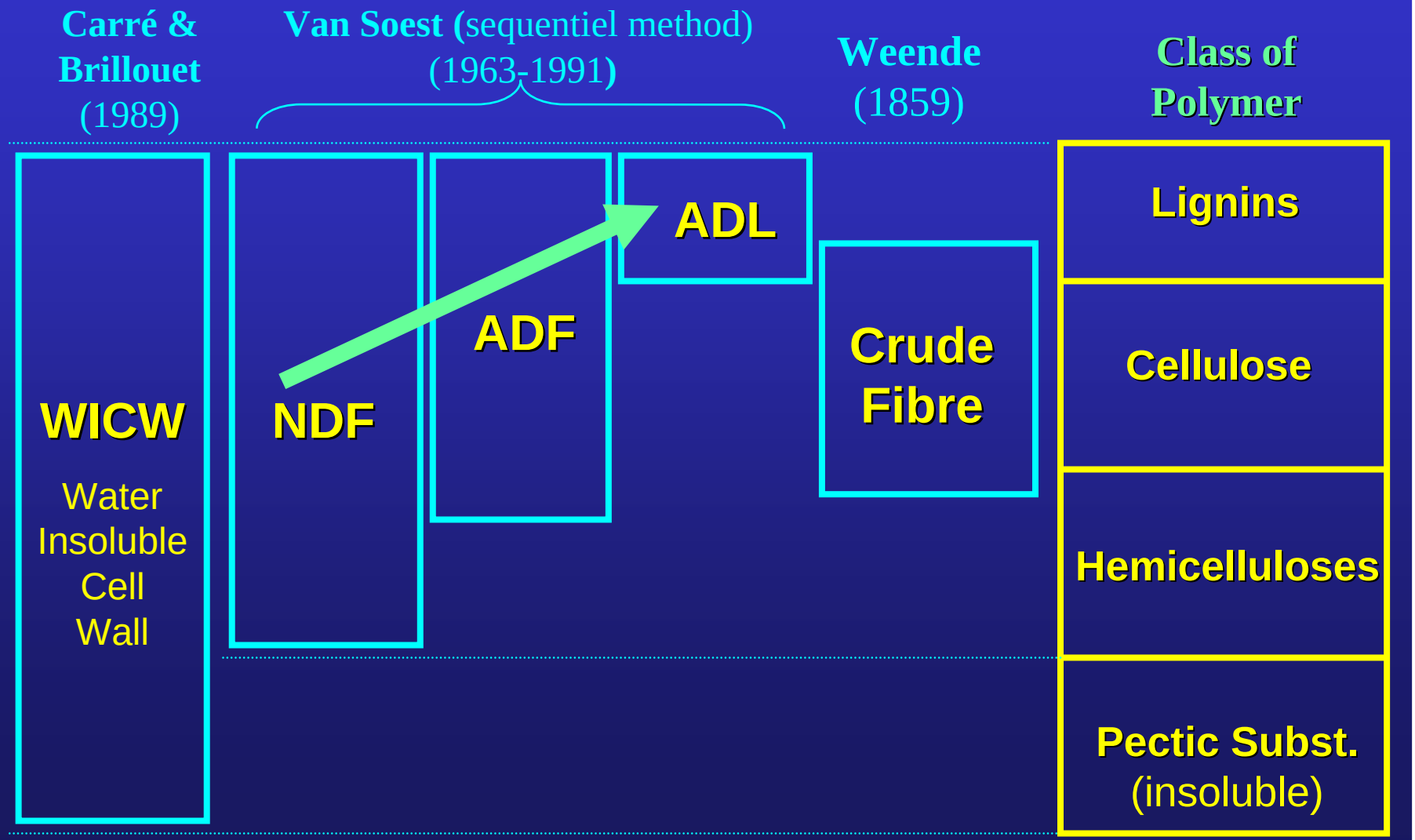
Hemicelluloses : a group of several polysaccharides with lower degree of polymerization than cellulose. A ß (1-4) linked backbone of xylose, mannose, arabinose or glucose units. Generally branched heteropolymers, units linked in ß 1-3 , ß 1-6 , α 1-4, α 1-3, …)

Pectins : are composed of a polygalacturonic linear chain backbone always branched with neutral sugars (mainly arabinose and galactose). From place to place the linear chain includes L-rahmnose unit

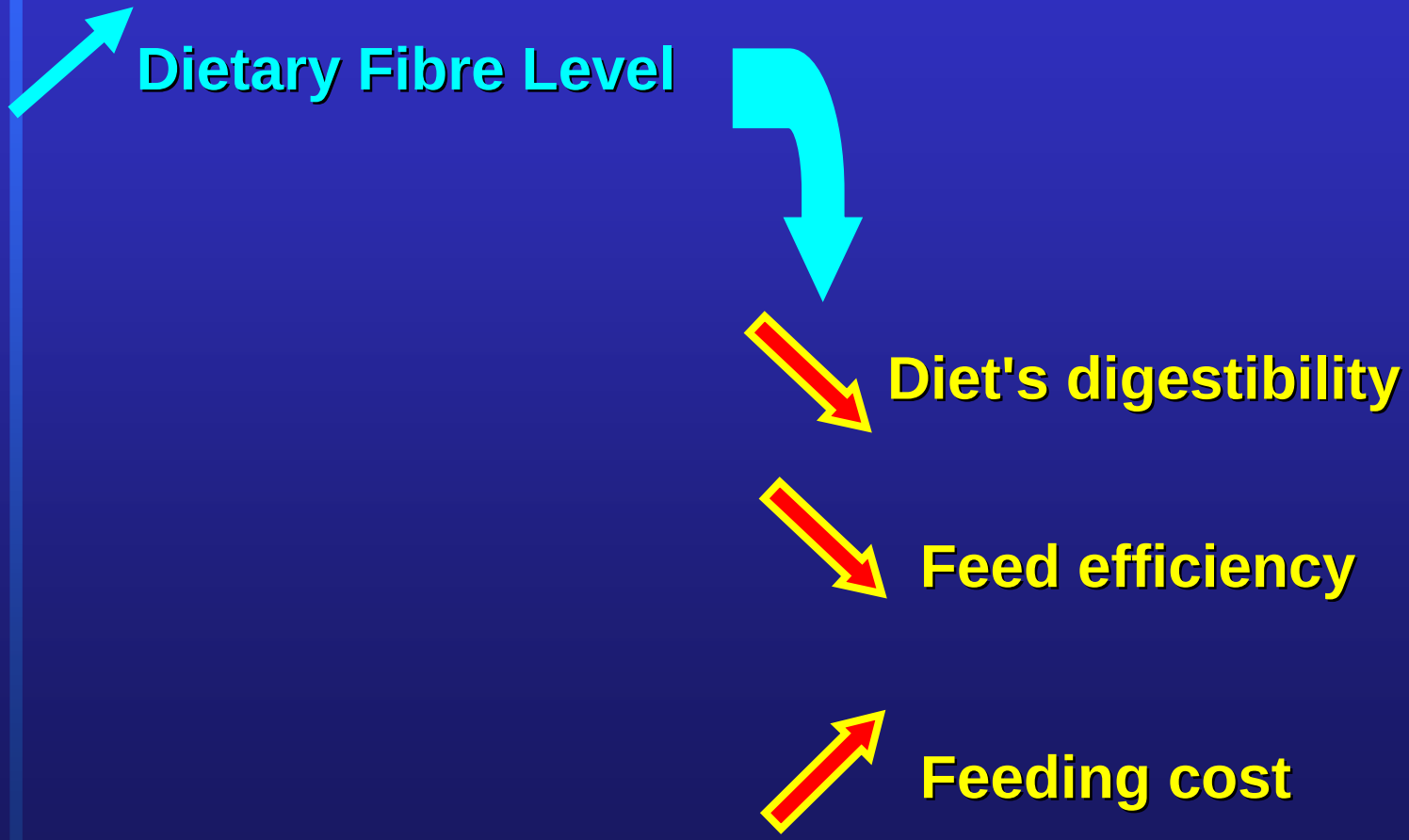
MAIN GRAVIMETRIC METHODS FOR DETERMINATION OF DIETARY FIBRE IN ANIMAL FEEDS



Apparent DIGESTIBILITY of the different types of fibre in the Rabbit

Class of dietary fibre	Mean	Range
Lignins (ADL)	**10 - 15**	-13 to +50
Cellulose (ADF – ADL)	**15 - 18**	5 to 40
Hemicellulose (NDF – ADF)	**25 - 35**	10 to 60
Pectins (total uronic acids)	**70 - 76**	30 to 85

GENERAL SITUATION



For the "nutritionist" , any reduction of diet's fibre level will induce a reduction of nutritional costs

Thus for him , it's clear and simple

THE BEST FIBRE LEVEL IS ALWAYS THE LOWEST

BUT "breeders" and "pathologists" have observed

that

low dietary fibre levels are frequently associated with digestive troubles and very often mortality

As a consequence : 2 questions

- 1 - How to measure the sanitary risk ?

- 2 - Which type of fibre is efficient to reduce the risk and if defined , at which level ?

Digestive Health Status Estimation in the Rabbit

For rabbits alive at the end of the period

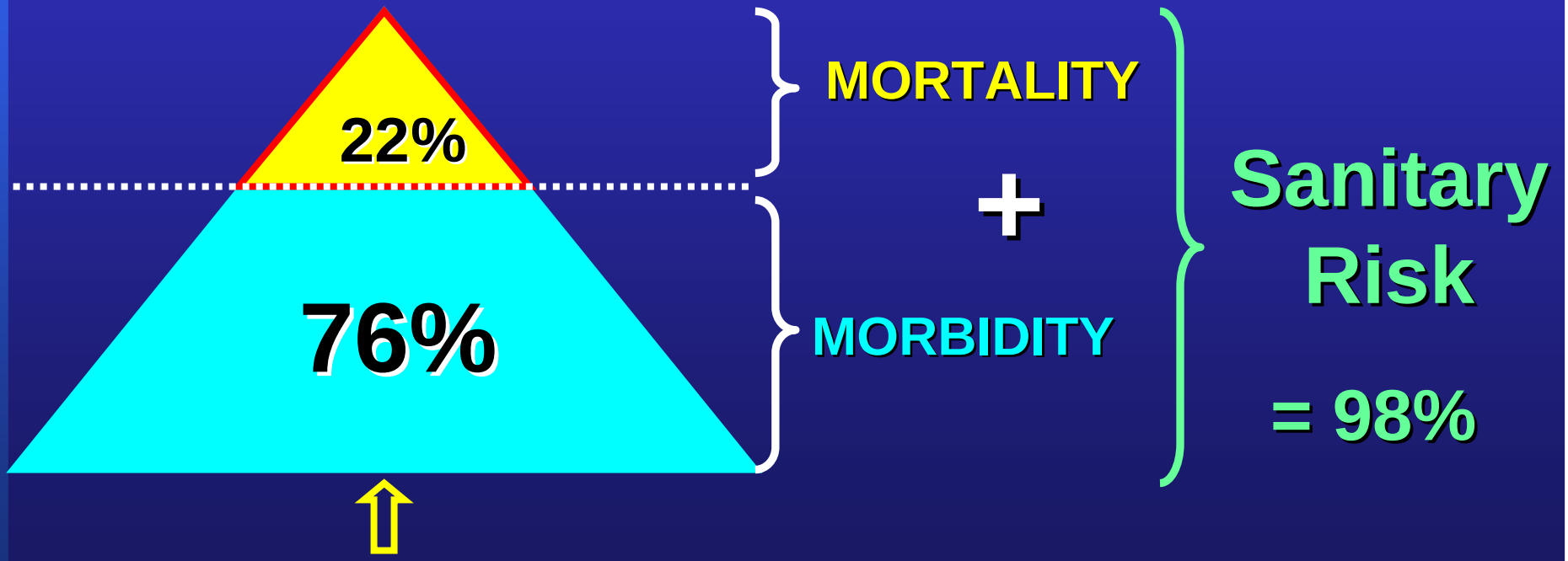
MORBIDITY = very low growth rate or weight loss
and/or transitory diarrhea
and/or intake trouble (sudden decrease, …)

} **MORTALITY**

a **YES/NO** criterion

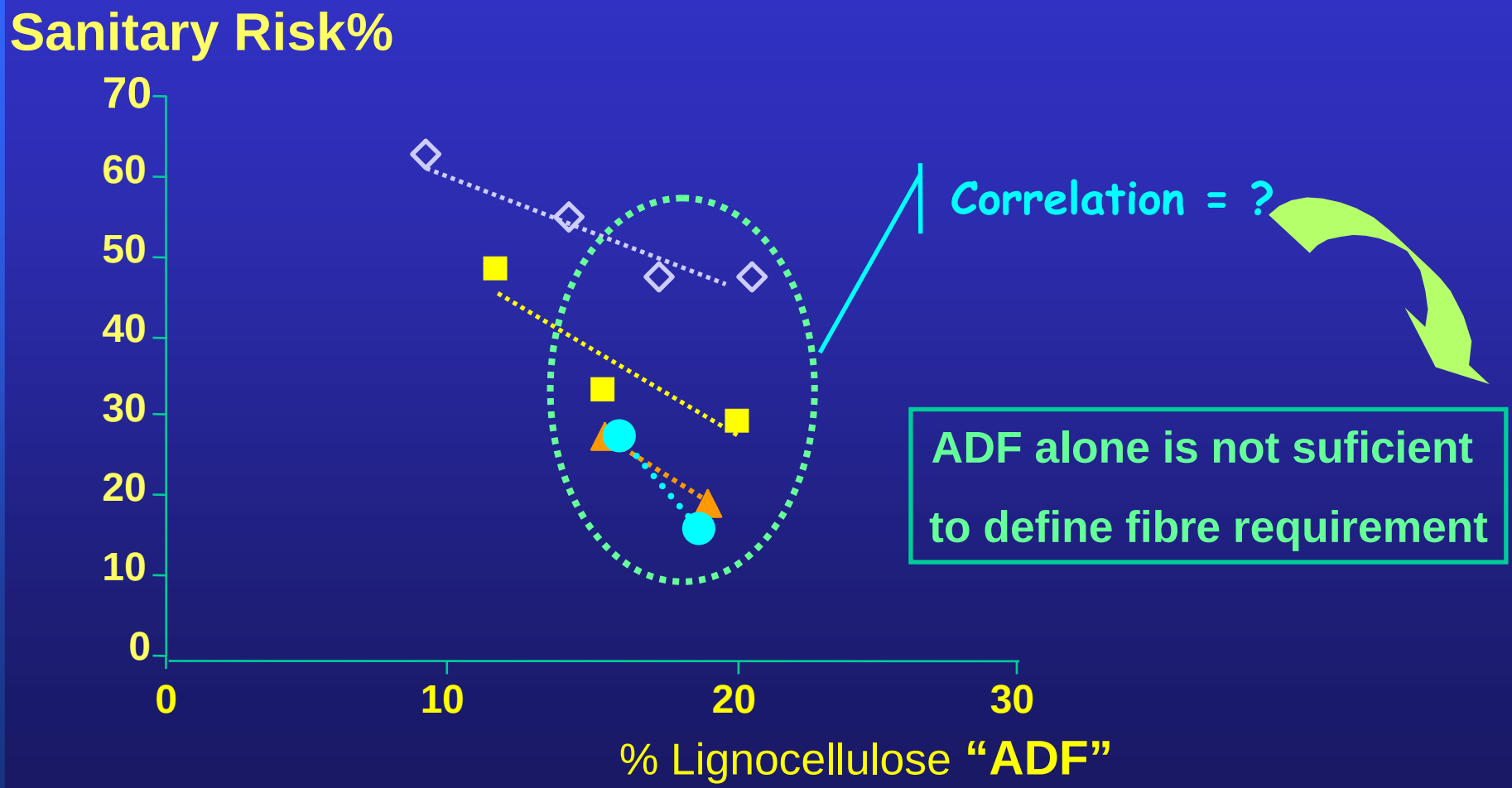
Example of **health trouble** with a fibre deficient diet (Bennegadi *et al.* 2000)

NEW CRITERIA FOR HEALTH STATUS ESTIMATION



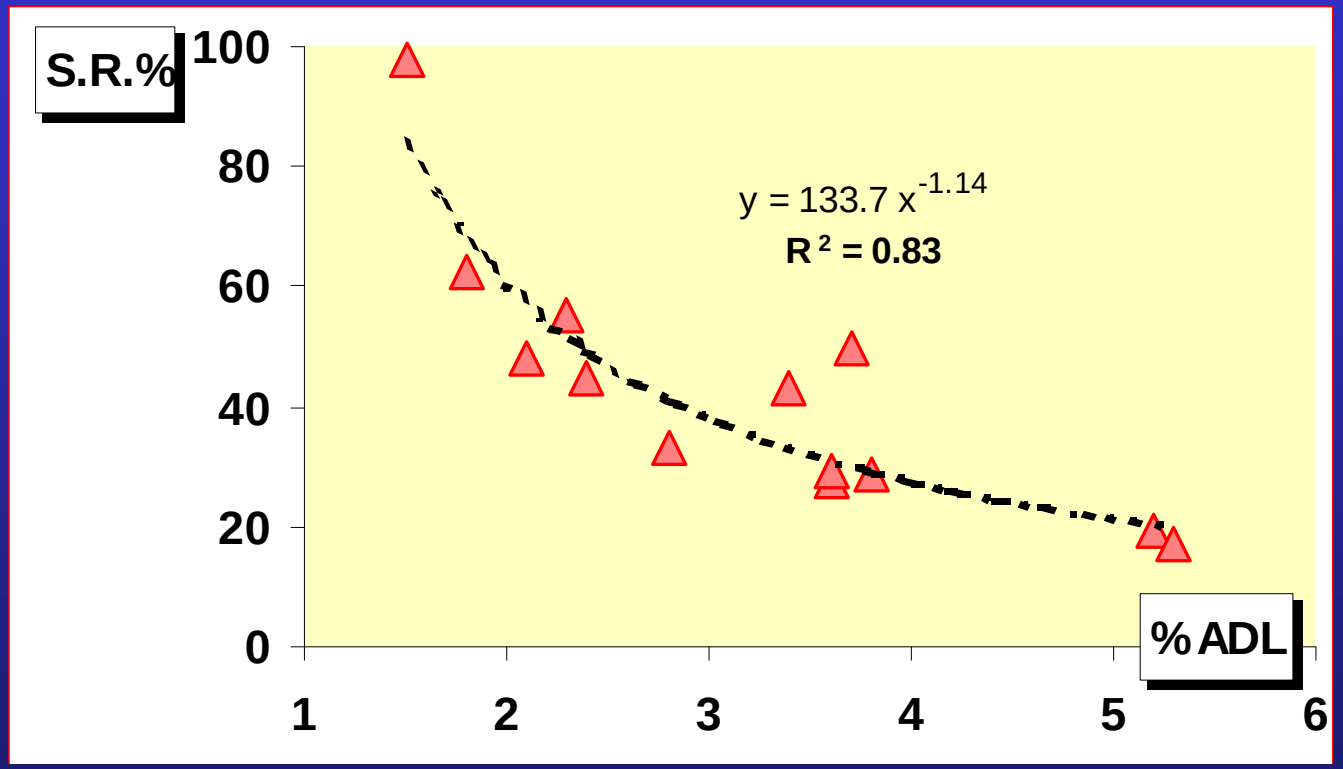
Example of **Sanitary Risk** with a fibre deficient diet (Bennegadi *et al.* 2000)

Is ADF a sufficient criterion or not ?



SR = period 28-70d. of age (> 40 rabbits / diet, one point = one diet)
(Gidenne et Jehl, 1999; Pinheiro et Gidenne, 1999; Gidenne et al., 1998).

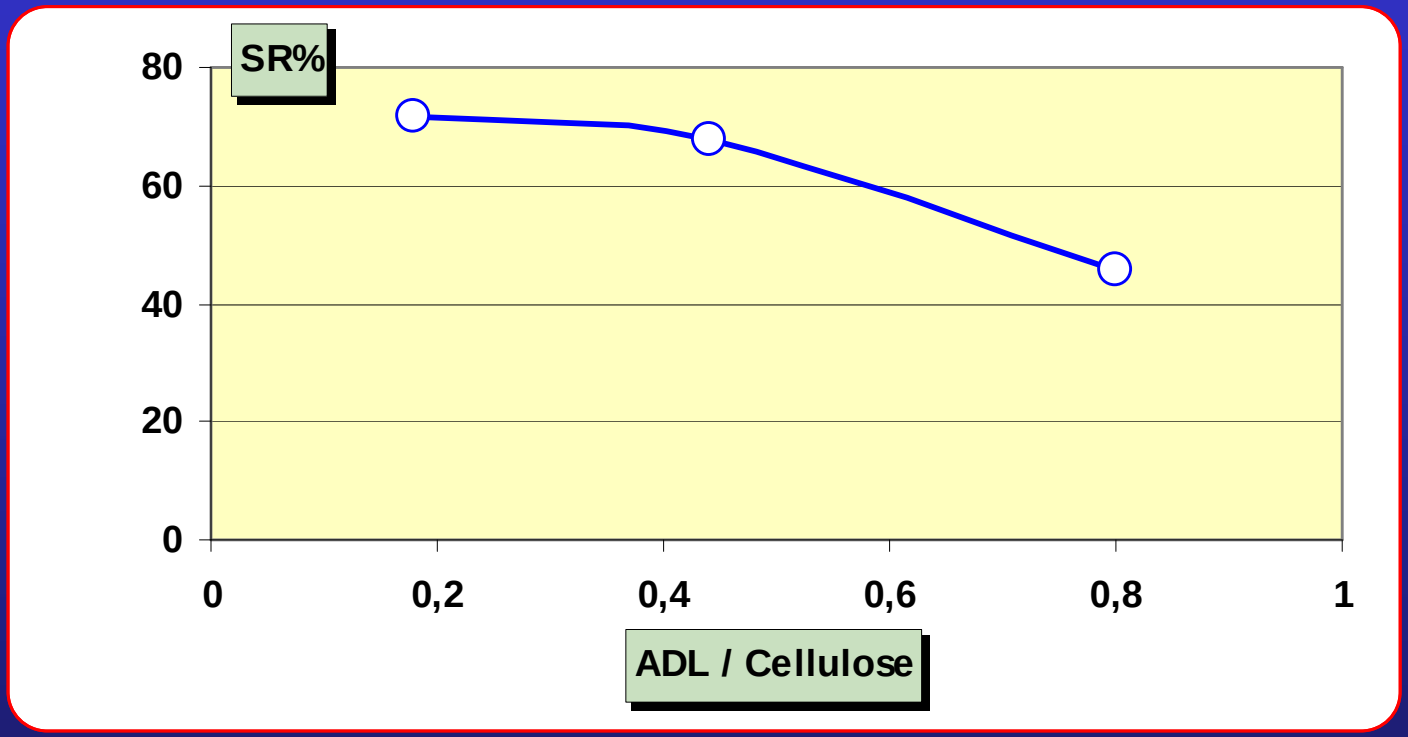
Sanitary risk and diet's ADL level



Recommendation : a minimum of 5% of lignin

but attention ADL is not = true lignin in some cases

Effect of proportion of lignin in the ADF

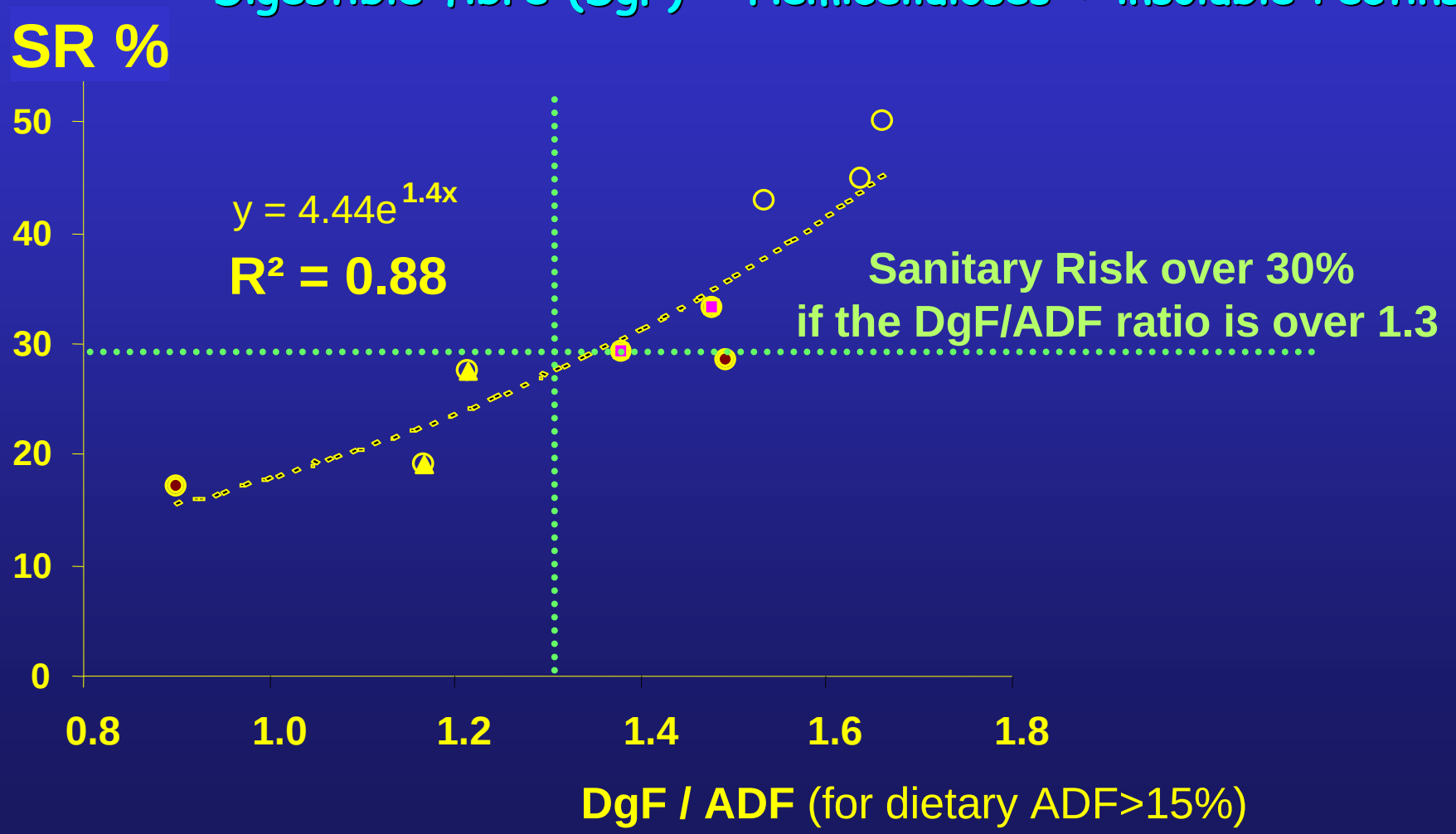


ADF = 16%(constant) ; NDF = 30% (constant)
Starch = 22% (constant)

(Gidenne et al. 2001a)

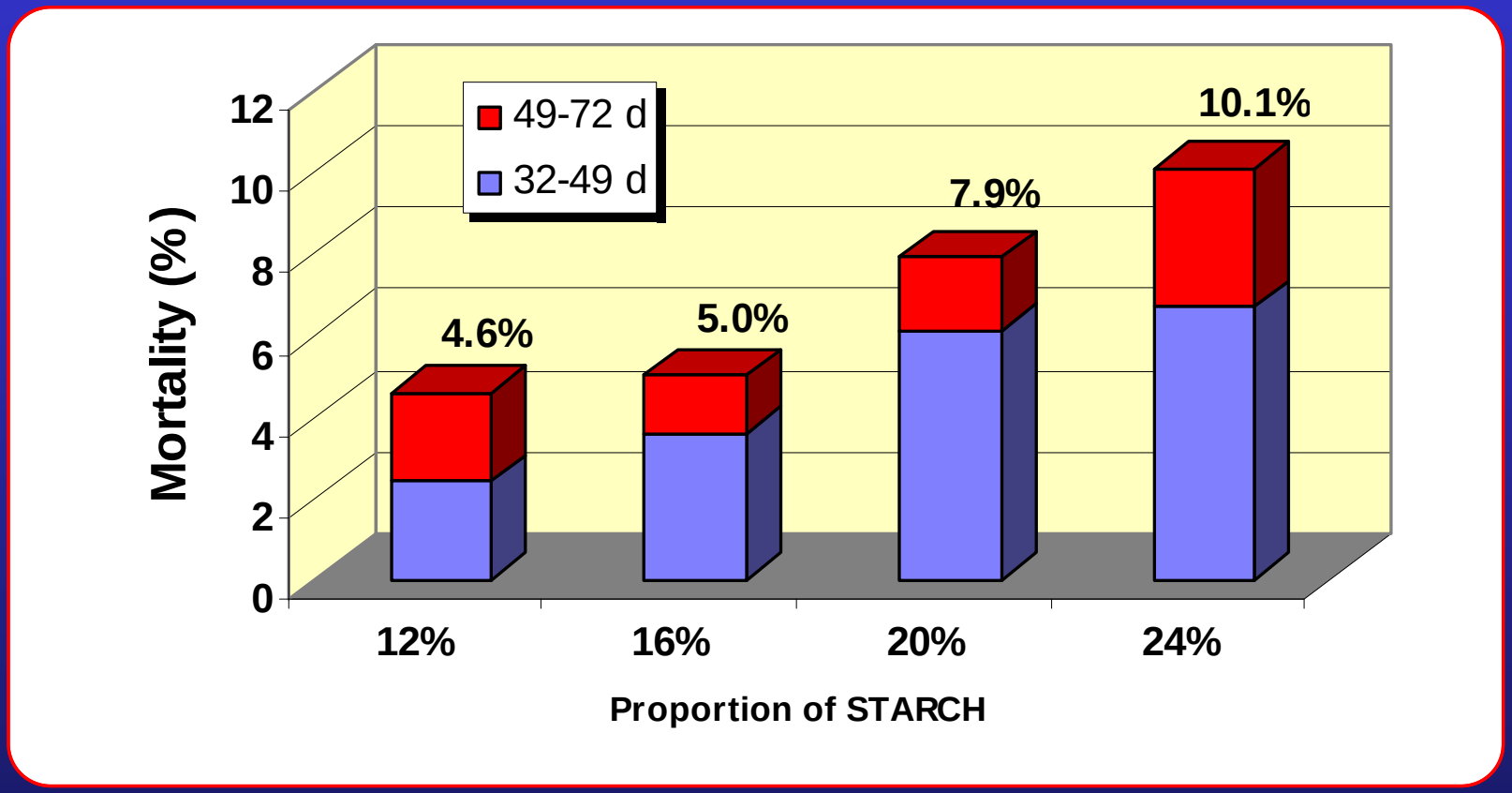
Sanitary risk and relative supply of digestible fibre "DgF" and of lignocellulose "ADF".

Digestible fibre (DgF) = Hemicelluloses + insoluble Pectins



Digestible Fibre *vs* Starch

(504 growing rabbits / diet - 6 experimental sites)



ADF = 18% ; ADL= 4.3% ; WICW + Starch = ~constant 52%

Growth rate = 42.5 g/d whatever starch proportion

Recommendations for growing rabbits

(as fed basis)	Weaning => 45 d	End of fattening
Lignocellulose "ADF" (%)	= 19	= 17
Lignins "ADL" (%)	= 5.5	= 5.0
Cellulose (ADF-ADL) (%)	= 13	= 11
Ratio lignins/cellulose	> 0.4	> 0.4
Hemicelluloses (NDF-ADF) (%)	> 12	> 10
Ratio Digest Fibre/ ADF	= 1.3	= 1.3
Starch	*< 13*	*< 18*

Thanks for your attention