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Correction

Correction: Chaves et al. Voltage-Gated Proton Channels in the Tree of Life. *Biomolecules* 2023, *13*, 1035

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In the original publication [1], there was a discrepancy in the citation order of the references, starting from reference [87]. The "Chaves, G.; Jardin, C.; Franzen, A.; Mahorivska, I.; Musset, B.; Derst, C. Proton channels in molluscs: A new bivalvian-specific minimal H_V4 channel. *FEBS J*. **2023**, *290*, 3436–3447. https://doi.org/10.1111/febs.16751." was missing from the reference list and has now been added as reference 126.

A correction has been made to Table 1, where "Hcl" has been modified to "hcl" for the cell type THP-1.

In Table 4, letter designations for "a,b,c,e,c" were incorrectly assigned. These designations have been corrected throughout the table to ensure proper attribution.

Additionally, several textual clarifications have been made: the term "putatively" was added to qualify the described mechanism, the phrase "translate to" was introduced to improve the accuracy of the affected sentence, and the repeated year "2006" in the description of the Ciona intestinalis homolog was removed.

With this correction, the order of some references has been adjusted accordingly. The authors state that the scientific conclusions are unaffected. This correction was approved by the Academic Editor. The original publication has also been updated.

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Table 1. H_V1 in human tissue and other mammalian tissue.

Respiratory Burst	Cell Type	Function of H_V1	References
Yes	Eosinophil (human) (rodent)	Charge compensation, prevention of cell death.	[10,12,17,36–46]
Yes	Neutrophil (human) PLB-985 (hcl) HL-60 (hcl) K-562 (hcl) Neutrophil (rodent)	Charge compensation, migration, granula release, calcium homeostasis, pH homeostasis, ERK activity, phagosomal pH homeostasis.	[6,8,10,12–15,41,45,47–53]
Yes	Monocyte (human)	Charge compensation.	[54]
Yes, small	Macrophage (human) THP-1 (hcl) Macrophage (mice)	Charge compensation, phagosome acidification.	[52,55,56]
Yes, small	Osteoclast (rodent/Leporidae)	pH homeostasis, charge compensation, ROS production.	[57–61]
Yes, small	Microglia (rodent) Microglia culture (human) BV-2 (rcl) GM1-R1 (rcl) MLS-9 (rcl)	pH homeostasis, charge compensation, ROS production, microglia-astrocyte communication, neuropathic pain promotion, brain damage enhancing, acidosis exacerbation, M2 polarization reduction, demyelination promotion, white matter injuries promotion, secondary spinal cord damage enhancing, neuroinflammation promotion, pyroptosis increase, motor deficit expansion, autophagy increase, M1 polarization promotion in aged mice.	[22,61–77]
Yes	Kupffer cell (mice/rodent)	Glucose metabolism, ROS production suppression, hyperglycaemia, and hyperinsulinemia prevention.	[23]
No	Cardiac fibroblast (human)	pH homeostasis, membrane potential, potentially beneficial in ischemia.	[78]
Yes, small	Dendritic cells (rodent/human)	TLR9 activation.	[28]
No	Sperm cell (human)	Capacitation, acid extrusion.	[32,33,79,80]
Yes	Oocyte (human)	pH homeostasis.	[34]
No	Type 2 alveolar cells (rodent)	pH regulation.	[5,30,47,81–87]
No	Mast cell (mouse)	pH homeostasis.	[88]
Yes, tiny	B cells (human) (rodent) LK35.2 (rodent)	B cell receptor signalling, migration and proliferation enhancing (short isoform).	[26,27,89,90]
No	T cells (human) Jurkat (human) T cells (rodent)	Apoptosis prevention, pH homeostasis, autoimmune disorders prevention.	[29,89,91–93]
No	Cardiomyocytes (canine)	pH homeostasis.	[11]
No	SHG-44 glioma cells (human)	Apoptosis prevention.	[18]
No	Colorectal cancer (human) SW620 (hcl) HT29 (hcl) LS174T (hcl) Colo205 (hcl)	Prevention of cellular acidosis, support of cancer cell metabolism, pH homeostasis, potential biomarker, and drug target.	[19]
No	Basophils (human)	Exocytosis (histamine release), pH homeostasis.	[16,94]
No	Ovary cells (Hamster)	pH homeostasis.	[95]

Table 1. *Cont.*

Respiratory Burst	Cell Type	Function of H_V1	References
No	Breast cancer cells (human primary) MDA-BA-231(hcl) MCF-7 (hcl) MDA-MB-468 (hcl) MDA-MB-453 (hcl) T-47D (hcl) SK-BR-3 (hcl)	Tumor growth, metastasis and invasiveness promotion, (expression predicts prognosis of tumor).	[20,21,96]
No	Lung cancer cell A549 (human)	No information.	[97]
No	Prostate cancer cell PC-3 (human)	No information.	[97]
No	Kidney (human) HEK-293	No information.	[97,98]
Yes, small	Nasal epithelium (human primary culture) JME/CF 15 (human) Cystic fibrosis genotype	Airway surface epithelium acidification, proton extrusion.	[99]
Yes, small	Ciliated tracheal cells (human)	NADPH oxidase activity driven proton extrusion.	[31,99]
Yes, small	lung epithelium fetal (human)	DUOX driven proton release, acid extrusion.	[100]
Yes, tiny	Serous gland cell line Calu-3 (human)	Airway surface epithelium acidification, proton extrusion (to a lesser extent than airway epithelium).	[31]
No	Skeletal muscle myocyte (human)	pH homeostasis.	[7]
No	Glioblastoma cell line (human) T98G	Cell's survival and migration.	[101]
No	Whole heart (rodent)	NOXs transcription and CO_2 homeostasis control, electrophysiological remodelling.	[102]
No/Yes	Vascular system, Immune system	Atherosclerosis advancement (hypothetical).	[103]
No/Yes Whole tissue	Lung (rodent)	Goblet cell hyperplasia prevention. Depression expression of IL-4, IL-5, and IL-13. Reduction of the expression levels of NOX2, NOX4, and DUOX1. Promotion of the expression of SOD2 and catalase. Reduction of the development of allergic asthma through ROS production enhancing.	[104]
Yes	Myeloid derived suppressor cells (MDSC) (rodent)	T-cells regulation (via ROS production).	[35]
No	epididymal adipose tissue (rodent)	Diet obesity induction.	[24]
Yes, tiny	Pancreatic β cells (rodent)	Insulin secretion, ROS production, NOX4 upregulation, glucotoxicity induction.	[25,105,106]

hcl = human cell line; rcl = rodent cell line.

Table 4. Biophysical properties of some H_V channels.

Organism	Species	Channel	Oligomerization?	Selectivity	Gating Charges, e_0	Slope V_{thres}/V_{rev}	V_{thres} at ΔpH = 0 (mV)	Δg_H-V/ΔpH (mV/pH$_o$)	H^+ Influx at Relevant Physiological pH?	References
Mammals	*H. sapiens*	hH_V1	confirmed [f,g,j,k]	$>10^6$ P_{H+}/P_{TMA+} [e,i] $>10^6$ $P_{H+}/P_{CH3SO3-}$ [i] $>10^6$ P_{H+}/P_{Cl-} [i]	~5 [h,δ] ~6 [l]	0.82 [e] 0.67–0.71 (expressed) [l] 0.71 (native) [l]	13.8 [e] −9 to −11 (expressed) [l] +27 (native) [l]	40 [l]	no (native) yes (if expressed) [l]	[111] [e], [139] [f], [140] [g], [141] [h], [142] [i], [41] [j], [143] [k], [98] [l]
	M. musculus	mH_V1	confirmed [n]	$>10^7$ P_{H+}/P_{NMDG+} $>10^7$ P_{H+}/P_{Na+} $>10^7$ P_{H+}/P_{K+}	~6 [m]	0.86 * (expressed) 0.69 [m] (expressed)	+10 to +20 −15 (expressed) [m]	50 40 [m]	no (native) yes (if expressed) [m]	[119], [98] [m], [144] [n]
	R. norvegicus	RnH_V1	possibly	$>10^7$ P_{H+}/P_{TMA+} [o] $>10^8$ P_{D+}/P_{TMA+} [p]	5.4 [p]	0.76	+18	44 40 [o,p]	no	[5], [81] [o], [83] [p]
Fish	*D. rerio*	DrH_V1	possibly	$>10^7$ P_{H+}/P_{NMDG+}	n.d.	0.69 *	~+10 mV [ε]	~40 [ε]	no	[145]
Sea squirt	*C. intestinalis*	CiH_V1	confirmed [c]	n.d.	4.4–5.9 (dimer) [c] 1.6–2.7 (monomer) [d]	n.d.	n.d.	~40 [d]	no	[119], [146] [c], [147] [d]
Insects	*N. phytophila*	NpH_V1	confirmed [b]	$>10^8$ P_{H+}/P_{TMA+} $>10^4$ P_{H+}/P_{Na+} $>10^4$ P_{H+}/P_{Cl-}	4.7–6.1 [b]	0.81 [a]	−3.4 [a]	47–54 [a]	no	[121] [a], [148] [b]
	E. tiaratum	EtH_V1	n.d.	$>10^6$ P_{H+}/P_{TMA+}	n.d.	0.77	−23	45	yes	[122]
Mollusks	*C. gigas*	CgH_V4	possibly	$>10^7$ P_{H+}/P_{TMA+}	n.d.	0.84	−12	49	no •	[126]
	A. californica	AcH_V1	possibly	$>10^7$ P_{H+}/P_{TMA+} $>10^6$ P_{H+}/P_{Na+} $>10^6$ P_{H+}/P_{K+}	5.7	0.78	5	43–45	no	[125]
	A. californica	AcH_V2	possibly	$>10^7$ P_{H+}/P_{TMA+} $>10^6$ P_{H+}/P_{K+}	5.3	0.77	−20	44 40 (pH_i)	yes	[125]
	A. californica	AcH_V3	possibly [+]	$>10^7$ P_{H+}/P_{TMA+}	n.d.	n.d.	n.d.	n.d.	yes [§]	[125]
	H. trivolvis	HtH_V1	possibly	$>10^7$ P_{H+}/P_{TMA+}	5.5	1.03 * 0.26 (pH_i) *	n.d.	60.0 15.3 (pH_i)	no	[149]
Corals	*A. millepora*	AmH_V1	confirmed	$>10^7$ P_{H+}/P_{TMA+}	2 [λ]	0.86 *	~+10 mV [θ]	~50 [θ]	no	[124]
Sea Urchin	*S. purpuratus*	SpH_V1	confirmed	$>10^7$ P_{H+}/P_{K+}	4.3 (dimer) 1.1 (monomer)	0.69 *	~+10 mV	~40 [β]	no	[123]
Fungi	*A. oryzae*	AoH_V1	possibly [+]	$>10^5$ P_{H+}/P_{TEA+} [#]	5	1.40–1.55 *	~−30 (pH 5.5) [γ] ~−30 (pH 6.5) [γ]	80–90	yes	[130]
	S. luteus	SlH_V1	possibly [+]	$>10^5$ P_{H+}/P_{TEA+} [#]	5	1.40–1.55 *	~+20 (pH 5.5) [γ] ~+40 (pH 6.5) [γ]	80–90	no	[130]

Table 4. *Cont.*

Organism	Species	Channel	Oligomerization?	Selectivity	Gating Charges, e_0	Slope V_{thres}/V_{rev}	V_{thres} at ΔpH = 0 (mV)	Δg_H-V/ΔpH (mV/pH$_o$)	H^+ Influx at Relevant Physiological pH?	References
Dinoflagellates	*K. veneficum*	kH$_V$1	possibly not [φ]	$>10^7$ P_{H+}/P_{TMA+} $>10^5$ P_{H+}/P_{Cl-}	n.d.	0.79	−37	46	yes	[133]
	L. polyedrum	LpH$_V$1	possibly [+]	$>10^9$ P_{H+}/P_{TMA+}	n.d.	0.69 *	46	40 **	yes [α]	[134]
Phytoplankton	*E. huxleyi*	EhH$_V$1	possibly	$>10^6$ P_{H+}/P_{K+} $>10^6$ P_{H+}/P_{Cl-}	n.d.	0.69 [μ] (expressed)	~+20 mV (expressed) [μ]	~40 [Ω]	no	[132]
	C. pelagicus	CpH$_V$1	possibly	$>10^6$ P_{H+}/P_{K+} $>10^6$ P_{H+}/P_{Cl-}	n.d.	0.69 [μ] (native)	+10 mV (native) [μ]	~40 [Ω]	no	[132]

* Calculated from conductance shifts (Δg_H-V/ΔpH) and $E_H = 58\,mV \cdot pH^{-1}$. [§] AcH$_V$3 leaks protons at the closed state [125]. [#] Calculated from pH = 6.0 and working solution containing 30 mM of TEA^+ as main cation. [•] CgH$_V$4 has an activation of −12 mV which permits proton influx at symmetrical pH (physiological) conditions. Nevertheless, the proximity of the offset value to V_{rev} makes the inward H^+ electrochemical gradient small. Thus, H^+ influx is small at ΔpH = 0 where currents rectify rapidly with depolarization, behaving more like a typical H$_V$ proton extruder. During measurements, strong and/or consistent H^+ influx currents were not detected. [φ] kH$_V$1 lacks the predicted coiled-coil which is important for H$_V$ dimerization, a potential monomeric expression is discussed by the authors [133]. [+] Protein sequence analysis predicts a C-terminal coiled-coil domain. ** LpH$_V$1 pH-dependent gating saturates above pH$_o$ 8.0 [134] similar to rat, human, *Karlodinium*, and *Emiliania* H$_V$ channels [137]. [α] Inward H^+ currents are onset at large inward pH gradients (1–3 ΔpH units) [134]. [β] estimated from g_H-V curves shift between pH$_o$ 6.5 and 7.0 (~20 mV), at pH$_i$ = 7.0 (Figure 2; [123]). The g_H-V shifts between pH$_o$ 6.0 to 6.5 and 6.5 to 7.0 are not identical due to experimental limitations reported by the authors. The calculated value on pH$_o$-dependent gating agrees with Δg_H-V/pH$_i$ unit (Figure S1; [123]). [γ] from normalized g_H-V curves (Figure 3; [130]). [δ] from Q_{on} of dimeric W207A-N214R mutant ([141]). [θ] from V_{thres}-ΔpH and slope of $V_{0.5}$-ΔpH curves (Figure 6; [124]). [λ] apparent from steepness of normalized g_H-V (Figure 6; [124]). [Ω] from current densities (Figure 1; [132]). [μ] the slope V_{thres}/V_{rev} was calculated from shifts of I_H onsets and E_H. V_{offset} was estimated shifts of I_H activation, E_H, and Equation (3) (Figure 4; [132]). P_{H+} = proton permeability, P_{TMA+} = tetramethylammonium permeability, P_{TEA+} = tetraethylammonium permeability, P_{K+} = potassium permeability, P_{Na+} = sodium permeability, P_{Cl-} = chloride permeability, P_{NMDG+} = N-methyl-d-glucamine permeability, $P_{CH3SO3-}$ = methanesulfonate permeability, n.d. = no data, V_{thres} = threshold potential, V_{rev} = reversal potential, ΔpH = proton gradient ($pH_{outside} - pH_{inside}$), g_H-V = proton conductance – voltage relationship, pH$_o$ = external pH, pH$_i$ = internal pH.

Reference

1. Chaves, G.; Jardin, C.; Derst, C.; Musset, B. Voltage-Gated Proton Channels in the Tree of Life. *Biomolecules* **2023**, *13*, 1035. [CrossRef] [PubMed]

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