FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

I SAPORI AMICI DELLE DONNE

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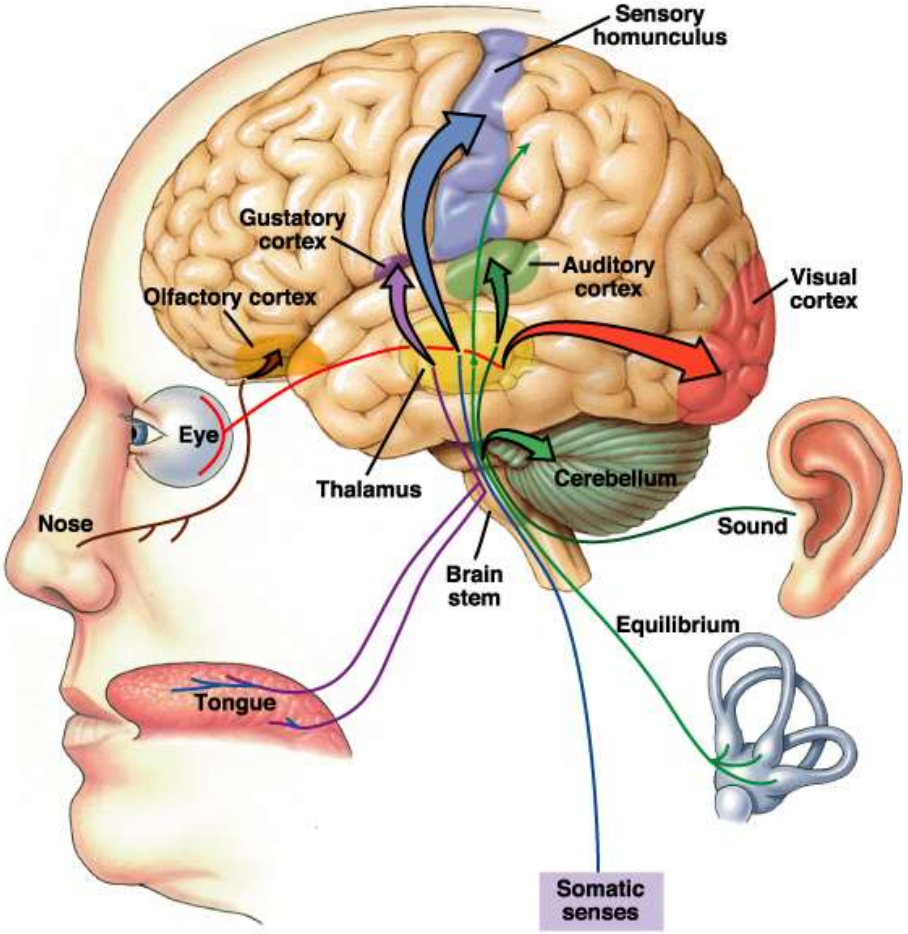
Università degli Studi di Milano

25 MAGGIO 2019 – Reggio Emilia

GLI ELEMENTI AMICI DELLE DONNE

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

La scienza non è altro che percezione
(Platone)



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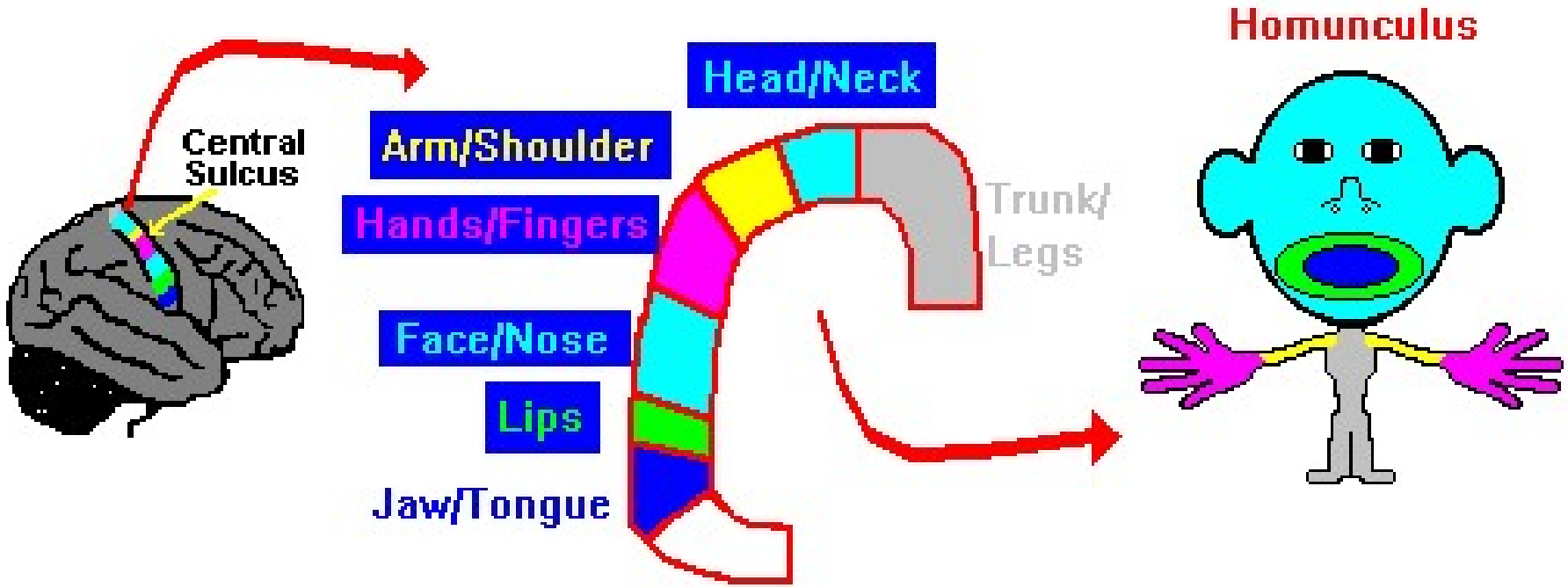
L'"HOMUNCULUS" SENSORIALE



FEDERAZIONE NAZIONALE DEGLI ORDINI DEI CHIMICI E DEI FISICI

IL GUSTO NELLA STORIA

Aristotele
(384 a.C.)
7 sapori

Dolce
Amaro
Acido
Salato

Piccante
Astringente
Rugoso (?)

AYURVEDA
6 “rasa”

Dolce
Amaro
Acido
Salato

Piccante
Astringente

MEDICINA TRADIZIONALE CINESE
5 “wei”

Dolce
Amaro
Acido
Salato

Piccante

Scienza moderna occidentale
4+1(+2?) sapori

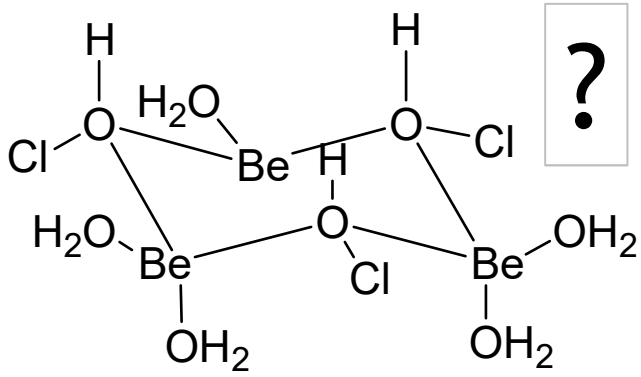
Dolce
Amaro
Acido
Salato

Umami

(Grasso?
Calcio??)

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

LA TAVOLA PERIODICA DEL SAPORE



Della Glucina

È questo il nome, che venne da Vauquelin imposto ad una terra particolare da esso scoperta nel 1797. entro l'acqua marina, ed il berillo. Derivò esso una tale denominazione dal greco vocabolo glucios, che significa dolce, e lo applicò a tal terra in ordine al sapor dolciguo, che hanno i sali da essa formati.

da "Istituzioni Chimiche" dettate dal Chiarissimo Professore Giuseppe Ramati, Medico Primario dell'Ospedale di Novara, 1815-17

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

$Pb(CH_3COO)_2$, LO «ZUCCHERO DI SATURNO»

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

LE BASI MOLECOLARI DEL GUSTO OGGI

REVIEW ARTICLE *Chemical Society Reviews*, Sept 2017 View Article Online View Journal

Tomáš Pluskal

Jing-Ke Weng

*"Gli esseri umani percepiscono le informazioni sull'ambiente circostante attraverso i **sensi**.*

*Questi messaggi vengono registrati da numerosi sensori specializzati (i **recettori**).*

*In natura esiste una moltitudine di **molecole bioattive** che sono in grado di legarsi a questi recettori."*

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DEI CHIMICI E DEI FISICI

I RECETTORI

OUTPUT (cervello)

RECETTORI (papille gustative, mucosa nasale, pelle ecc)

INPUT (stimolo)

FEDERAZIONE NAZIONALE
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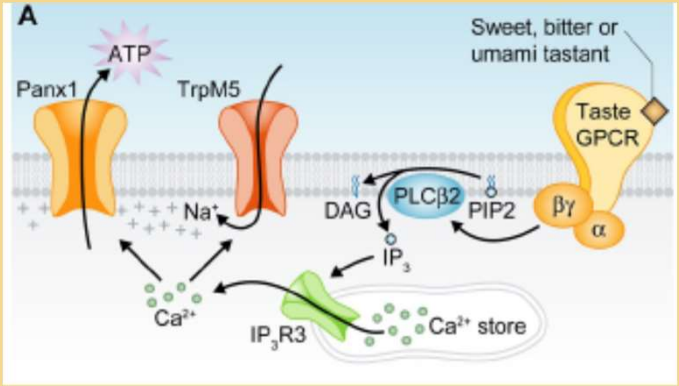
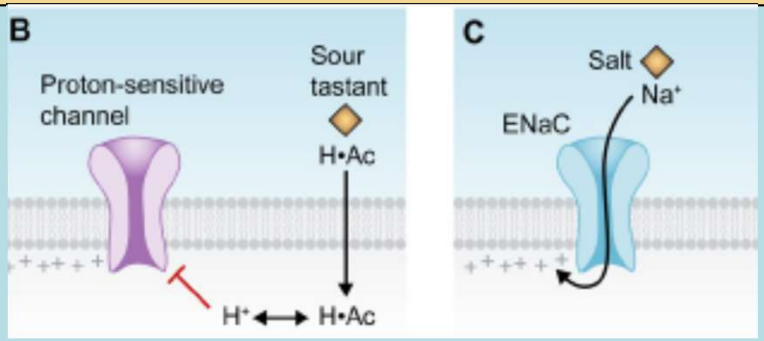
Recettori GPCRs

(*DOLCE*, *AMARO*, *UMAMI*)



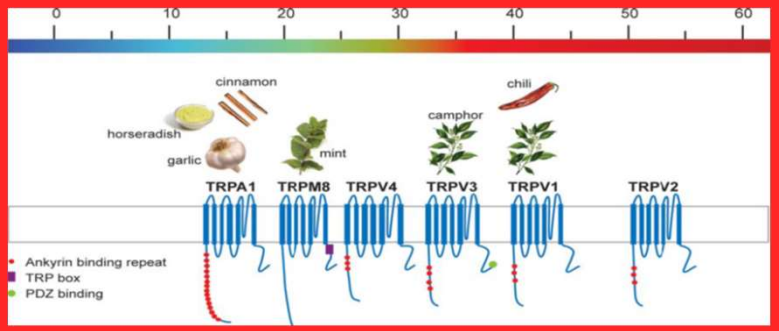
Canali ionici gustativi

(*SALATO*, *ACIDO*)



TRP ion channels

(componenti gustative *SOMATOSENSORIALI*)



PIANTE - COMPOSTI NATURALI - RECETTORI - SENSI

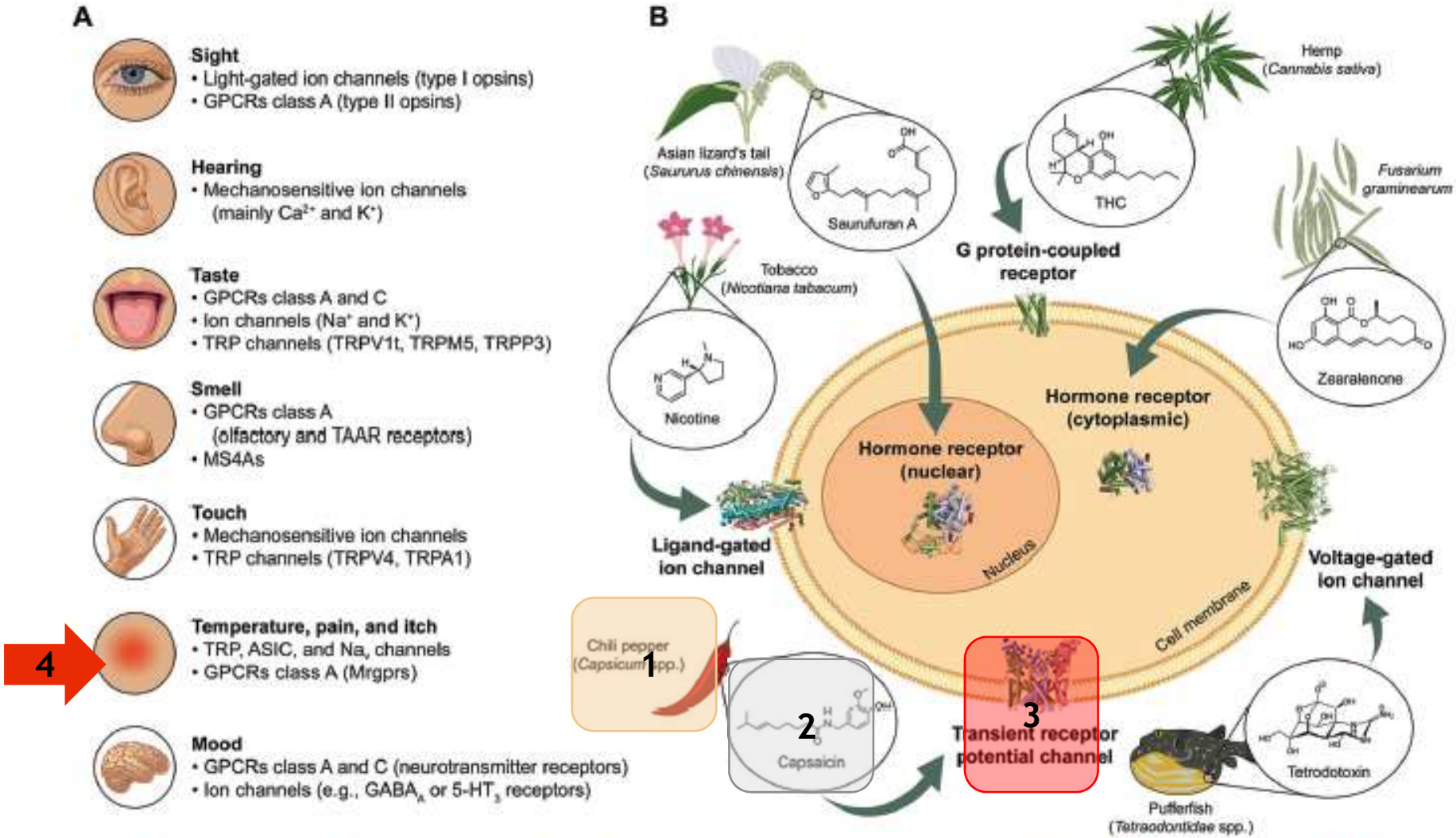
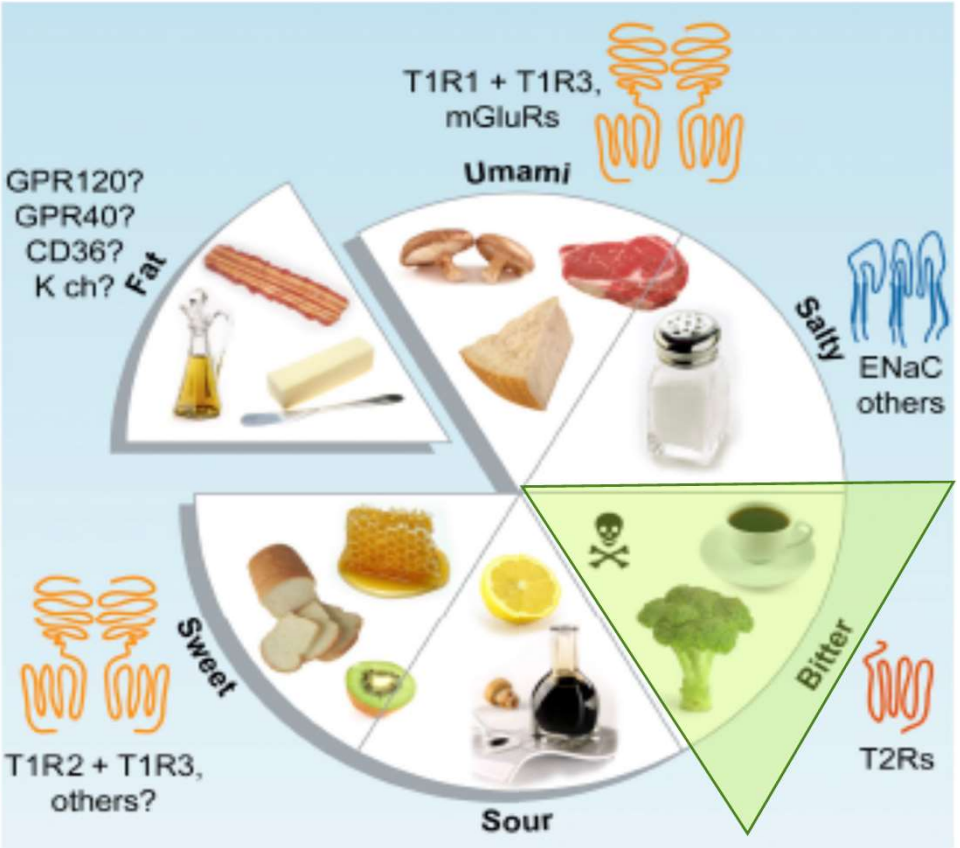
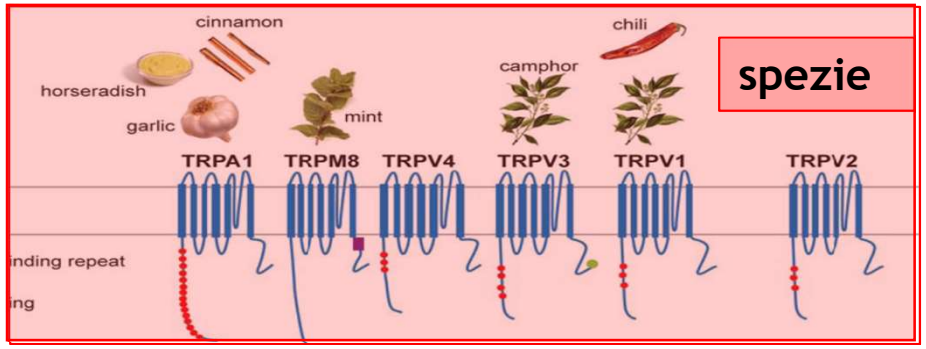


Fig. 1 (A) Human senses and the principal molecular receptors involved in their perception and regulation. (B) Schema of a somatic cell to illustrate th

I SEGNALI CHIMICI DEL GUSTO



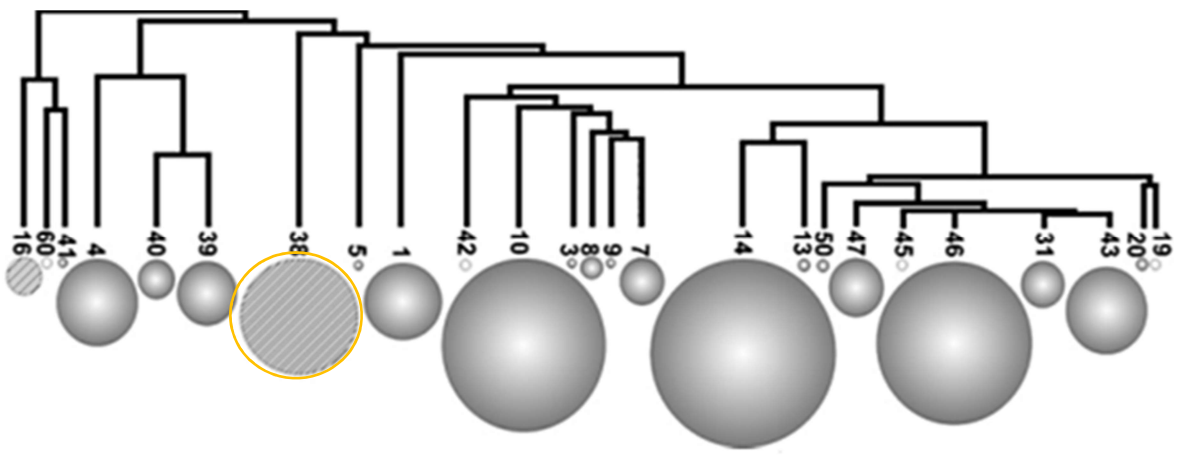


Individuazione e accettazione dei nutrienti essenziali

Rifiuto di composti potenzialmente tossici

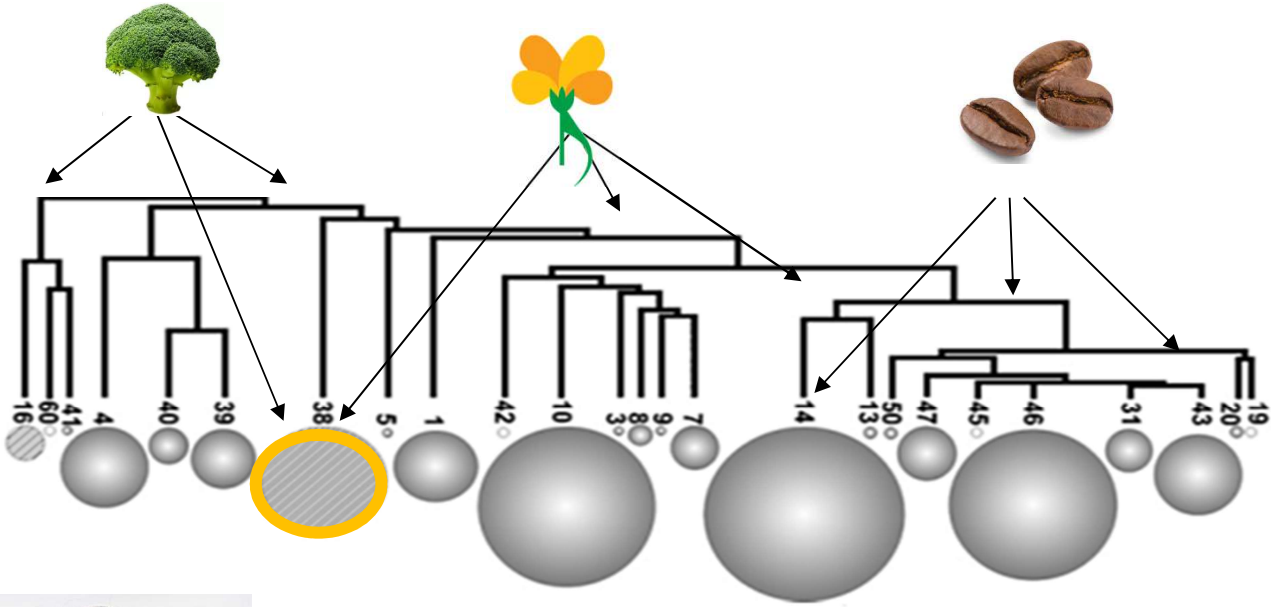
Individuazione e modulazione di sostanze farmacologicamente attive («cibo-medicina»)

25 SFUMATURE DI AMARO: I T2Rs



- I recettori del gusto amaro T2Rs sono **tanti** (25 nell'uomo)
- Funzionamento **combinatoriale**
- Riconoscimento e modulazione di **migliaia di composti amari** diversi (*di cui solo ca il 20-25% è tossico!)*
- Alta **variabilità genetica** (polimorfismi). T2R38 , «non taster» e «super taster»

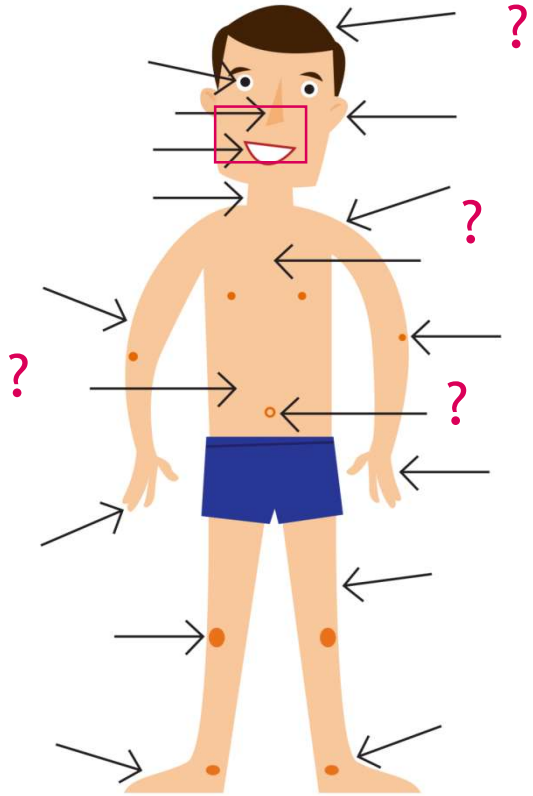
QUINDI ”AMARO“ NON E’ UNA SOLA NOTA, MA UNA *MUSICA* CHE OGNUNO SENTE IN MODO DIVERSO



IL GUSTO AMARO SI SENTE ANCHE “DENTRO”

I recettori T2R sono espressi in diversi organi interni, oltre che nella cavità orale:

FUNZIONI EXTRA GUSTATIVE NELL’UOMO



...e nella donna?

ANATOMIA DELL'AMARO

PAPILLE GUSTATIVE, EPITELIO NASALE

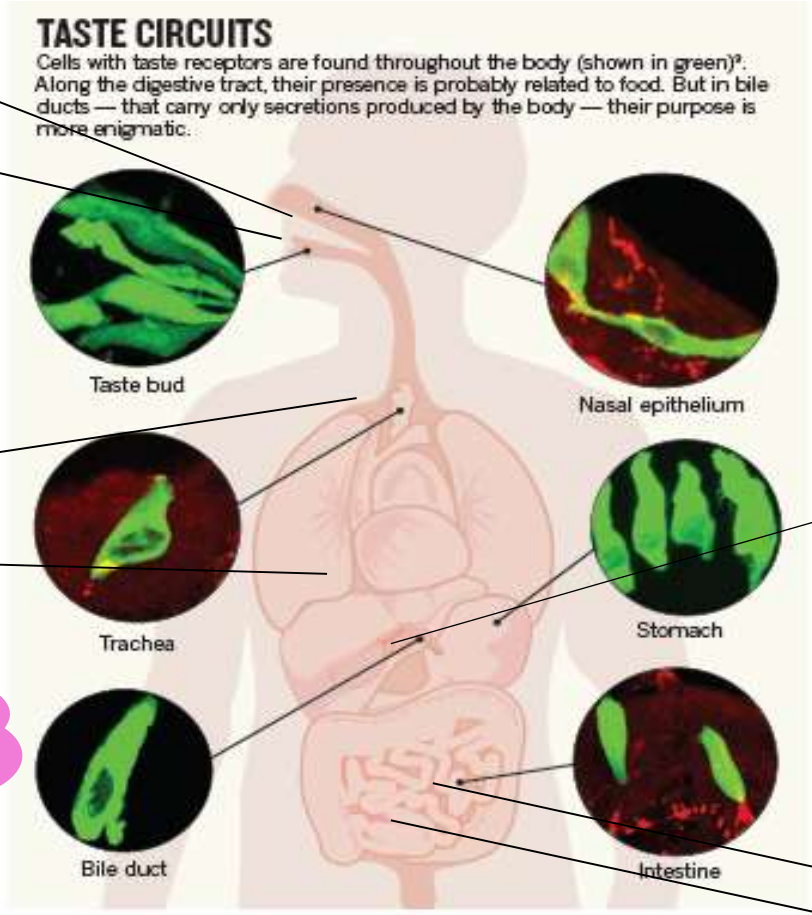
FARINGE

GUSTO, AUTO- DIFESA

TRACHEA

BRONCHI

....interessante, ma mi mancano alcuni pezzi..



CERVELLO

CUORE

?

MIDOLLO OSSEO

PANCREAS

DIGESTIONE, REGOLAZIONE DELL'APPETITO

COLON

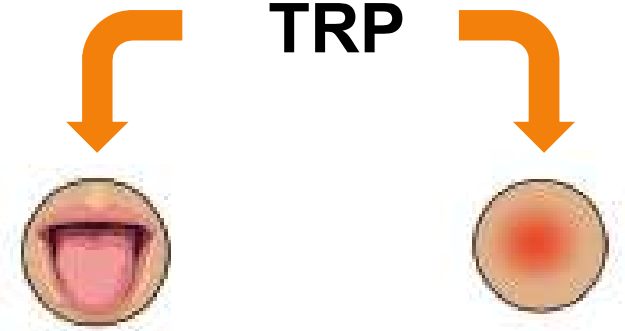
INTESTINO

I TRP: “STRANI” MA BUONI

Piccante (hot); rinfrescante (cooling); pungente / lacrimogeno; solletico / formicolìo; anestesia …

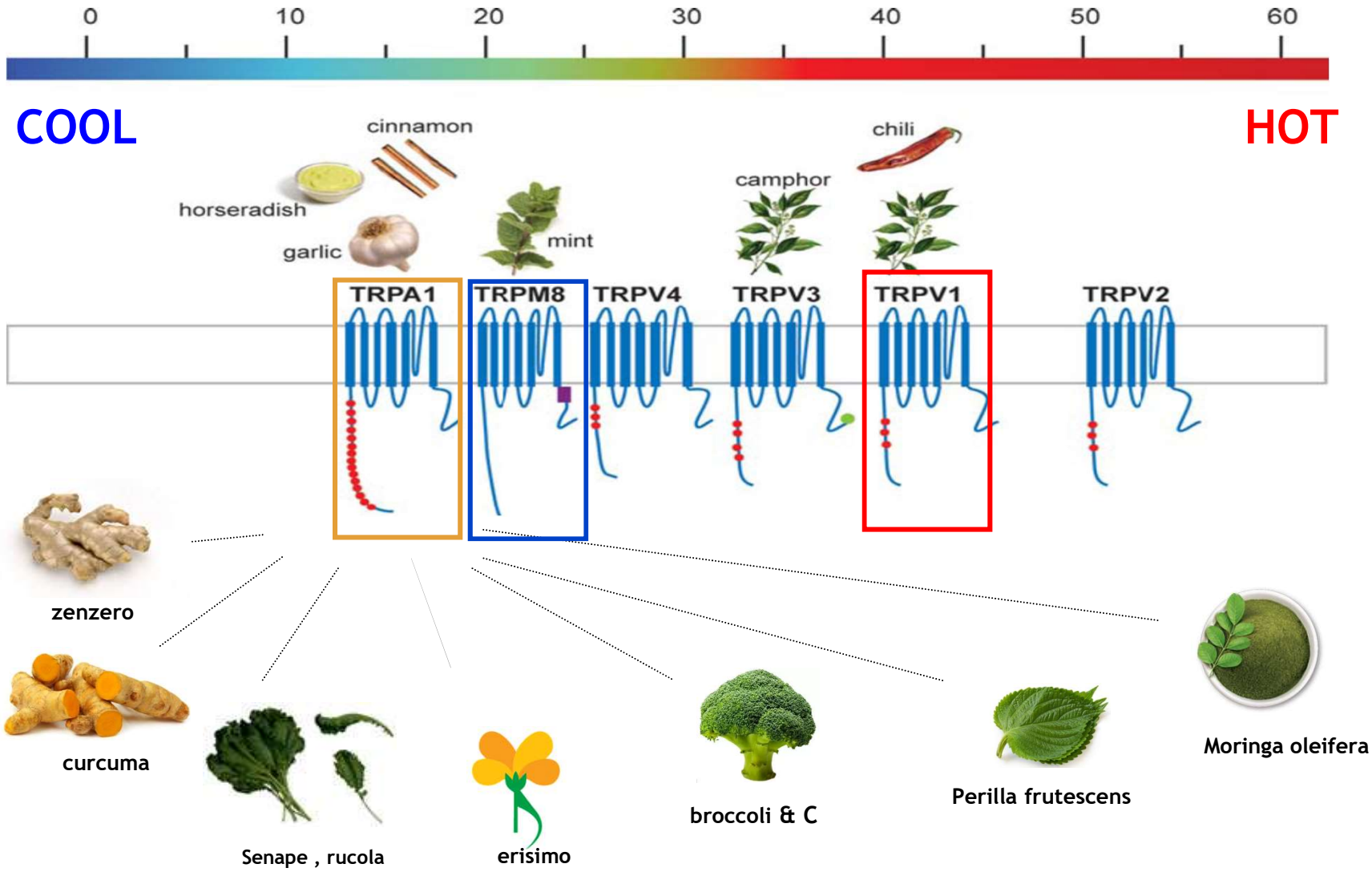
TRP

•SEGNALI GUSTATIVI “STRANI” (spezie, cucina tradizionale ed “etnica”)

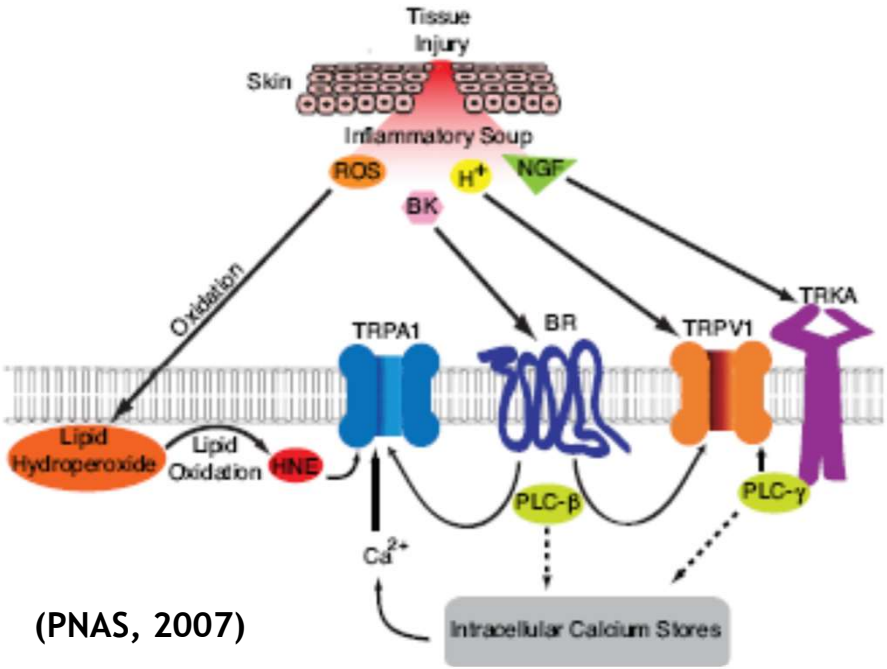


•**DOLORE, IRRITAZIONE, (nocicezione)**

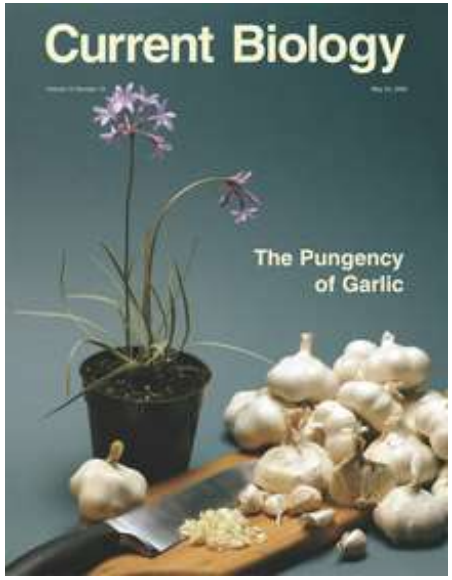
SAPORE E CALORE



PICCANTE, PUNGENTE E…ANTIDOLORE



(PNAS, 2007)



Marcello Trevisani*, Jan Siemens†, Serena Materazzi*, Diana M. Bautista†, Romina Nassini*, Barbara Campi‡, Noritaka Imamachi§, Eunice Andrè‡, Riccardo Patacchini¶, Graeme S. Cottrell‖, Raffaele Gatti‡, Allan I. Basbaum§, Nigel W. Bunnett‖, David Julius†**, and Pierangelo Geppetti*‡***

Agonisti di TRPA1 e TRPV1 possono desensibilizzare alla percezione dolorosa generata da dolore infiammatorio

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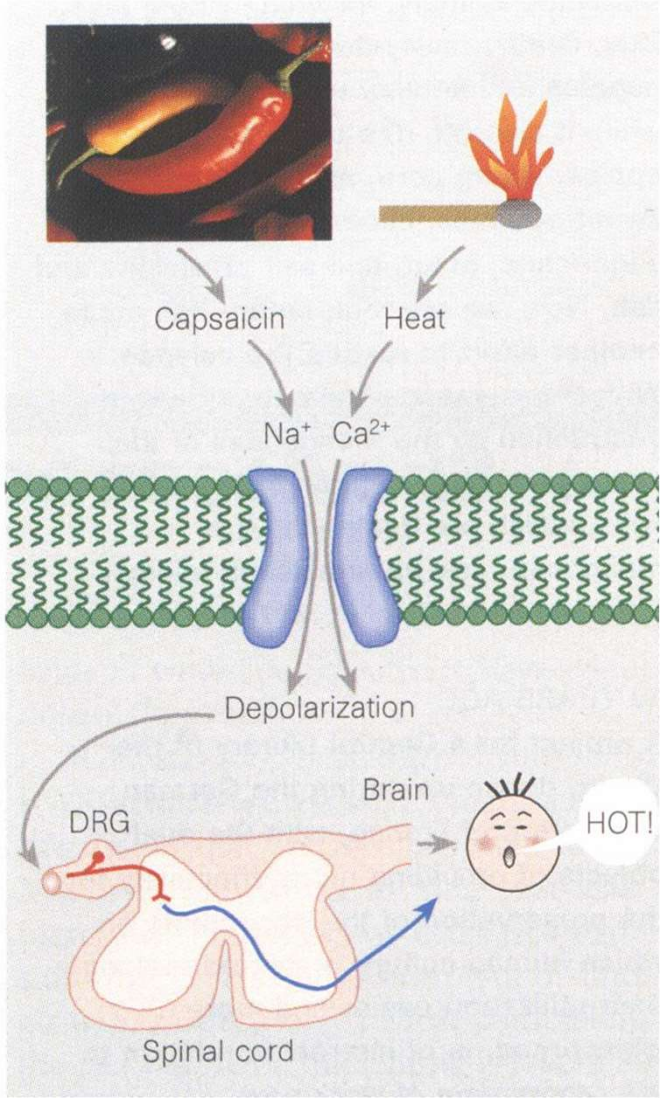
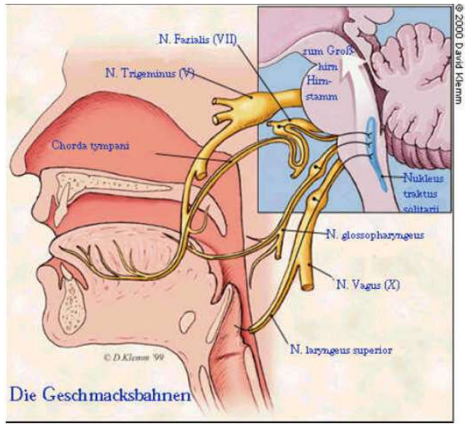
DEI CHIMICI E DEI FISICI



La capsaicina e il dolore trigeminale.



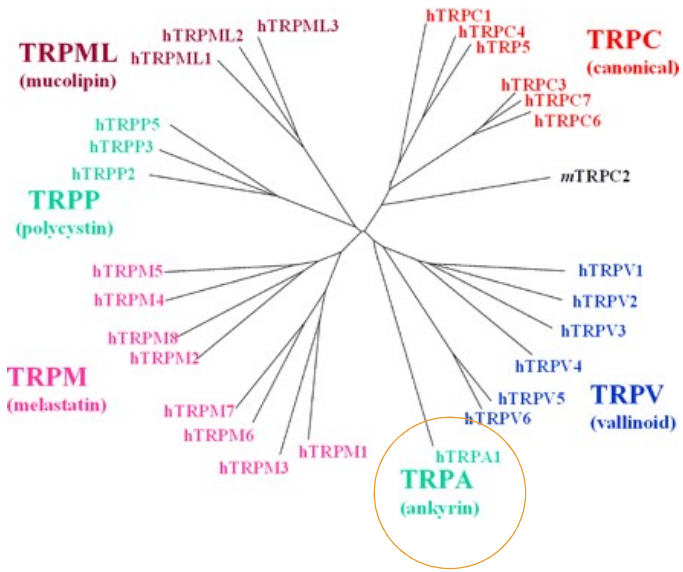
TRPV1 è coinvolto nei meccanismi dell'emicrania e della cefalea a grappolo. Le donne sono colpite da emicrania 3 volte più degli uomini, probabilmente per motivi ormonali.
TRPV1 è' un target promettente sia nella prevenzione che nel trattamento delle emicranie e dei dolori di origine infiammatoria e neurogenica.

Le donne sono più sensibili degli uomini agli effetti della capsaicina, perché l'estradiolo potenzia l'azione della capsaicina sul TRPV1.

Ad alte dosi la capsaicina, attiva la lipolisi e porta alla diminuzione dei depositi corporei di grasso.

Il deidroepiandrosterone, l'ormone della giovinezza, agisce da antagonista della capsaicina sul TRPV1. La sensibilità alla capsaicina aumenta con l'età.

TRPA1: PUNGENTE MA NON SOLO



TRPA1 è espresso in nocicettori, DRG (Dorsal Root Ganglia), trigemino, orecchio interno, cellule ciliate, papille gustative.

Ruolo comprovato in:

-**termorecezione** (freddo non nocivo)
- percezione della **pungenza**
- **nocicezione**
- **meccanorecezione**, tatto, suono (*molecular springs*)
- propricezione, **equilibrio**

ottimo per combattere la nausea!

GLI AGONISTI NATURALI DI TRPA1

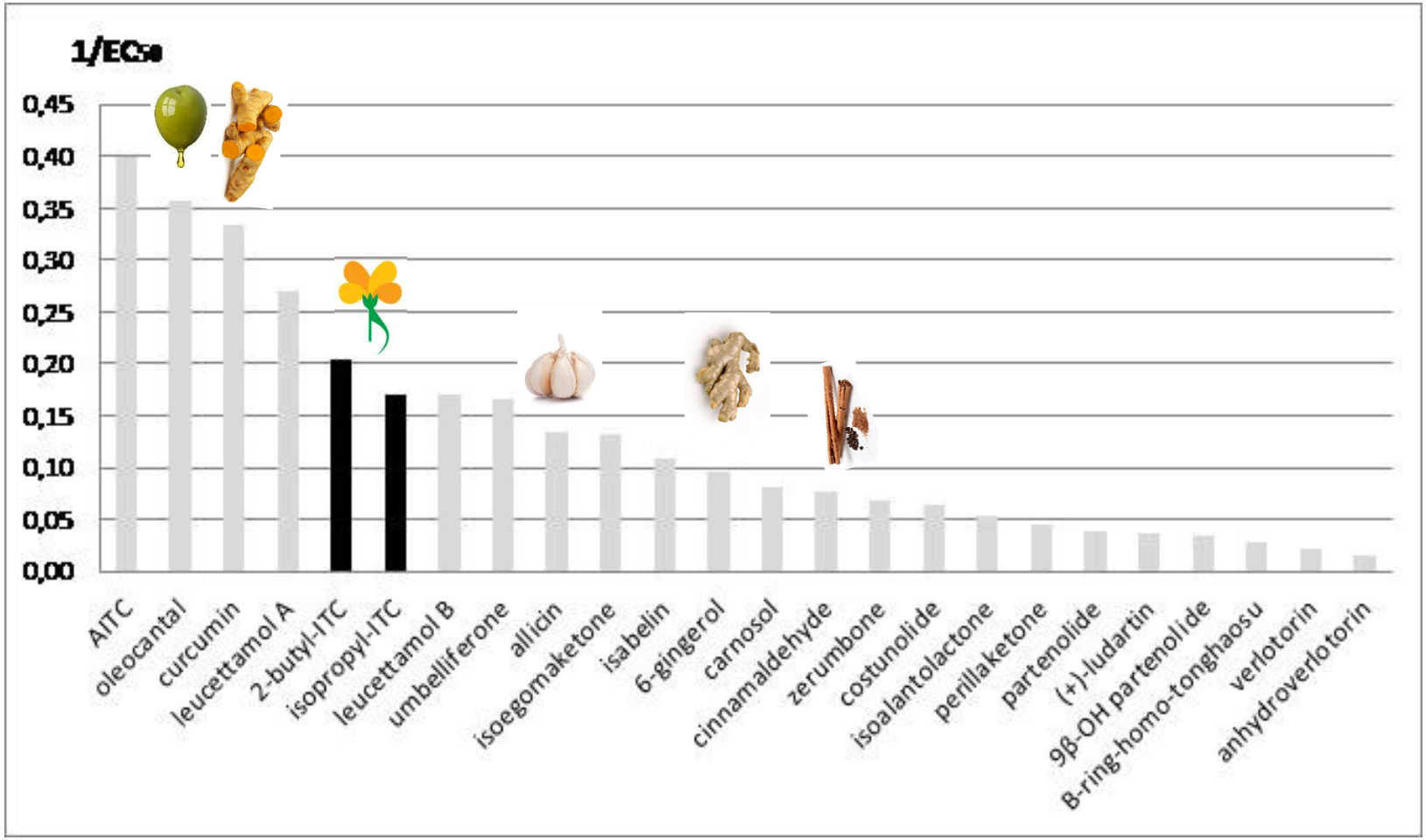


Figure 3. Comparison between TRPA1's activity of ITC from Sisymbrium officinale and other natural known agonists. Potency is expressed as $1/EC_{50}$.

Borgonovo, G., Zimbaldi, N., de Nisi, P., De Petrocellis, L. & Aniello Schiano Moriello, A. B. 'Isothiocyanates and glucosinolates from Sisymbrium officinale (the "singers'plant"): isolation and in vitro assays on the somatosensory and pain receptor TRPA1 channel.' (Molecules, 2019)

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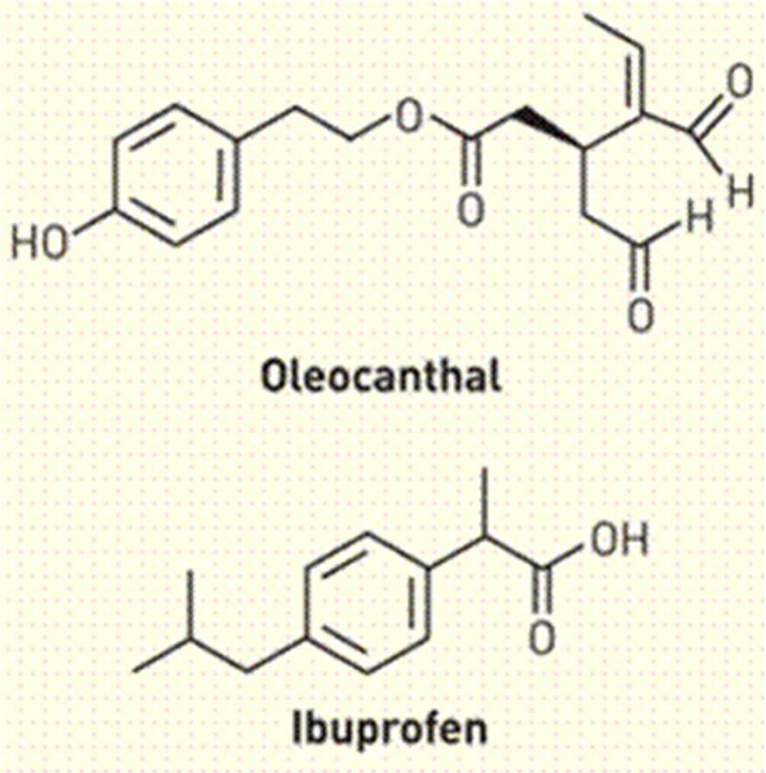

Vol 437|1 September 2005 nature

BRIEF COMMUNICATIONS

Ibuprofen-like activity in extra-virgin olive oil

Enzymes in an inflammation pathway are inhibited by oleocanthal, a component of olive oil.

Newly pressed extra-virgin olive oil contains oleocanthal — a compound whose pungency induces a strong stinging sensation in the throat, not unlike that caused by solutions of the non-steroidal anti-inflammatory drug ibuprofen[1]. We show here that this similar perception seems to be an indicator of a shared pharmacological activity, with oleocanthal acting as a natural anti-inflammatory compound that has a potency and profile strikingly similar to that of ibuprofen. Although structurally dissimilar, both these molecules inhibit the same cyclooxygenase enzymes in the prostaglandin-biosynthesis pathway.

The agent in extra-virgin olive oil responsible for throat irritation is thought to be the dialdehydic form of (−)deacetoxy-ligstroside aglycone[2] (or oleocanthal, with oleo- for olive, -canth- for sting, and -al for aldehyde) (Fig. 1). To confirm this, we isolated (−)oleocanthal from different premium olive oils and measured its intensity as a throat irritant. We found that irritation intensity was positively correlated with oleocanthal concentration. Although this finding indicates that oleocanthal is probably the principal irritating compound in olive oil, it was possible that co-elution of a minor component or a mixture of components could be causing the burning sensation[2]. We therefore completed a *de novo* synthesis of oleocanthal, assigned the absolute stereochemistry (A.B.S. and Q.H., unpublished results), and tested the throat-irritant properties of this synthetic (−)oleocanthal, dissolved in non-irritating corn oil. The effect was comparable to that of premium extra-virgin olive-oil oleocanthal and was also dose-dependent. (For details and for methods, see supplementary information.)

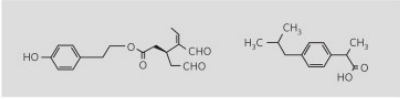

Figure 1 | Structures of (−)oleocanthal (left) and the anti-inflammatory drug ibuprofen (right). How they underpin the similar throat-irritating and pharmacological properties of the two compounds is unclear as yet.

Forty years ago, it was found that the bitterness of certain compounds correlated with their pharmacological activity[3]. On the basis of their shared irritant properties, we therefore tested whether oleocanthal might mimic the pharmacological effects of ibuprofen (Fig. 1), a potent modulator of inflammation and analgesia[4]. Ibuprofen is a non-selective inhibitor of the cyclooxygenase enzymes COX-1 and COX-2, but not of lipoxygenase[4], which catalyse steps in the biochemical inflammation pathways derived from arachidonic acid. We found that, like ibuprofen, both enantiomers of oleocanthal caused dose-dependent inhibition of COX-1 and COX-2 activities but had no effect on lipoxygenase *in vitro* (Table 1).

Our findings raise the possibility that long-term consumption of oleocanthal may help to protect against some diseases by virtue of its ibuprofen-like COX-inhibiting activity[5,6]. If 50 g of extra-virgin olive oil containing up to 200 μg per ml oleocanthal is ingested per day[7], of which 60–90% is absorbed[8,9], then this corresponds to an intake of up to 9 mg per day. This dose is relatively low, corresponding to about 10% of the ibuprofen dosage recommended for adult pain relief, but it is known that regular low doses of aspirin, for example, another COX inhibitor, confer cardiovascular health benefits[10]. Ibuprofen is associated with a reduction in the risk of developing some cancers[5] and of platelet aggregation in the blood[11], as well as with the COX-independent secretion of amyloid-β42 peptide in a mouse model of Alzheimer's disease[6]. A Mediterranean diet, which is rich in olive oil, is believed to confer various health benefits, some of which[12] seem to overlap with those attributed to non-steroidal anti-inflammatory drugs.

Our discovery of COX-inhibitory activity in a component of olive oil offers a possible mechanistic explanation for this link.

Table 1 | Selective inhibition of COX enzymes by oleocanthal enantiomers

Agent	Concentration (μM)	COX-1 (%)	COX-2 (%)	15-LO (%)
(−)Oleocanthal	100	83.5 ± 3.5	70.9 ± 8.6	0.4 ± 0.8
	25	56.1 ± 3.2	56.6 ± 9.5	0.0 ± 0.0
	7	24.6 ± 7.3	14.5 ± 2.3	0.0 ± 0.0
(+)Oleocanthal	100	68.0 ± 15.2	69.6 ± 3.9	3.5 ± 5.5
	25	54.5 ± 4.6	41.3 ± 15.9	0.7 ± 1.0
	7	24.6 ± 7.5	6.1 ± 4.2	0.0 ± 0.0
Ibuprofen	25	17.8 ± 2.3	12.7 ± 3.6	0.2 ± 0.3
	7	0.0	1.3	ND
Indomethacin	25	90.1	89.8	0.1 ± 0.9
	7	86.6	66.3	0.5 ± 0.1
NDGA	25	ND	ND	63.1 ± 0.8
	7	ND	ND	52.5 ± 1.1
caffeic acid	25	ND	ND	25.2 ± 2.2
	7	ND	ND	19.8 ± 1.3

Percentage inhibition of cyclooxygenases 1 and 2 (COX-1, COX-2) and 15-lipoxygenase (15-LO) by three different concentrations of oleocanthal and of ibuprofen are presented as mean ± s.e.m. for three independent experiments. ND, not determined. Indomethacin was used as a positive (inhibitory) control in the cyclooxygenase assays and nor-dihydroguaiaretic acid (NDGA) and caffeic acid were used as positive (inhibitory) controls in the lipoxygenase assay. The concentrations for 50% inhibition (IC_{50}; calculated by least-squares regression analysis of inhibition versus concentration) for the natural (−) oleocanthal are 23 μM and 28 μM for COX-1 and COX-2, respectively; IC_{50} values for (+) oleocanthal are 25 μM and 40 μM for COX-1 and COX-2, respectively; IC_{50} values for ibuprofen are 5 μM and 223 μM for COX-1 and COX-2, respectively[13]. (For methods, see supplementary information.)

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FEDERAZIONE NAZIONALE
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Un meccanismo alternativo per prevenire/alleviare il dolore?

ALCALOIDI
(SNC)

AGONISTI DEI TRP?

SOGLIA DI RESISTENZA AL DOLORE ⬆
AFFATICAMENTO FISICO E MENTALE ⬇

Diete ricche di composti attivi sui TRP sono comuni in paesi con:

- Condizioni climatiche estreme
- Scarso sviluppo economico e lavoro fisico duro
- Resistenza al dolore fisico come fattore culturale

SAPORI PER «UOMINI (?) VERI»?

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

LE DONNE E I SAPORI: ALLA RICERCA DI UN RUOLO ATTIVO

Nella ricerca sul gusto, le donne sono state analizzate soprattutto dal punto di vista EDONICO come CONSUMATORI. Pochissime le ricerche di genere sugli aspetti MOLECOLARI.

Ma COME SENTE la donna?

Che relazione ha il suo sistema sensoriale con la SALUTE?

E come influenza in modo attivo la SOCIETÀ?

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

nutrients

MDPI

BUONE NOTIZIE

Article

Are (All) Consumers Averse to Bitter Taste?

Riccardo Vecchio, Carla Cavallo *, Gianni Cicia and Teresa Del Giudice

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Abstract: The current study combined hedonic liking with non-hypothetical experimental auctions to measure consumer preferences for bitter tasting food and identify individual socio-demographic and psychographic characteristics that influence bitter aversion. Furthermore, the research analyzed whether consumer preferences for bitter food were influenced by sensory and health-related information. Findings reveal that respondents (N = 205) are not averse to bitter taste; while, socio-demographic traits influence bitter acceptance, as higher education level and gender (female) positively affect preferences, together with specific individual characteristics as high compensatory health beliefs. Moreover, results prove that participants positively respond to health-related information, whereas information on bitterness-taste generates lower preferences.

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Lo svezzamento gustativo

BAMBINO → ADOLESCENTE → ADULTO → ANZIANO

VIETATO AI BAMBINI!

amaro (caffè, birra, broccoli e vegetali in genere)

piccante (spezie)

metallico (sangue, carne cruda, frattaglie…)

astringente (vino)

pungente (senape, ravanelli, spezie..

FEDERAZIONE NAZIONALE
DEGLI ORDINI
DEI CHIMICI E DEI FISICI

Indaghiamo nel corpo delle donne (e anche degli uomini!)

Review

Interactions between Bitter Taste, Diet and Dysbiosis: Consequences for Appetite and Obesity

Alexandria Turner [1], Martin Veysey [1,2], Simon Keely [3,4], Christopher Scarlett [5], Mark Lucock [5] and Emma L. Beckett [1,4,*]

LA «FOEMINA SENSORIA»

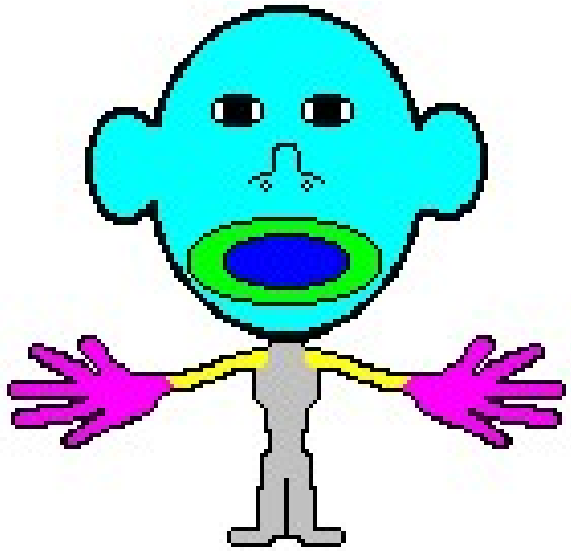
FEATURE ARTICLE

The *Her*munculus: What Is Known about the Representation of the Female Body in the Brain?

Cerebral cortex, 2013

Paula M. Di Noto[1], Leorra Newman[1], Shelley Wall[2] and Gillian Einstein[1,3]

[1]Department of Psychology and, [2]Biomedical Communications, Institute of Medical Science and [3]Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada



?

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LA «DONNA SENSORIALE» E' ANCORA TUTTA DA DISEGNARE!

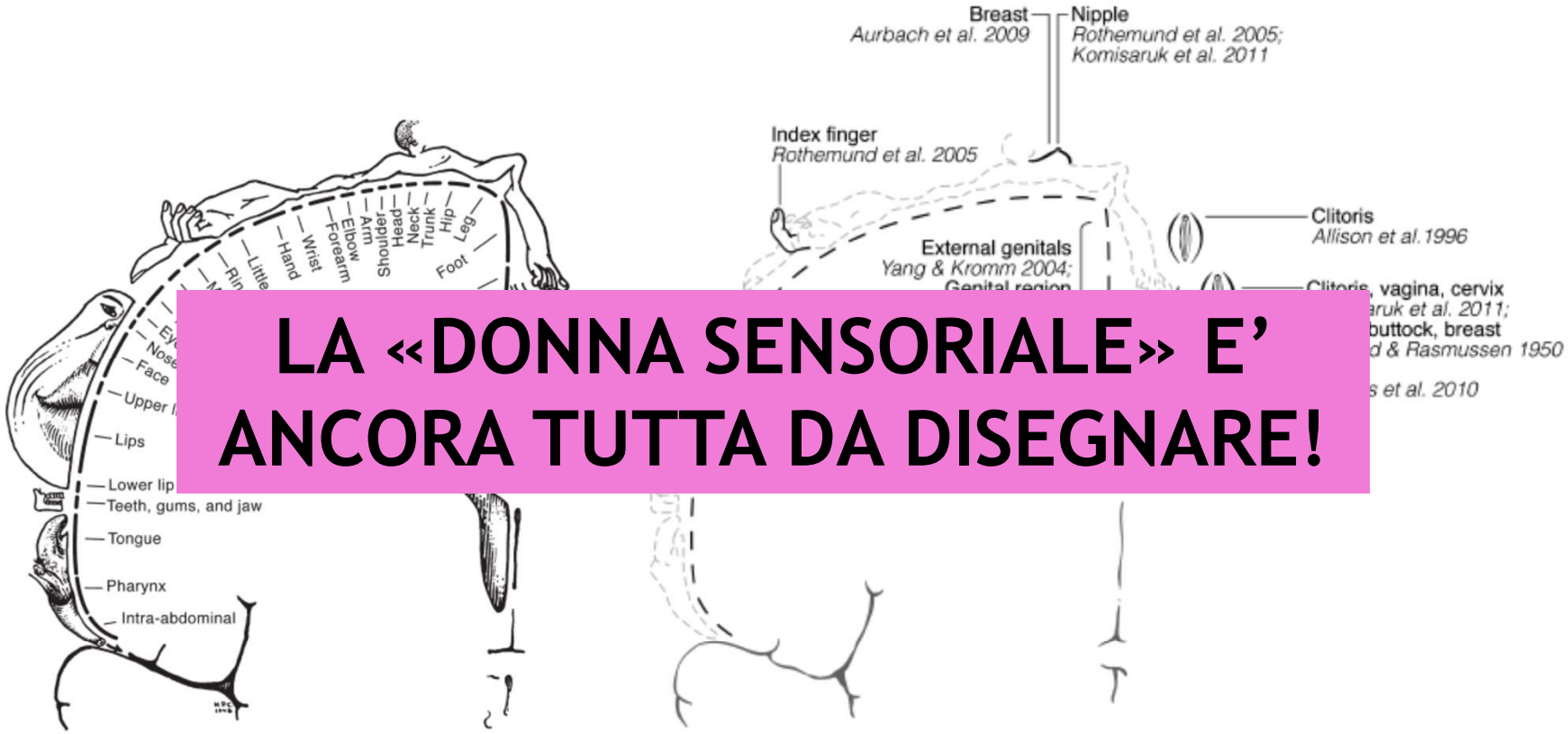

Figure 2. Two versions of the somatosensory hermunculus, depicting findings from human female mapping studies and showing alternative localizations for the genitalia. Left depicts the genitalia mapped to the dorsal somatosensory cortex and right depicts the genital representation mapped along the medial wall. Penfield's homunculus (shown with a gray dashed outline) is included to provide context and to demonstrate how much of the female SS remains unmapped. These illustrations are conceptual: the extent and location of each representation are not precise.

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