Chimioréception de la saveur sucrée

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Journée Pôle Pass - SweetFlavors – Aix en Provence – 09/10/2018

Odorat et goût : 2 sens chimiques

- Input = signal chimique ou physique

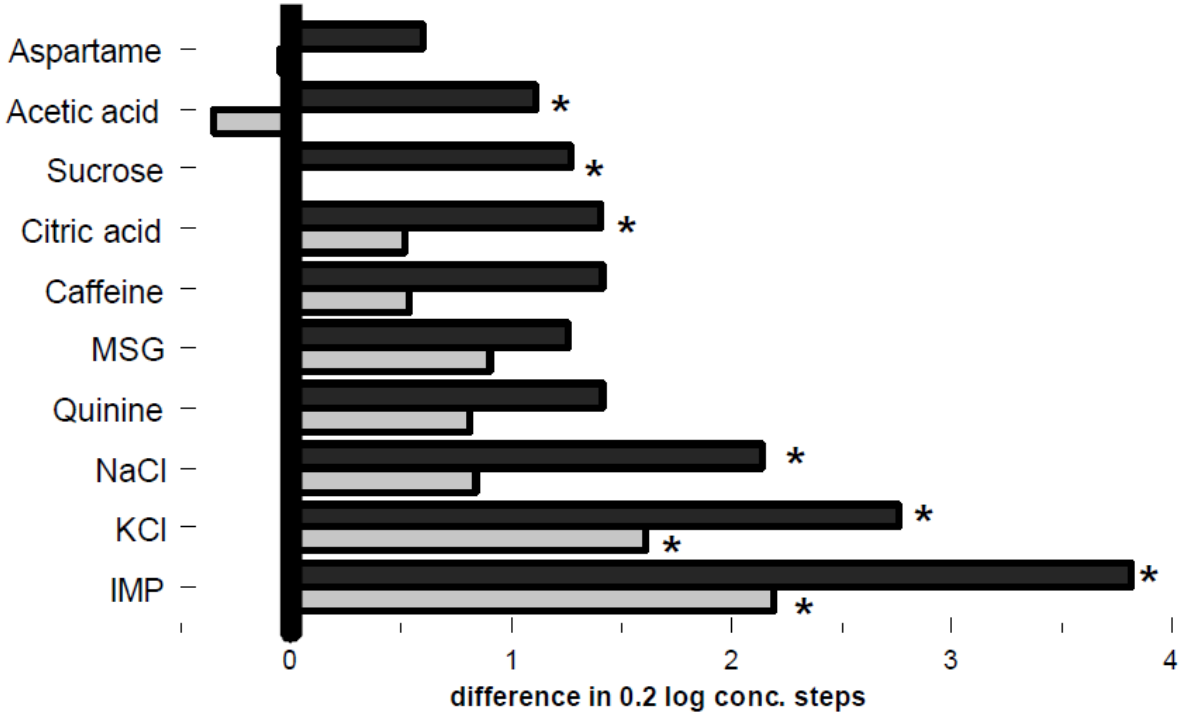
- Output =

@Neurone : signal électrique

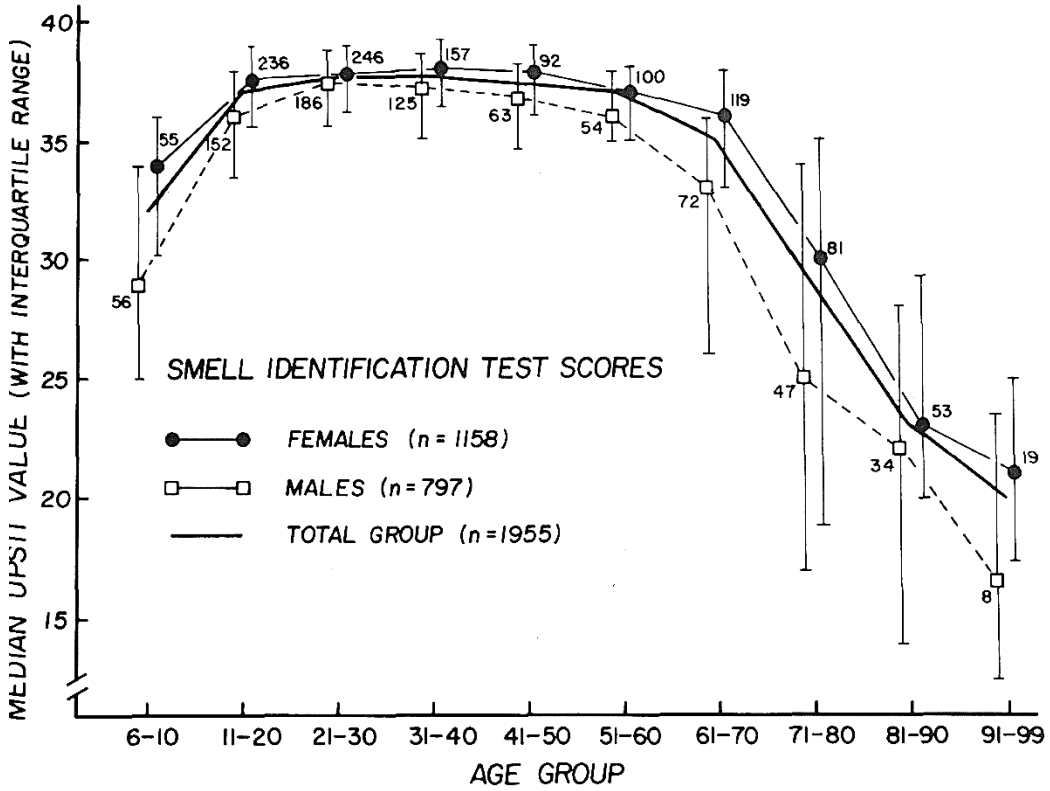
@Cerveau : intégration du signal

@Humain : perception, émotion, cognition, souvenir, …

Perte des performances sensorielles avec l'âge



Mojet *et al.* Chem. Senses 2001



Doti *et al.* Physiol. Behav. 1984

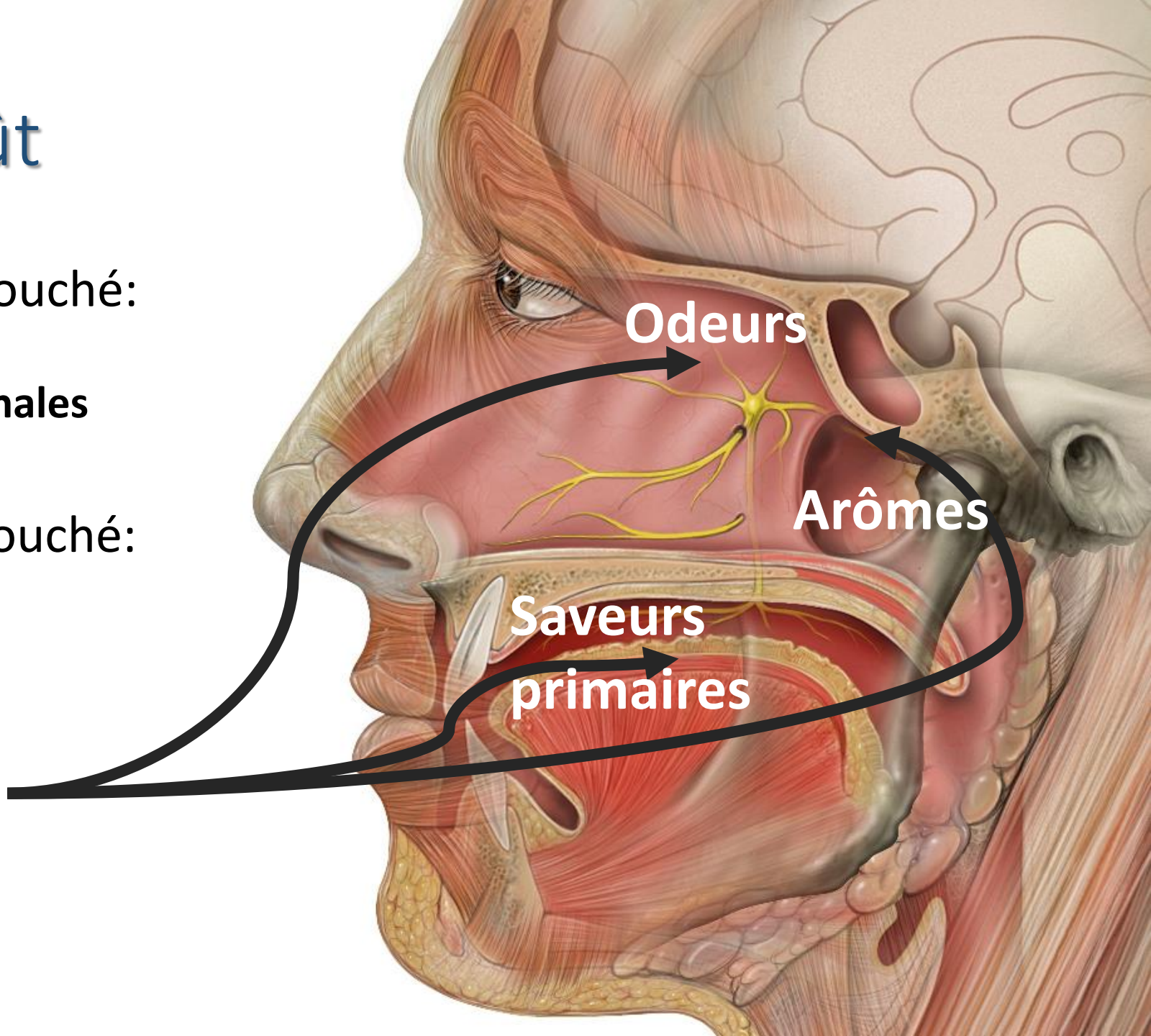
Physiologie du goût

- Goûter avec le nez bouché:

  Saveurs primaires
  + perceptions trigéminales

- Goûter sans le nez bouché:

  + arômes



Le sens du goût

Saveurs primaires

sucré

salé

acide

amer

umami

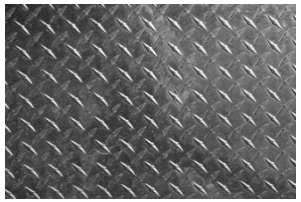
Arômes (odeurs)

Perception trigéminale

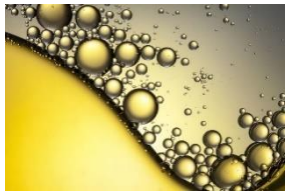
Chaud

froid

astringence



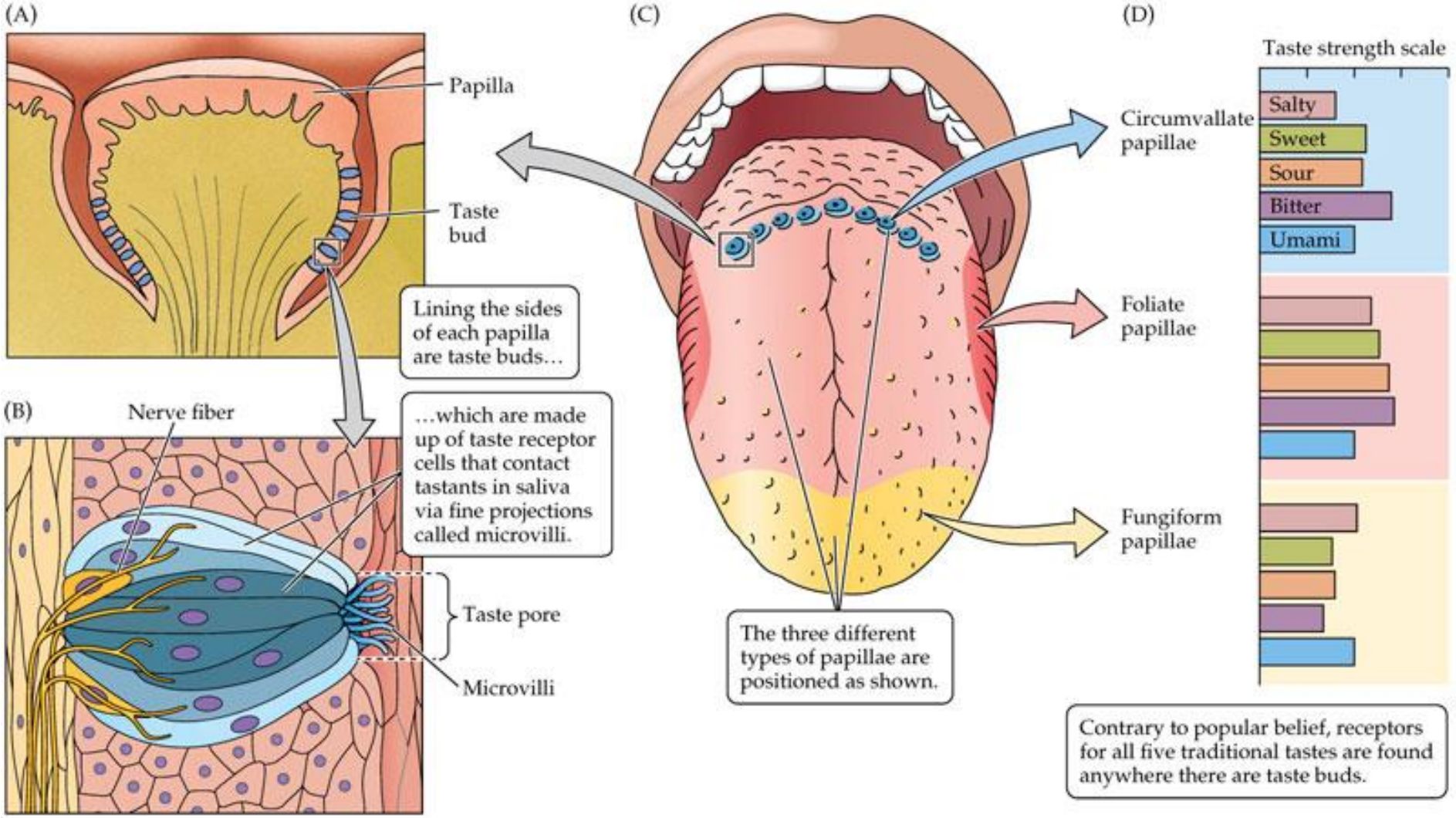
métallique



gras (saveur primaire?)

Nos cinq sens (réal. S. Scala)
© Film Concept Associés

Anatomie du système gustatif



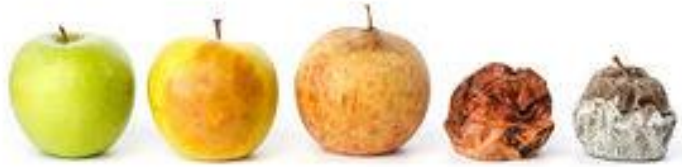
***THE MIND'S MACHINE 2e*, Figure 6.16**

© 2016 Sinauer Associates, Inc.

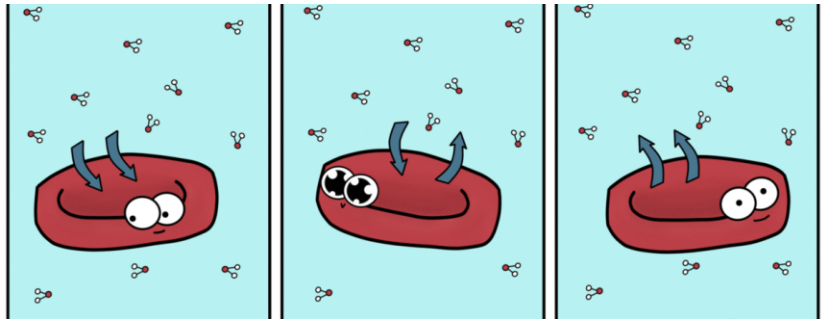
Les saveurs : des fonctions différentes

Sucrée

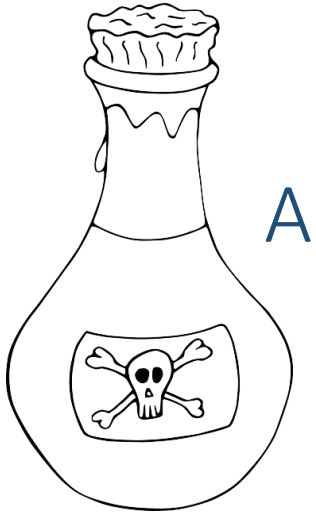
Acide



Salé



Amer

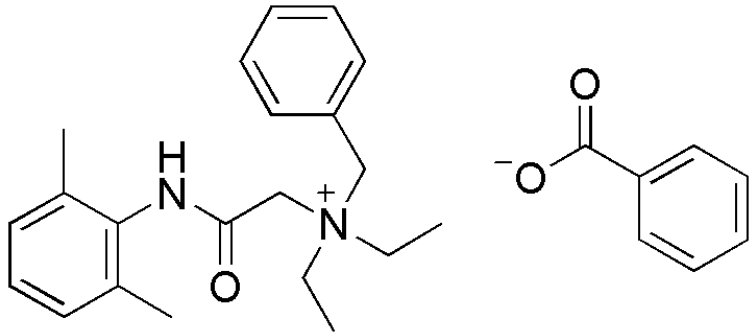


Umami

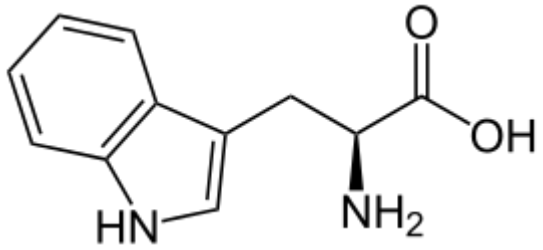
Code combinatoire de la perception des saveurs

Saveurs	Nombre de récepteur(s)	Seuils de détection
Sucré	1 récepteur	0,01 M
Salé	1 récepteur	0,01 M
Umami	1 récepteur	0,001 M
Acide	1 récepteur	0,0001 M
Amer	~ 25-30 récepteurs	0,00000001 M

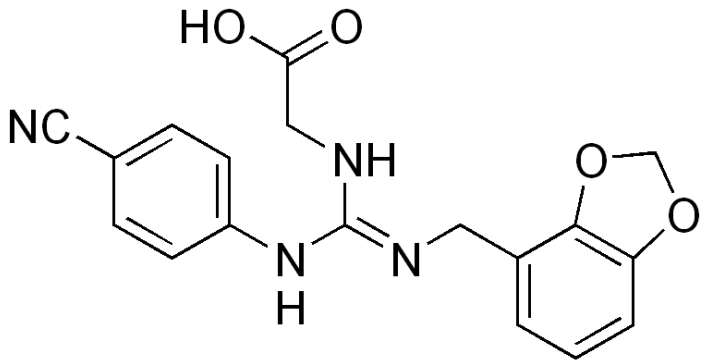
Relations structure - goût



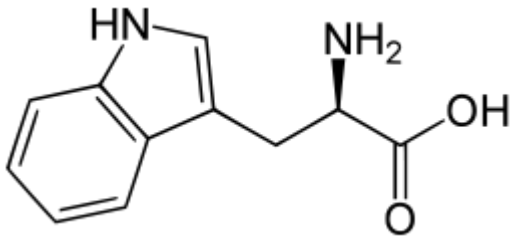
Benzoate de dénatonium
(amer)



L-tryptophane
(amer)

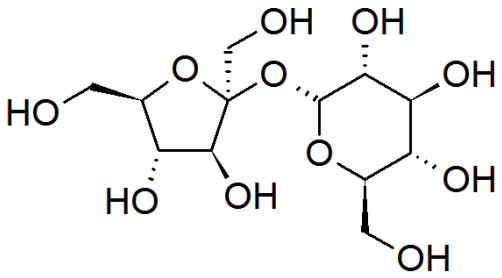


Lugduname
(sucré)



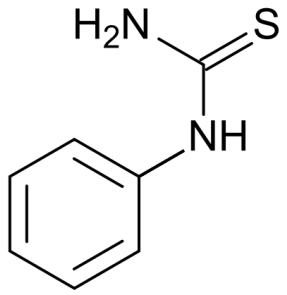
D-tryptophane
(sucré)

Du récepteur au comportement alimentaire



Polymorphisme TAS1R2 impacte la perception du sucrose

Eni *et al.* Am. J. Clin. Nutr. 2010



Polymorphisme TAS2R38 impacte la perception PTC (phenylthiocarbamide)

Kim *et al.* Science 2003

Récepteurs gustatifs

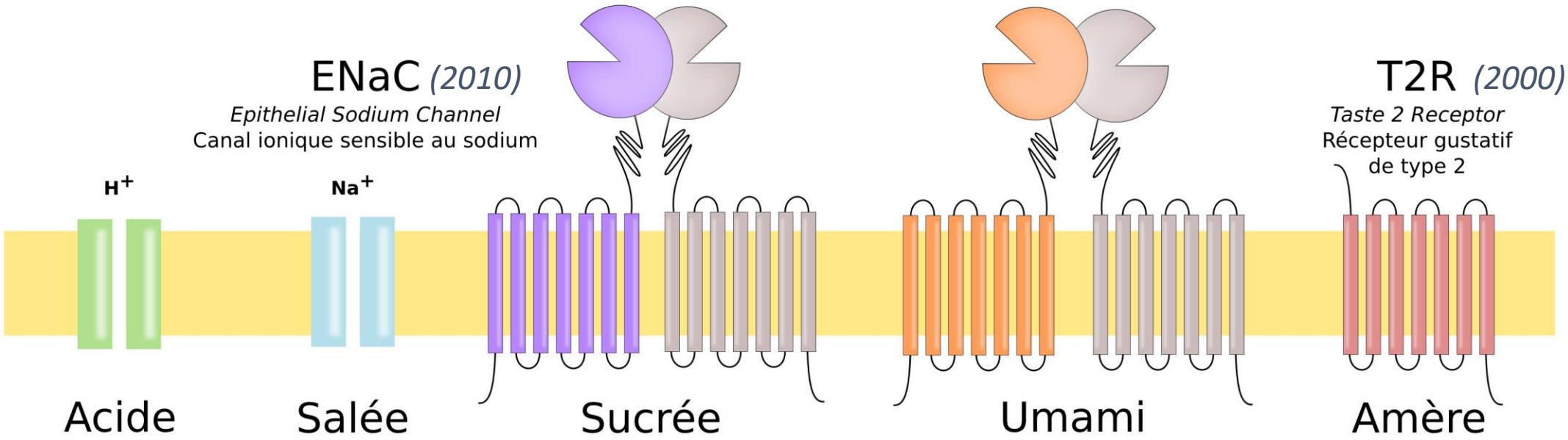
PKD2L1 *(2006)*
Polycystic-Kidney-Disease-Like
Canal ionique perméant aux protons

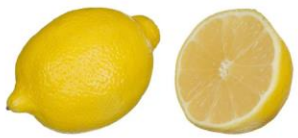
T1R2-T1R3 *(2001)*
Taste 1 Receptor
Récepteur gustatif
de type 1 membres 2 et 3

T1R1-T1R3 *(2002)*
Taste 1 Receptor
Récepteur gustatif
de type 1 membres 1 et 3

ENaC *(2010)*
Epithelial Sodium Channel
Canal ionique sensible au sodium

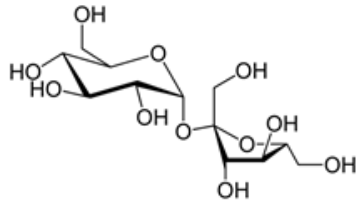
T2R *(2000)*
Taste 2 Receptor
Récepteur gustatif
de type 2



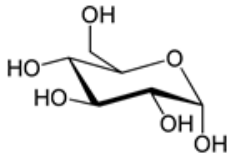


Chéron *et al.* L'Act. Chim. 2017

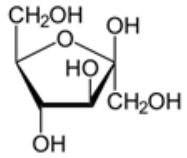
Goût sucré : Un large espace chimique



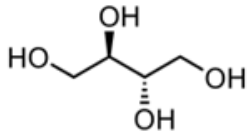
sucrose



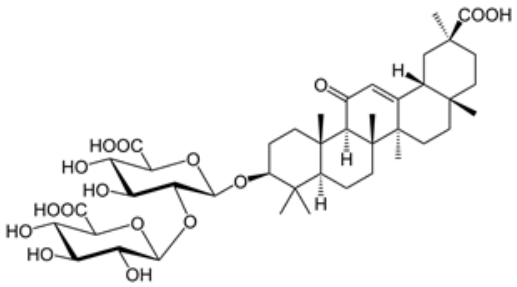
β-D-glucose



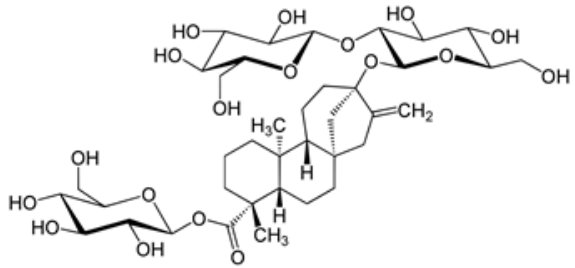
α-D-fructose



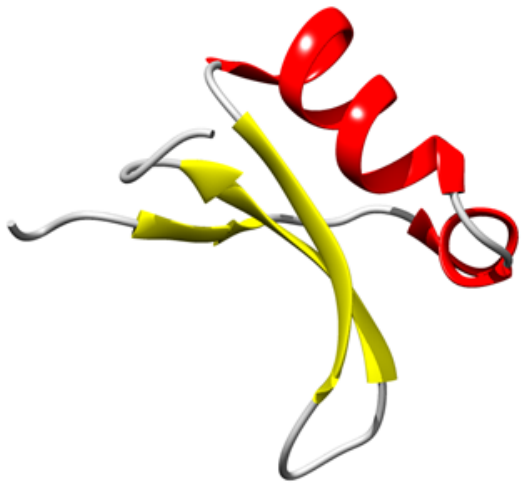
erythritol



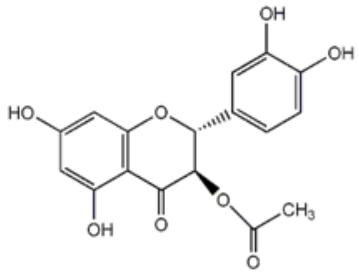
glycyrrhizin



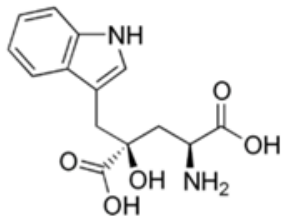
stevioside



brazzein



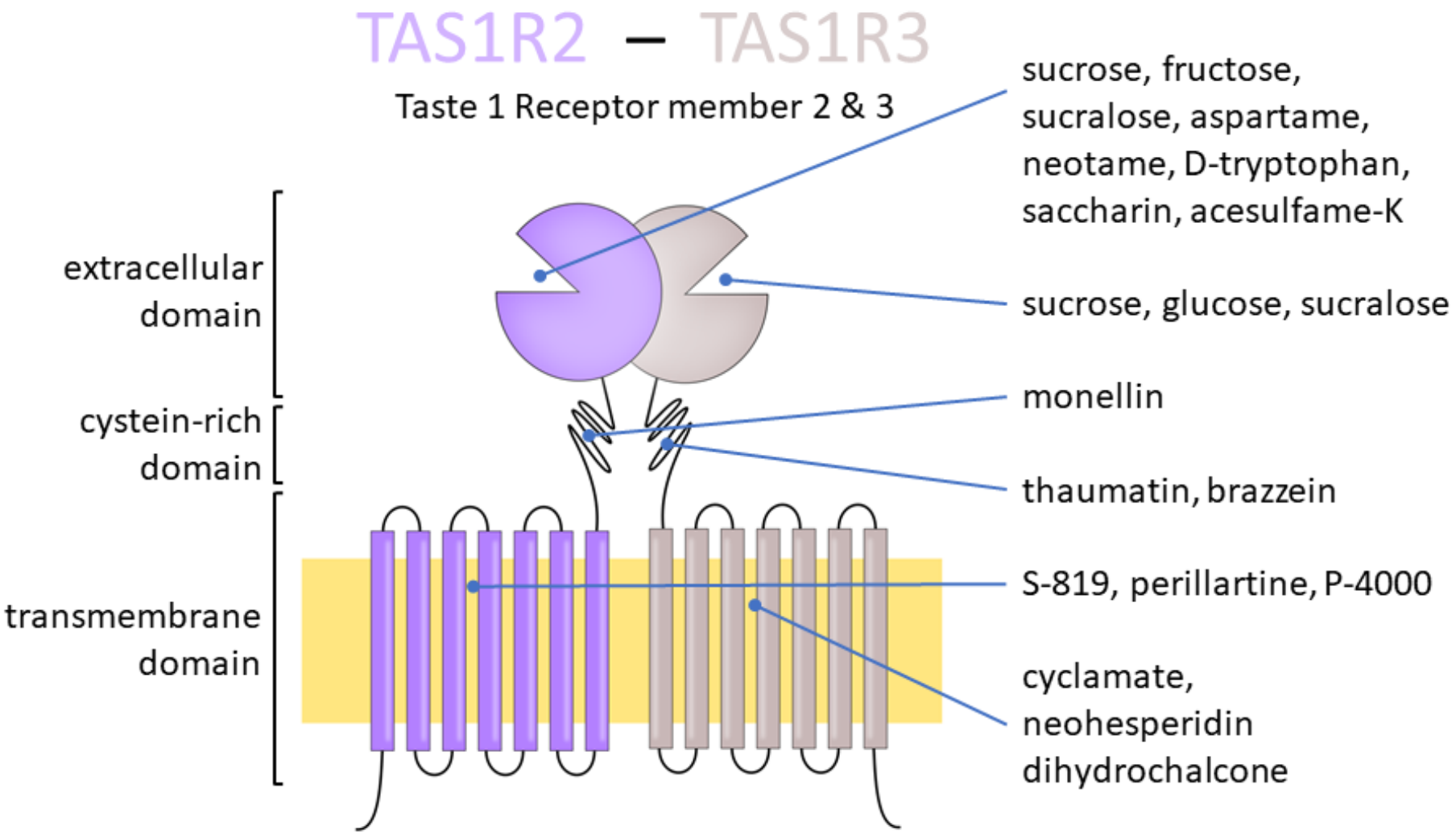
taxifolin 3-acetate



monatin

Chéron *et al.* Encyclopedia of food chemistry. 2018

Goût sucré : un unique récepteur



Chéron *et al.* Encyclopedia of food chemistry. 2018

Protéines « sucrées » & récepteur gustatif

THE JOURNAL OF BIOLOGICAL CHEMISTRY
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Printed in U.S.A.

The Cysteine-rich Region of T1R3 Determines Responses to Intensely Sweet Proteins*[S]

Received for publication, June 17, 2004, and in revised form, August 4, 2004
Published, JBC Papers in Press, August 6, 2004, DOI 10.1074/jbc.M406779200

Peihua Jiang‡, Qingzhou Ji§, Zhan Liu§, Lenore A. Snyder‡, Lumie M. J. Benard§, Robert F. Margolskee§¶, and Marianna Max‡‖

From the ‡Department of Physiology and Biophysics and §Howard Hughes Medical Institute, Mount Sinai School of Medicine, New York, New York 10029

Jiang *et al.* J. Biol. Chem. 2004

The anatomy of mammalian sweet taste receptors

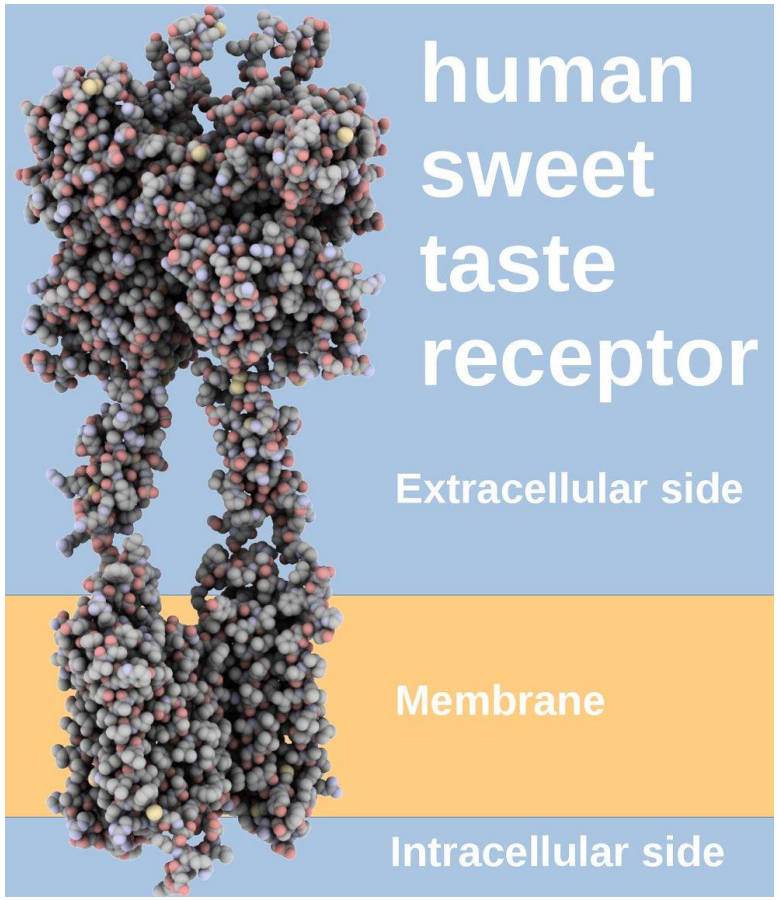
PROTEINS
STRUCTURE ● FUNCTION ● BIOINFORMATICS

Jean-Baptiste Chéron,[1] Jérôme Golebiowski,[1,2] Serge Antonczak,[1] and Sébastien Fiorucci[1]*

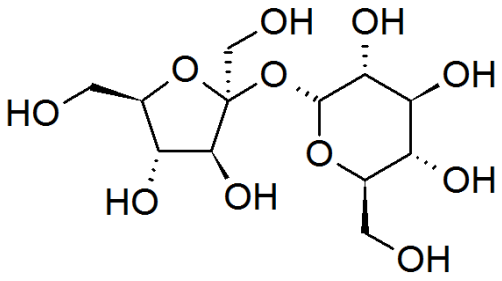
[1] Université Côte d'azur, CNRS, Institut de Chimie de Nice UMR7272, 06108 Nice, France

[2] Department of Brain and Cognitive Science, DGIST (Daegu Gyeongbuk Institute of Science & Technology), Daegu, Korea

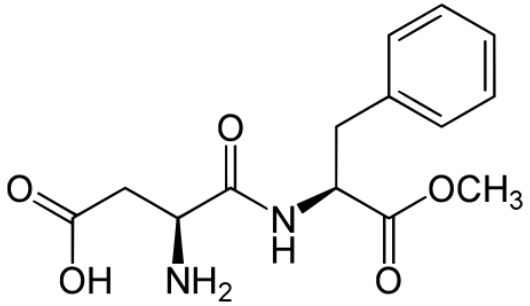
Chéron *et al.* Proteins. 2017



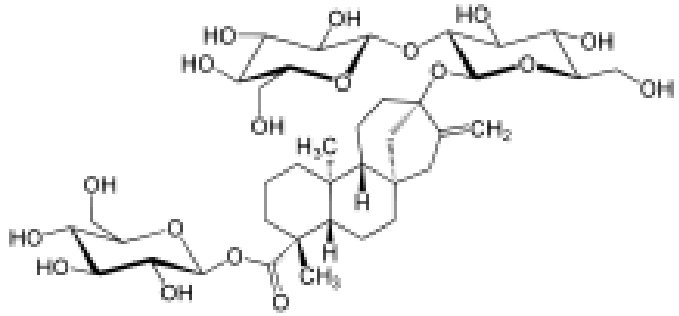
Alternatives au saccharose



saccharose



aspartame



stévia (stévioside)

Duper nos papilles ?

Miraculine (fruit du miracle)

Acide ?

Duper nos papilles ?

Miraculine (fruit du miracle)

Sucré !

« Les perceptions des sens et les jugements de l'esprit sont des sources d'illusion et des causes d'incertitudes »
Anatole France

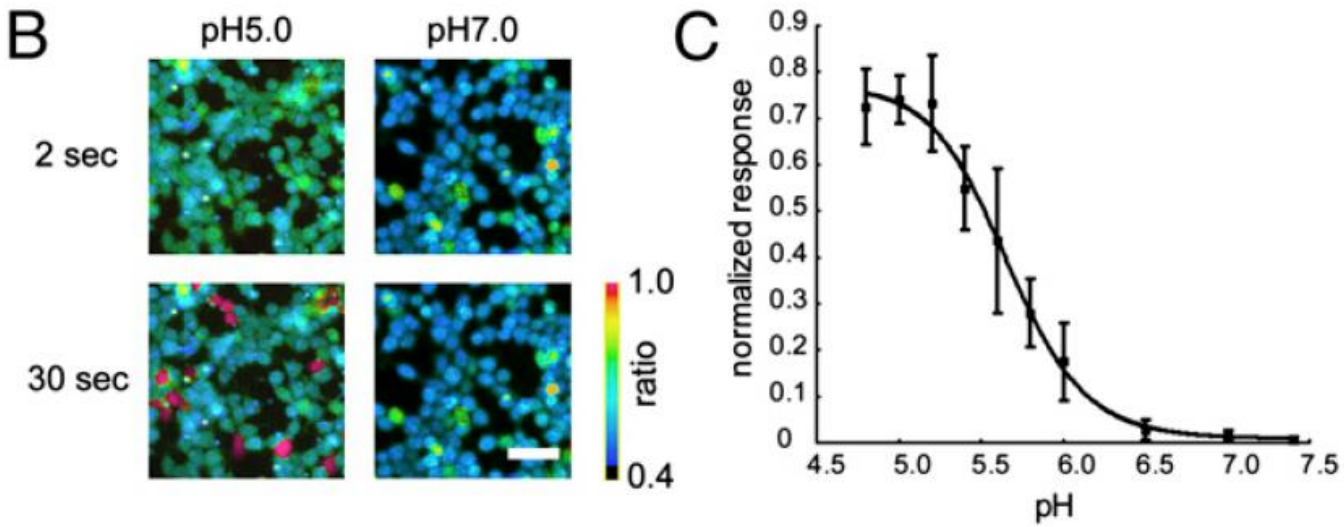
Human sweet taste receptor mediates acid-induced sweetness of miraculin

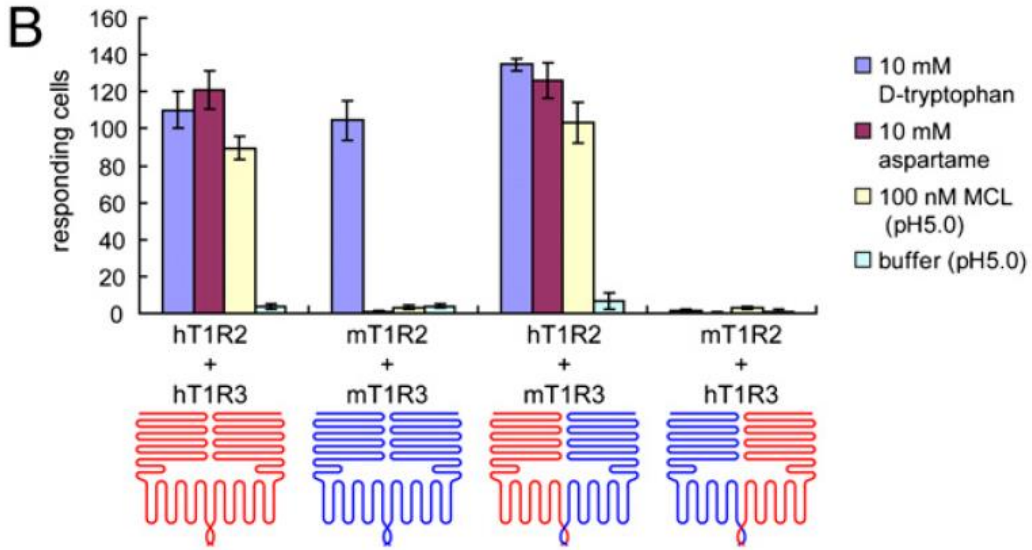
Ayako Koizumi[a], Asami Tsuchiya[a], Ken-ichiro Nakajima[a], Keisuke Ito[a], Tohru Terada[b], Akiko Shimizu-Ibuka[a], Loïc Briand[c], Tomiko Asakura[a], Takumi Misaka[a,1], and Keiko Abe[a,d,1]

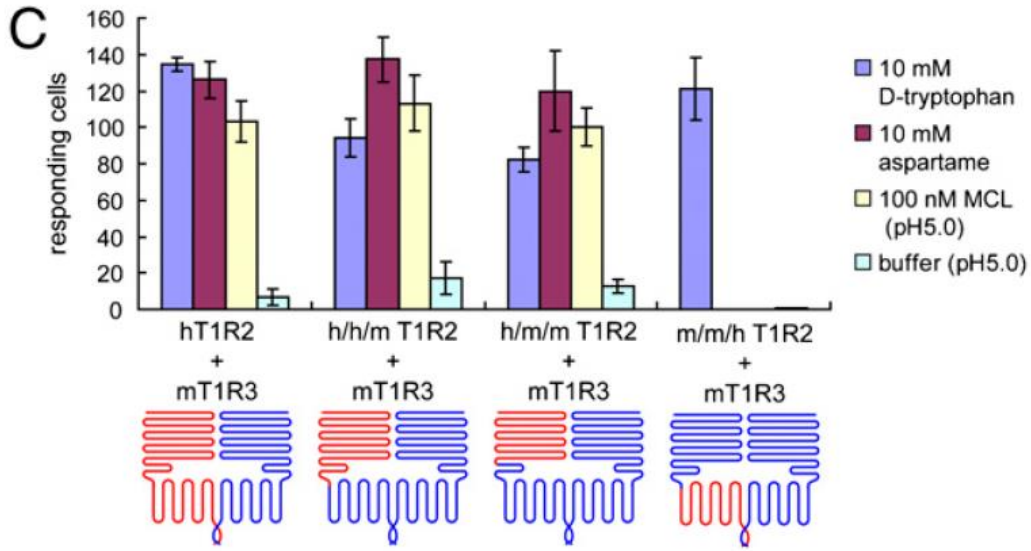
[a]Department of Applied Biological Chemistry, and [b]Agricultural Bioinformatics Research Unit, Graduate School of Agricultural and Life Sciences, University of Tokyo, Bunkyo-ku, Tokyo 113-8657, Japan; [c]Centre des Sciences du Goût et de l'Alimentation, Unité Mixte de Recherche-6265 Centre National de la Recherche Scientifique, Unité Mixte de Recherche-1324 Institut National de la Recherche Agronomique, Université de Bourgogne, Agrosup Dijon, F-21000 Dijon, France; and [d]Health and Anti-Aging Project, Kanagawa Academy of Science and Technology, Takatsu-ku, Kawasaki 213-0012, Japan

Edited by David Julius, University of California, San Francisco, CA, and approved August 30, 2011 (received for review November 26, 2010)

Koizumi *et al.* PNAS. 2011







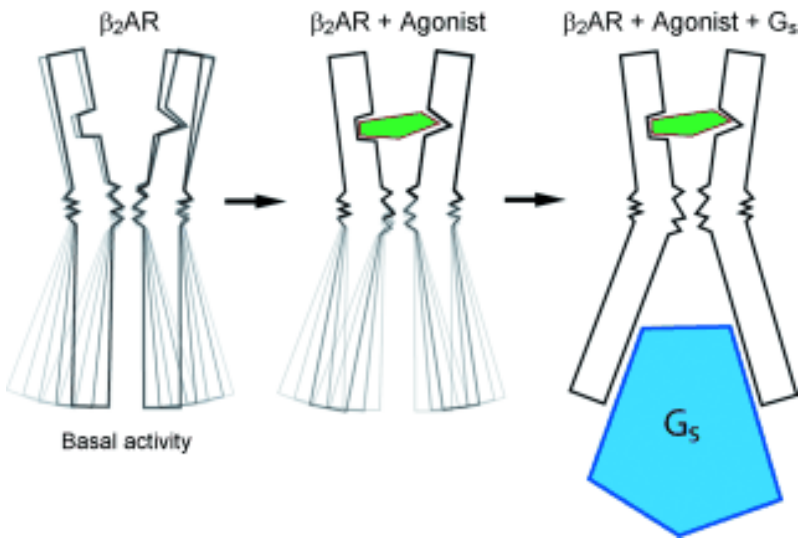
Projets en cours :

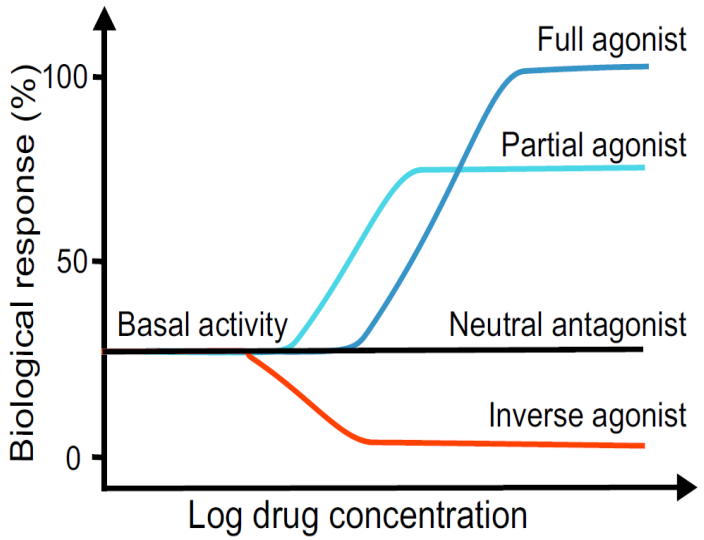
Modèles numériques de la perception des saveurs

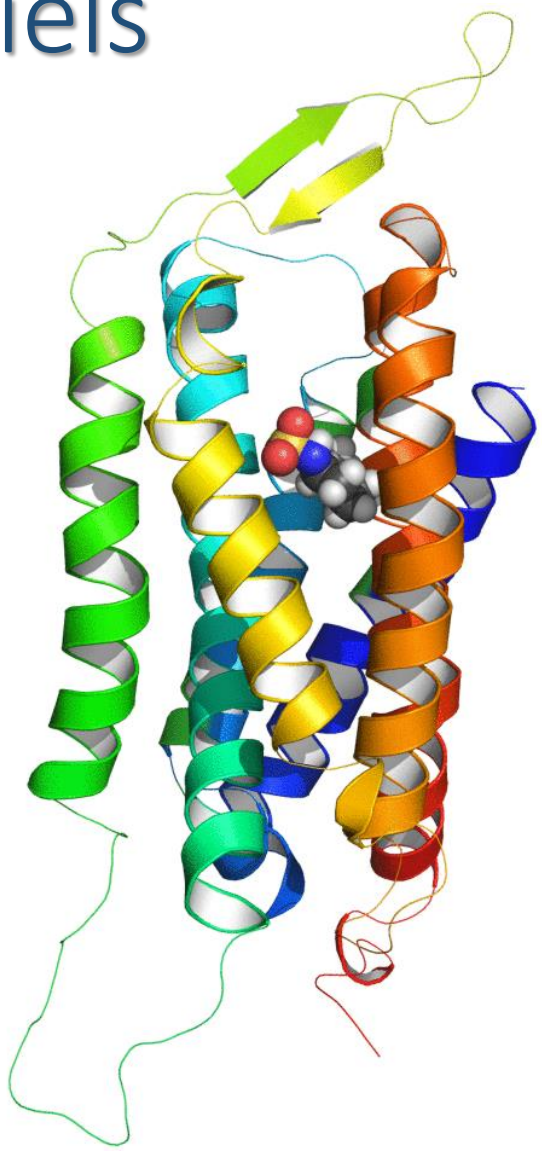
Décrypter les mécanismes moléculaires (modèle 3D & dynamique)

Récepteurs chimio-sensoriels

- RCPG
- Domaine 7TM
- Traduction d'une information chimique en influx nerveux

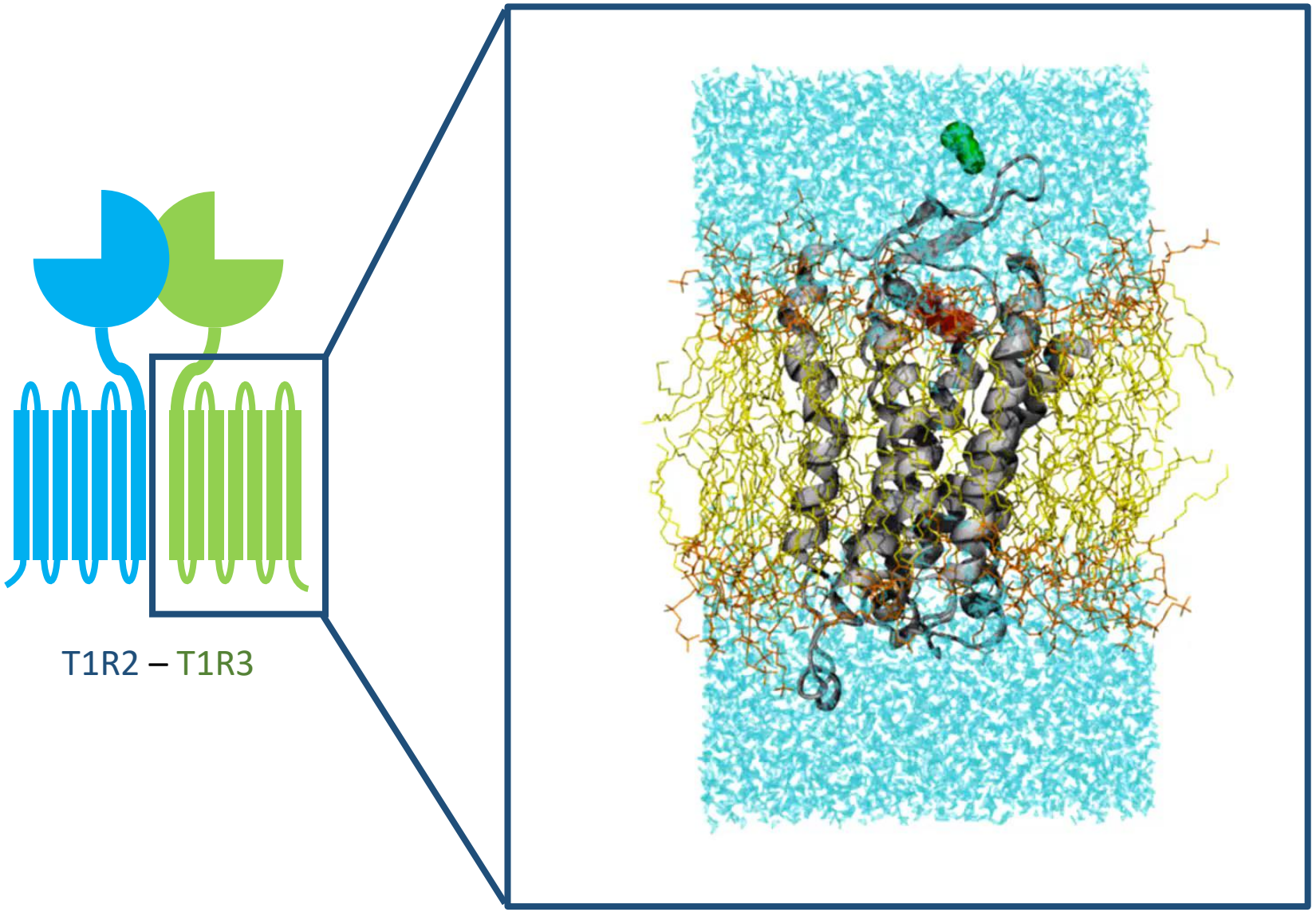






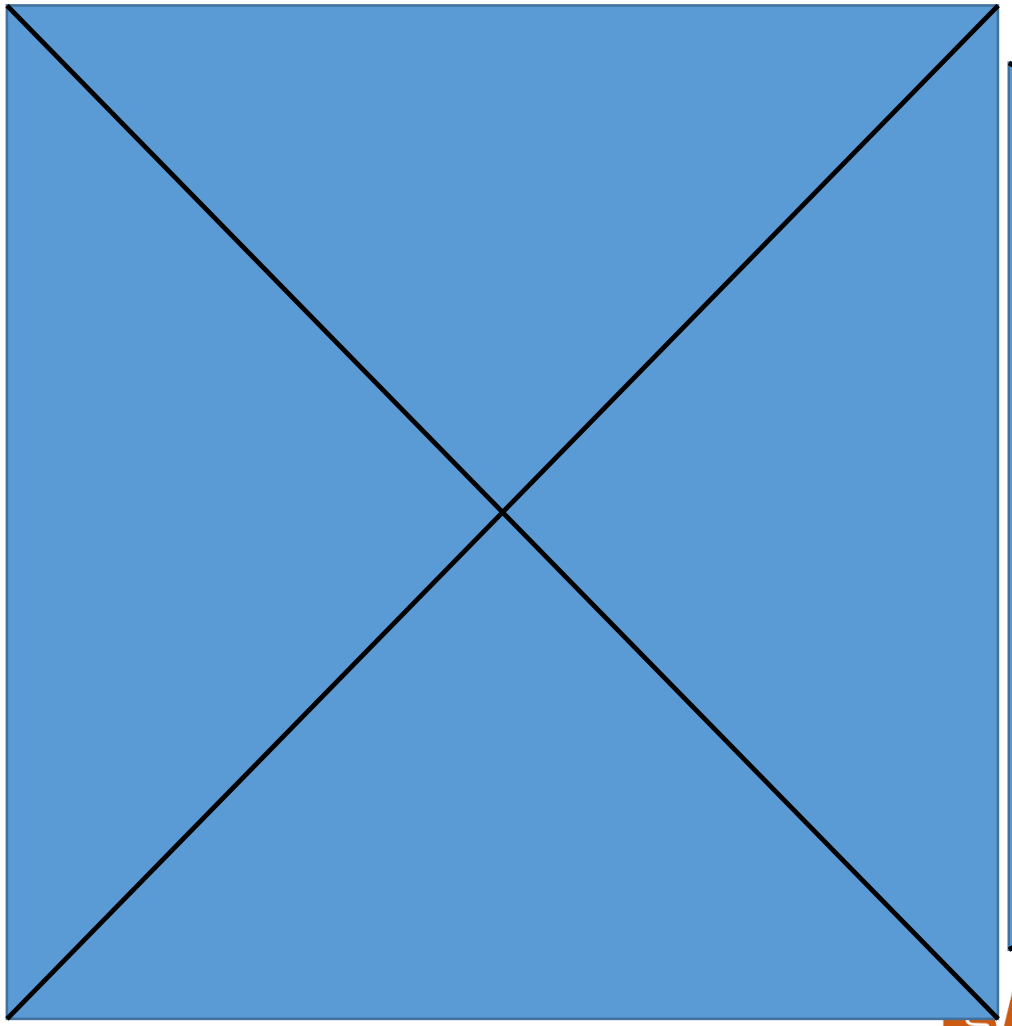
Kobilka *Angew Chem Int Ed* 2013

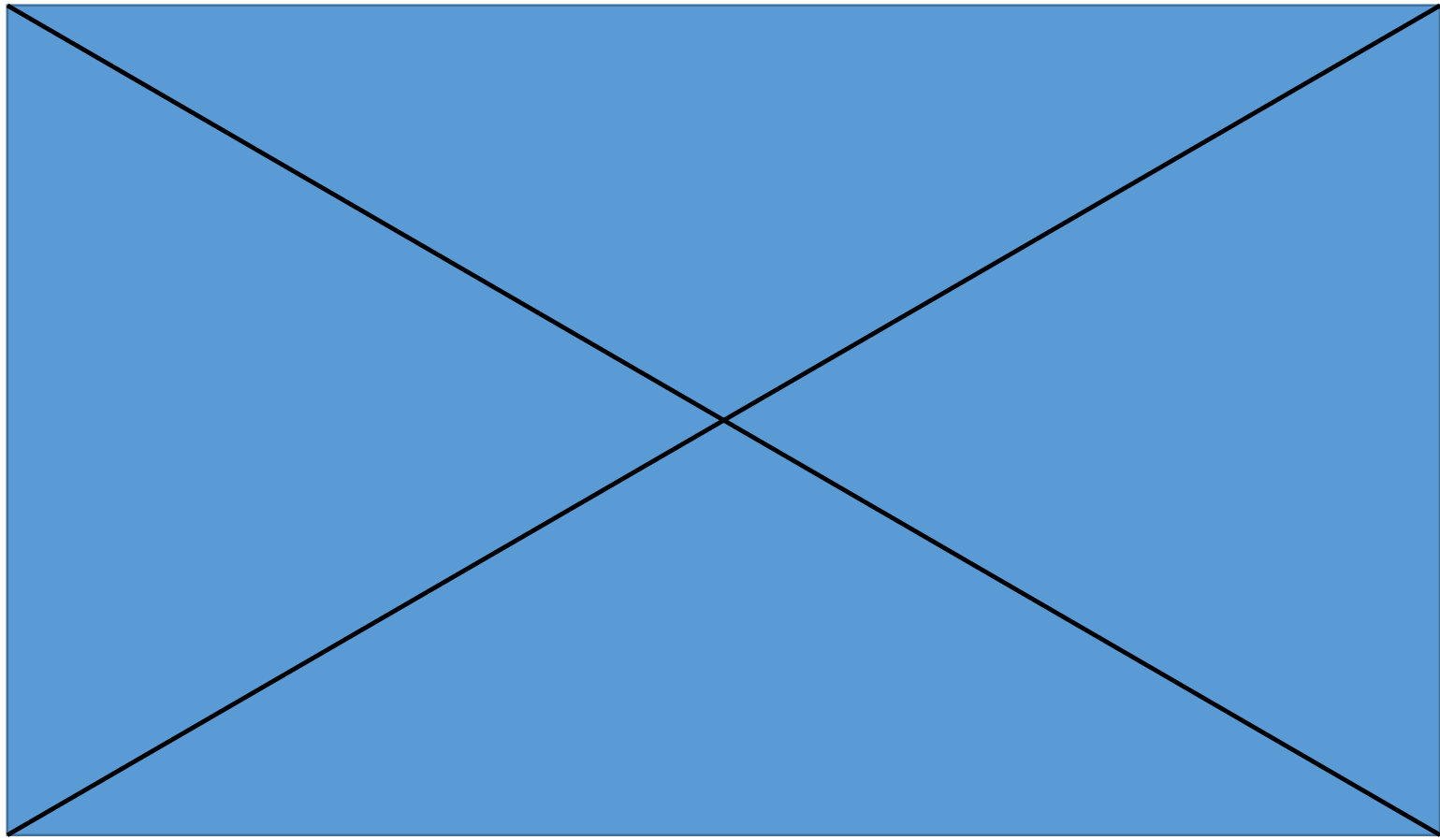
Site allostérique du récepteur au goût sucré



MD simulations
Amber16
FF14SB
15 μs, NPT, TIP3P

Mécanismes de modulation du goût





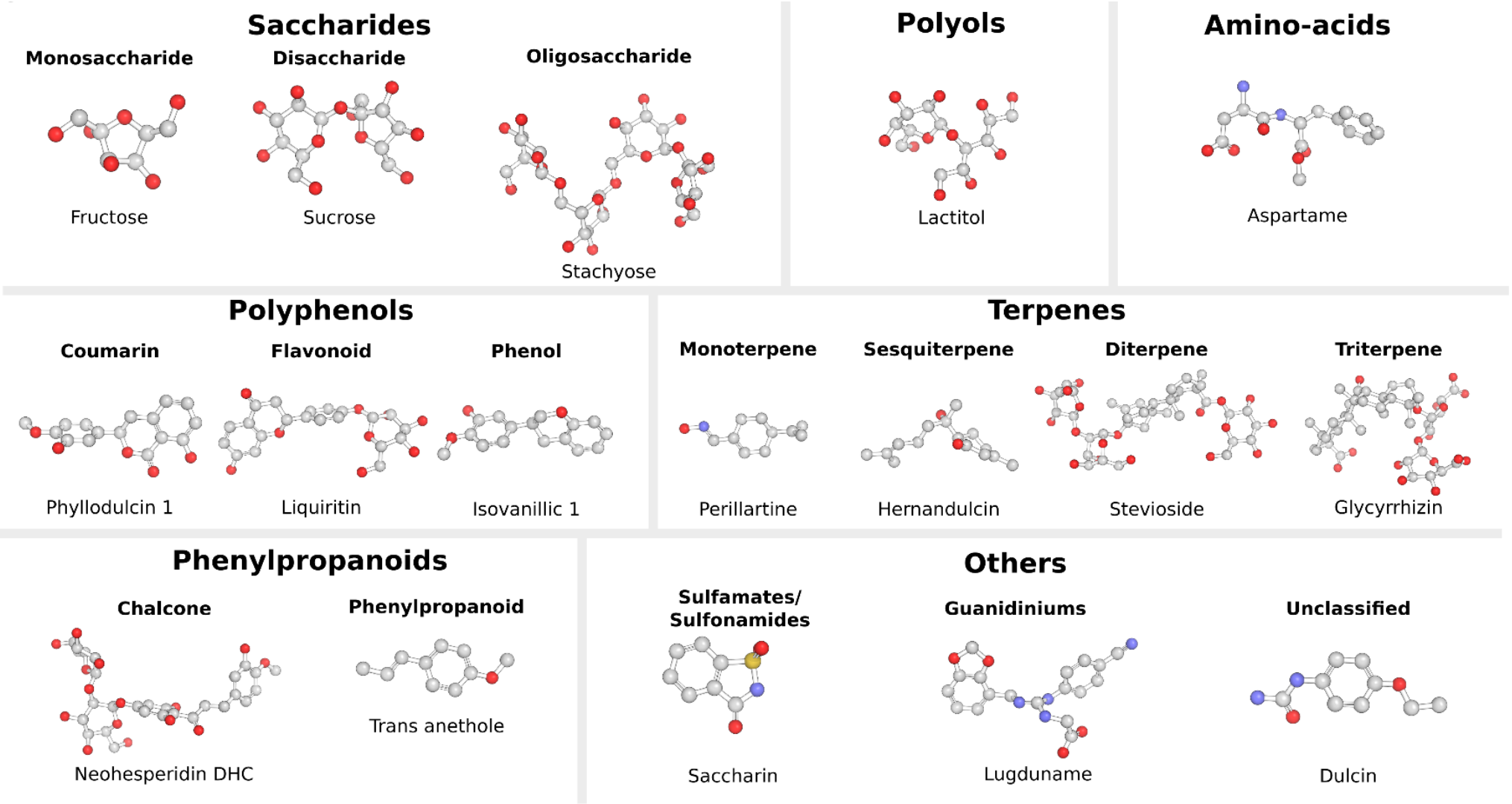
MONELL CENTER
ADVANCING DISCOVERY IN TASTE AND SMELL

Données *In vitro* : P. Jiang (Monell Chemical Senses Center)

Chéron *et al.* en révision

Explorer les espaces chimiques
-
Relations structure - goût

SweetenersDB



Chéron *et al.* Food Chem 2017

Apprentissage supervisé, les modèles QSAR

molécules	descripteur 1	descripteur 2	descripteur 3	...	valeur cible exp.
1	X1	Y1	Z1	...	42
2	X2	Y2	Z2	...	23
3	X3	Y3	Z3	...	56
...	...	...	...	...	...
K	Xk	Yk	Zk	...	12

Machine learning

valeur cible théo.

40
23
57
...
12

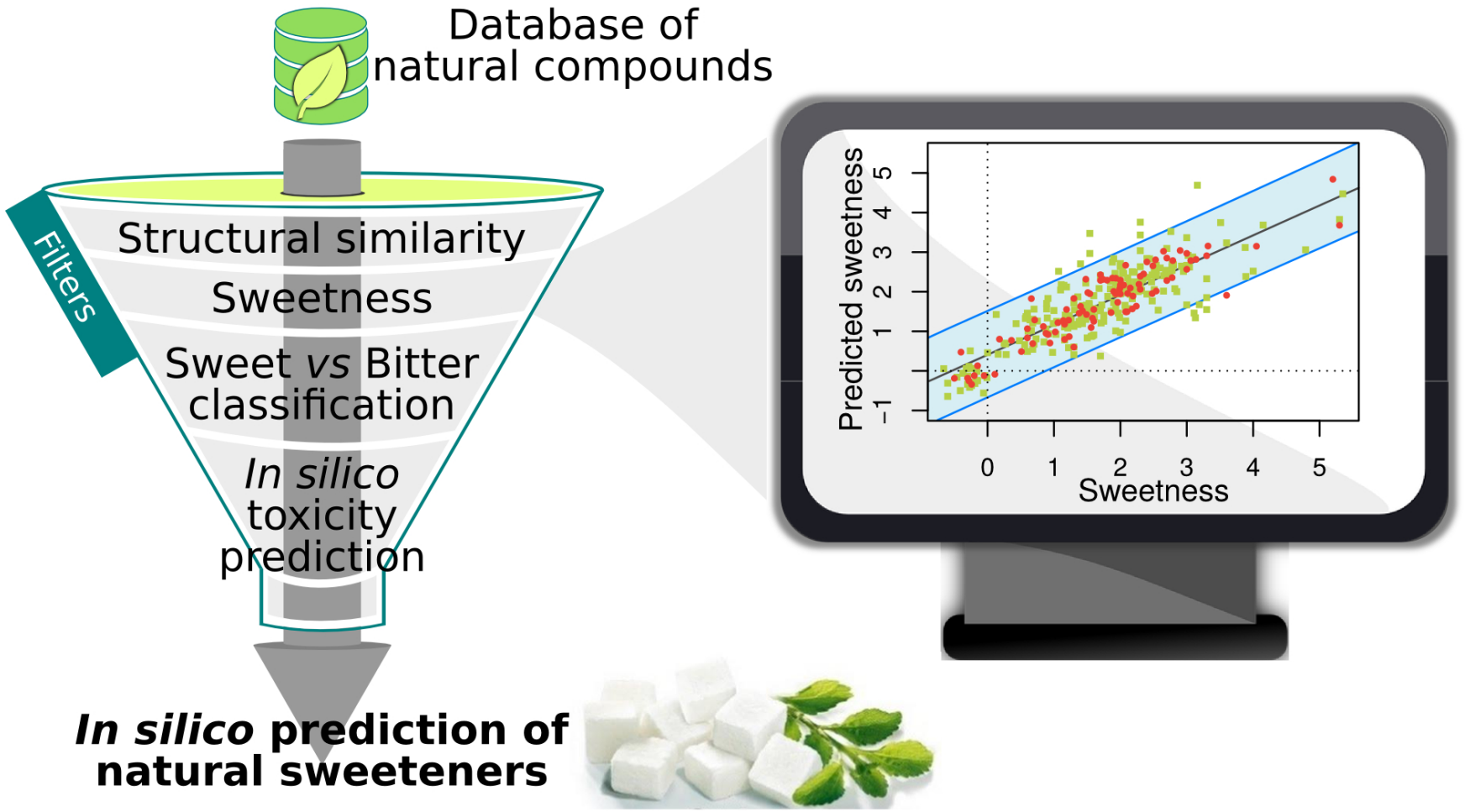
Molécule à tester

N	Xn	Yn	Zn	...

prédiction

64

Modèle de relations structure - goût sucré

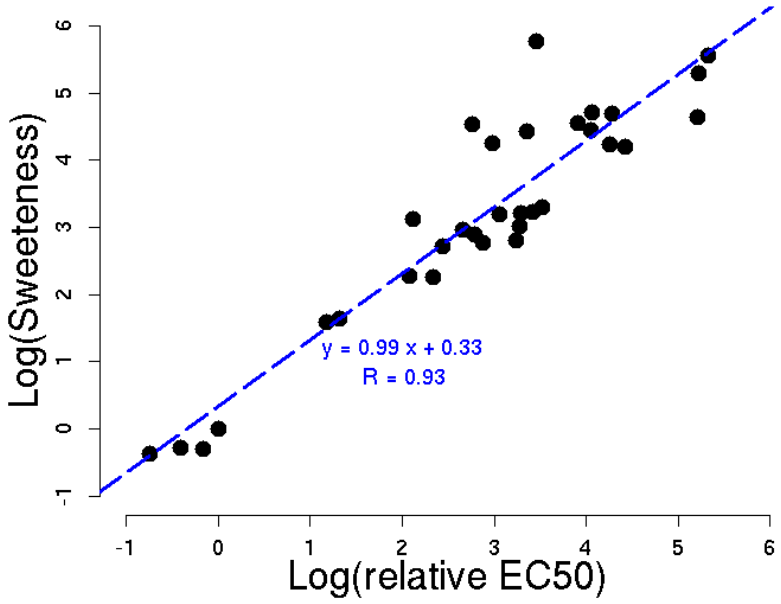


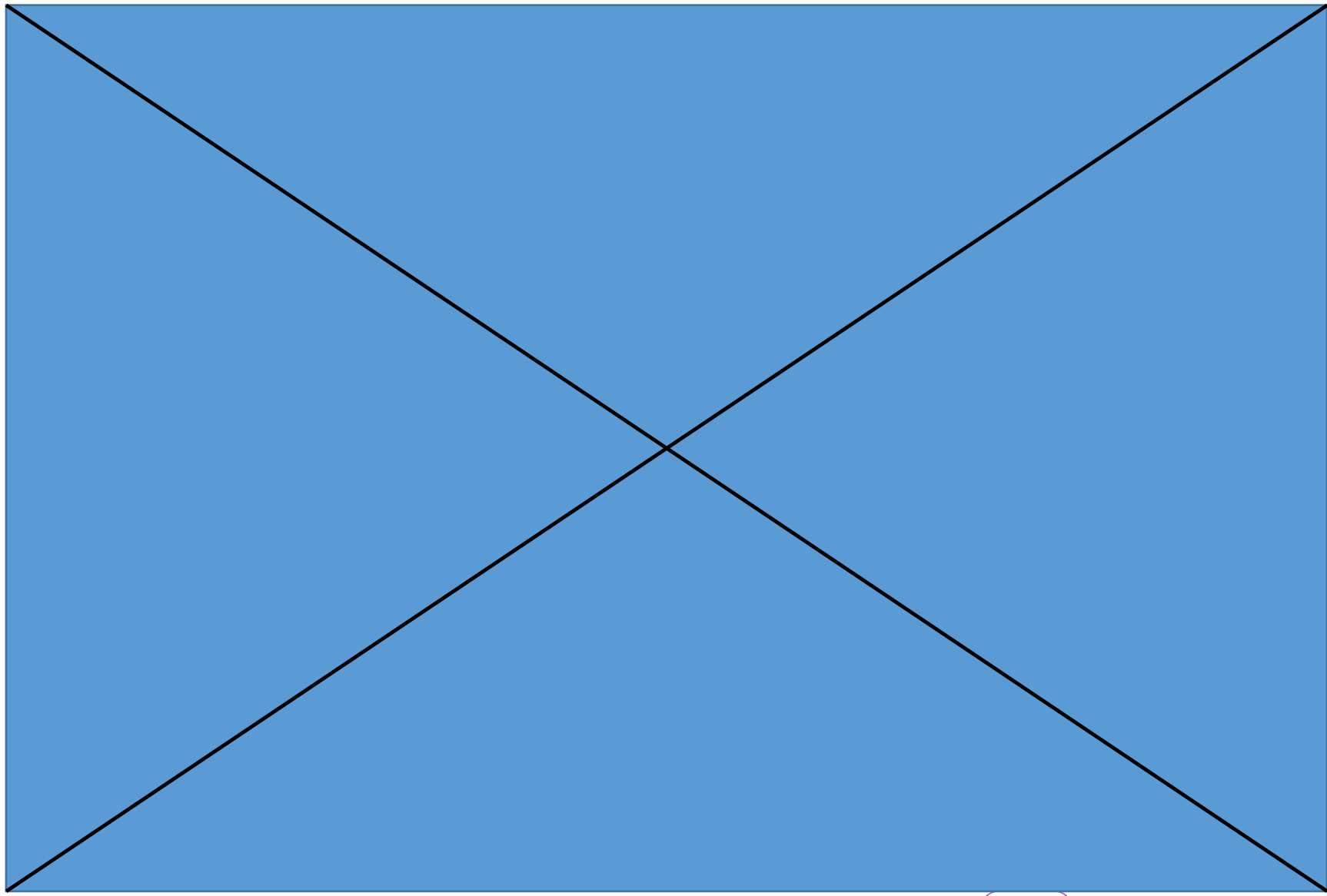
Chéron *et al.* Food Chem 2017

Tests *in vitro*

- Contrôle vecteur vide (vv)
- Ligand (référence sucralose)

Indice de pouvoir sucrant:
- Saccharose (référence) : 1
- Sucralose : 600-650
- Molécule A : ~ 50 ?



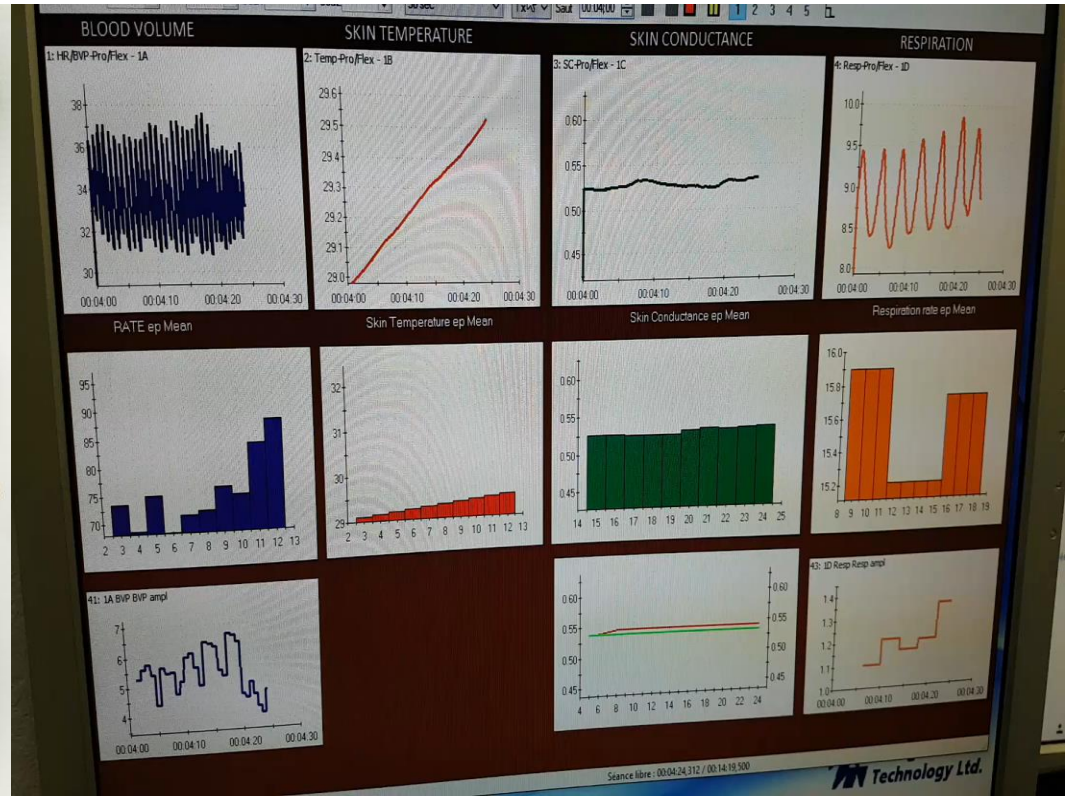


Données *In vitro* : L. Briand & C.Belloir (CSGA, Dijon)

Centre des Sciences du Goût et de l'Alimentation

Mesure des émotions
-
Réponse inconsciente de l'organisme à un stimulus sensoriel

Stimulation sensorielle & mesures psychophysiques



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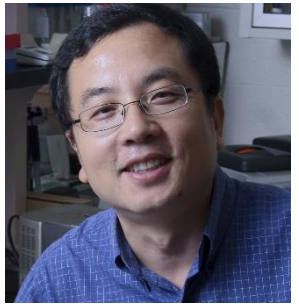

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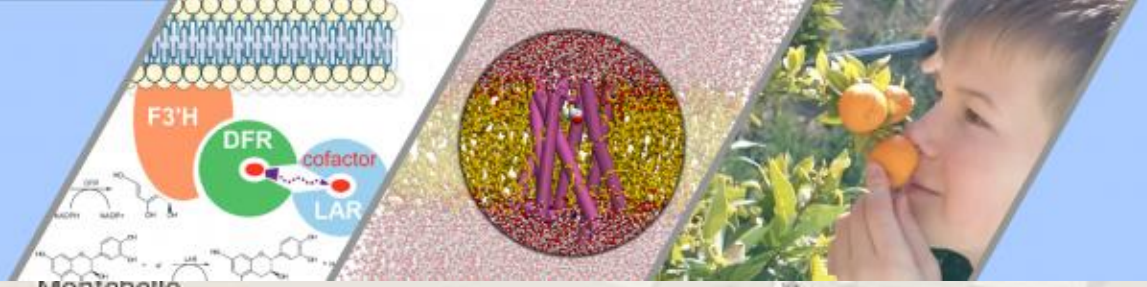

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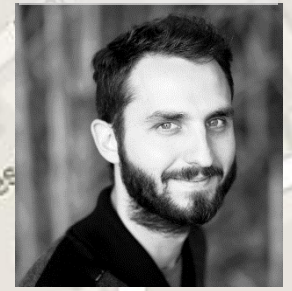

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