How do you test for cations and anions

Most elements are rarely found in their pure form. They are found chemically combined with other elements in compounds. Compounds are often found mixed with other compounds. Mixtures may be separated and analysed. Hofmeister, F. 24. Zur Lehre von der Wirkung der Salze. Naunyn-Schmiedeberg's Archives of Pharmacology 27 (6), 395–413 (1890).Article Google Scholar Hofmeister, F. Zur Lehre von der Wirkung der Salze. Naunyn-Schmiedeberg's Archives of Pharmacology 24 (4), 247–260 (1888).Article Google Scholar Zhang, Y. J. & Cremer, P. S. Chemistry of Hofmeister Anions and Osmolytes. Annu. Rev. Phys. Chem. 61, 63–83 (2010).Article CAS Google Scholar Collins, K. D. & Washabaugh, M. W. The Hofmeister Effect and the Behavior of Water at Interfaces. Q. Rev. Biophys. 18, 323–422 (1985).Article CAS PubMed Google Scholar Horowicz, P. Effects of Anions on Excitable Cells. Pharmacol. Rev. 16 (2), 193–221 (1964).CAS PubMed Google Scholar Cacace, M. G., Landau, E. M., & Ramsden, J. J. The Hofmeister series: salt and solvent effects on interfacial phenomena. Q. Rev. Biophys. 30 (3), 241–277 (1997).Article CAS PubMed Google Scholar Baldwin, R. L. How Hofmeister ion interactions affect protein stability. Biophys. J. 71 (4), 2056–2063 (1996).Article ADS CAS PubMed PubMed Central Google Scholar Napper, D. H. Steric stabilization and the Hofmeister series. Journal of Colloid and Interface Science 33 (3), 384–392 (1970).Article ADS Google Scholar Ninham, B. W. & Nostro, P. L. Molecular Forces and Self Assembly In Colloid, Nano Sciences and Biology. (Cambridge University Press, 2010).Parsegian, V. A. Ion-Membrane Interactions as Structural Forces. Ann. NY Acad. Sci. 264 (DEC30), 161–174 (1975).Article ADS CAS PubMed Google Scholar Brown, M. F. & Seelig, J. Ion-Induced Changes in Head Group Conformation of Lecithin Bilayers. Nature 269 (5630), 721–723 (1977).Article ADS CAS Google Scholar Loosleymillman, M. E., Rand, R. P., & Parsegian, V. A. Effects of Mono-Valent Ion Binding and Screening on Measured Electrostatic Forces Between Charged Phospholipid-Bilayers. Biophys. J. 40 (3), 221–232 (1982).Article ADS CAS Google Scholar Tatulian, S. A. Binding of Alkaline-Earth Metal-Cations and some Anions to Phosphatidylcholine Liposomes. Eur. J. Biochem. 170 (1–2), 413–420 (1987).Article CAS PubMed Google Scholar Cunningham, B. A., Gelerinter, E., & Lis, L. J. Mono-Valent Ion-Phosphatidylcholine Interactions - an Electron-Paramagnetic Resonance Study. Chem. Phys. Lipids 46 (3), 205–211 (1988).Article CAS PubMed Google Scholar Macdonald, P. M. & Seelig, J. Anion Binding to Neutral and Positively Charged Lipid-Membranes. Biochemistry 27 (18), 6769–6775 (1988).Article CAS PubMed Google Scholar Roux, M. and M. Bloom Ca-2+, Mg-2+, Li+, Na+ and K+ Distributions in the Headgroup Region of Binary Membranes of Phosphatidylcholine and Phosphatidylserine as Seen by Deuterium NMR. Biochemistry 29, 7077–7089 (1990).Article CAS PubMed Google Scholar Rydall, J. R. & Macdonald, P. M. Investigation of Anion Binding to Neutral Lipid-Membranes Using H-2 NMR. Biochemistry 31, 1092–1099 (1992).Article CAS PubMed Google Scholar Garcia-Celma, J. J., Hatahet, L., Kunz, W., & Fendler, K. Specific anion and cation binding to lipid membranes investigated on a solid supported membrane. Langmuir 23 (20), 10074–10080 (2007).Article CAS PubMed Google Scholar Klasczyk, B., Knecht, V., Lipowsky, R., & Dimova, R. Interactions of Alkali Metal Chlorides with Phosphatidylcholine Vesicles. Langmuir 26 (24), 18951–18958 (2010).Article CAS PubMed Google Scholar Eisenberg, M., Gresalfi, T., Riccio, T., & McLaughlin, S. Adsorption of Mono-Valent Cations to Bilayer Membranes Containing Negative Phospholipids. Biochemistry 18 (23), 5213–5223 (1979).Article CAS PubMed Google Scholar Parsegian, V. A., Rand, R. P., Lipowsky, R., & Sackmann, E. Chapter 13 Interaction in membrane assemblies in. Handbook of Biological Physics (North-Holland, 1995), Vol. Volume 1, Part 2, pp. 643–690.Kunz, W., Henle, J., & Ninham, B. W. 'Zur Lehre von der Wirkung der Salze' (about the science of the effect of salts): Franz Hofmeister's historical papers. Curr. Opin. Colloid Interface Sci. 9 (1–2), 19–37 (2004).Article CAS Google Scholar Simon, S. A., Lis, L. J., Kauffman, J. W., & Macdonald, R. C. Calorimetric and Monolayer Investigation of Influence of Ions on Thermodynamic Properties of Phosphatidylcholine. Biochimica Et Biophysica Acta 375 (3), 317–326 (1975).Article CAS PubMed Google Scholar Hauser, H. et al. Interaction of Ions with Phosphatidylcholine Bilayers. Biochimica Et Biophysica Acta 468 (3), 364–377 (1977).Article CAS PubMed Google Scholar Lis, L. J., Parsegian, V. A., & Rand, R. P. Binding of Divalent-Cations to Dipalmitoylphosphatidylcholine Bilayers and its Effect on Bilayer Interaction. Biochemistry 20 (7), 1761–1770 (1981).Article CAS PubMed Google Scholar Lis, L. J., Lis, W. T., Parsegian, V. A., & Rand, R. P. Adsorption of Divalent-Cations to a Variety of Phosphatidylcholine Bilayers. Biochemistry 20 (7), 1771–1777 (1981).Article CAS PubMed Google Scholar Akutsu, H. & Seelig, J. Interaction of Metal-Ions with Phosphatidylcholine Bilayer-Membranes. Biochemistry 20 (26), 7366–7373 (1981).Article CAS PubMed Google Scholar Altenbach, C. & Seelig, J. Ca-2+ Binding to Phosphatidylcholine Bilayers as Studied by Deuterium Magnetic-Resonance - Evidence for the Formation of a Ca-2+ Complex with 2 Phospholipidmolecules. Biochemistry 23 (17), 3913–3920 (1984).Article CAS PubMed Google Scholar Oshima, H., Inoko, Y., & Mitsui, T. Hamaker constant and binding constants of Ca2+ and Mg2+ in dipalmitoyl phosphatidylcholine/water system. Journal of Colloid and Interface Science 86 (1), 57–72 (1982).Article ADS Google Scholar Afzal, S., Tesler, W. J., Blessing, S. K., Collins, J. M., & Lis, L. J. Hydration force between phosphatidylcholine surfaces in aqueous electrolyte solutions. Journal of Colloid and Interface Science 97 (2), 303–307 (1984).Article ADS CAS Google Scholar Rappolt, M., Pabst, G., Amenitsch, H., & Laggner, P. Salt-induced phase separation in the liquid crystalline phase of phosphatidylcholines. Colloid Surf. A-Physicochem. Eng. Asp. 183, 171–181 (2001).Article Google Scholar Scarpa, M. V., Maximiano, F. A., Chaimovich, H., & Cuccovia, I. A. Interfacial concentrations of chloride and bromide and selectivity for ion exchange in vesicles prepared with dioctadecyldimethylammonium halides, lipids and their mixtures. Langmuir 18 (23), 8817–8823 (2002).Article CAS Google Scholar Jendrasiak, G. L. Halide Interaction with Phospholipids - Proton Magnetic-Resonance Studies. Chem. Phys. Lipids 9 (2), 133–146 (1972).Article CAS PubMed Google Scholar Jendrasiak, G. L., Smith, R., & Ribeiro, A. A. Chaotropic Anion Phosphatidylcholine Membrane Interactions - an Ultra High-Field NMR-Study. Biochimica Et Biophysica Acta 1145 (1), 25–32 (1993).Article CAS PubMed Google Scholar Loshchilova, E. & Karvaly, B. Laser Raman Studies of Molecular-Interactions with Phosphatidylcholine Multilayers .2. Effects of Mono-Valent and Divalent Ions on Bilayer Structure. Biochimica Et Biophysica Acta 514 (2), 274–285 (1978).Article CAS PubMed Google Scholar Macdonald, P. M. & Seelig, J. Anion binding to neutral and positively-charged lipid membranes. Biochemistry 27 (18), 6769–6775 (1988).Article CAS PubMed Google Scholar Epand, R. M. & Bryszewska, M. Modulation of the Bilayer to Hexagonal Phase-Transition and Solvation of Phosphatidylethanolamines in Aqueous Salt-Solutions. Biochemistry 27 (24), 8776–8779 (1988).Article CAS PubMed Google Scholar McLaughlin, S., Bruder, A., Chen, S., & Moser, C. Chaotropic Anions and Surface-Potential of Bilayer Membranes. Biochimica Et Biophysica Acta 394 (2), 304–313 (1975).Article CAS PubMed Google Scholar Tatulian, S. A. Effect of Lipid Phase-Transition on the Binding of Anions to Dimyristoylphosphatidylcholine Liposomes. Biochimica Et Biophysica Acta 736 (2), 189–195 (1983).Article CAS PubMed Google Scholar Tatulian, S. A., Gordeliy, V. I., Sokolova, A. E., & Syrykh, A. G. A Neutron-Diffraction Study of the Influence of Ions on Phospholipid Membrane Interactions. Biochimica Et Biophysica Acta 1070 (1), 143–151 (1991).Article CAS PubMed Google Scholar Clarke, R. J. & Lupfert, C. Influence of anions and cations on the dipole potential of phosphatidylcholine vesicles: A basis for the Hofmeister effect. Biophys. J. 76 (5), 2614–2624 (1999).Article ADS CAS PubMed PubMed Central Google Scholar Chapman, D., Peel, W. E., Kingston, B., & Lilley, T. H. Lipid Phase-Transitions in Model Biomembranes - Effect of Ions on Phosphatidylcholine Bilayers. Biochimica Et Biophysica Acta 464 (2), 260–275 (1977).Article CAS PubMed Google Scholar Cunningham, B. A. & Lis, L. J. Thiocyanate and Bromide Ions Influence the Bilayer Structural Parameters of Phosphatidylcholine Bilayers. Biochimica Et Biophysica Acta 861 (2), 237–242 (1986).Article CAS PubMed Google Scholar Cunningham, B. A., Lis, L. J., & Quinn, P. J. The Influence of Mono-Valent Anions on Dipalmitoylphosphatidylcholine Bilayer Phase-Transitions - a Time Resolved X-Ray-Diffraction Study. Molecular Crystals and Liquid Crystals 141 (3–4), 361–367 (1986).Article CAS Google Scholar Sanderson, P. W., Lis, L. J., Quinn, P. J., & Williams, W. P. The Hofmeister Effect in Relation to Membrane Lipid Phase-Stability. Biochimica Et Biophysica Acta 1067 (1), 43–50 (1991).Article CAS PubMed Google Scholar Adriana, P., Bozenna, R. z.-R., & Marek, L. The effect of selected anions on dipalmitoylphosphatidylcholine phase transitions. Z Naturforsch [C] 57 (7–8), 712–716 (2002).Article Google Scholar Cunningham, B. A. & Lis, L. J. Interactive Forces Between Phosphatidylcholine Bilayers in Mono-Valent Salt-Solutions. Journal of Colloid and Interface Science 128 (1), 15–25 (1989).Article ADS CAS Google Scholar Petrache, H. I., Zemb, T., Belloni, L., & Parsegian, V. A. Salt screening and specific ion adsorption determine neutral-lipid membrane interactions. Proc. Natl. Acad. Sci. U. S. A. 103 (21), 7982–7987 (2006).Article ADS CAS PubMed PubMed Central Google Scholar Bartucci, R. & Sportelli, L. Spin-Label EPR Study of the Effects of Monovalent Cations, Anions and Chaotropics on DPPC Multilayers. Biochim. Biophys. Acta-Biomembr. 1195 (2), 229–236 (1994).Article Google Scholar Bartucci, R., Belsito, S., & Sportelli, L. Neutral lipid bilayers interacting with chaotropic anions. Chem. Phys. Lipids 79 (2), 171–180 (1996).Article CAS Google Scholar Claessens, M., van Oort, B. F., Leermakers, F. A. M., Hoekstra, F. A., & Stuart, M. A. C. Charged lipid vesicles: Effects of salts on bending rigidity, stability and size. Biophys. J. 87 (6), 3882–3893 (2004).Article CAS PubMed PubMed Central Google Scholar Pautot, S., Frisken, B. J., & Weitz, D. A. Production of unilamellar vesicles using an inverted emulsion. Langmuir 19 (7), 2870–2879 (2003).Article CAS Google Scholar Pautot, S., Frisken, B. J., & Weitz, D. A. Engineering asymmetric vesicles. Proc. Natl. Acad. Sci. U. S. A. 100 (19), 10718–10721 (2003).Article ADS CAS PubMed PubMed Central Google Scholar Hadorn, M., Burla, B., & Eggenberger Hotz, P. Towards Tailored Communication Networks in Assemblies of Artificial Cells in. LNAI, vol. 5865, edited by Kevin Korb, Marcus Randall, & Tim Hendtlass (Springer, Heidelberg, 2009) pp. 126–135.Hadorn, M. & Hotz, P. E. Encapsulated Multi-vesicle Assemblies of Programmable Architecture: Towards Personalized Healthcare in. Biomedical Engineering Systems and Technologies, edited by A. Fred, J. Filipe, & H. Gamboa (Springer-Verlag Berlin, Berlin, 2011), Vol. 127, pp. 141–151.Nishimura, K. et al. Population Analysis of Structural Properties of Giant Liposomes by Flow Cytometry. Langmuir 25 (18), 10439–10443 (2009).Article CAS PubMed Google Scholar Toyota, T. et al. Population study of sizes and components of self-reproducing giant multilamellar vesicles. Langmuir 24 (7), 3037–3044 (2008).Article CAS PubMed Google Scholar Hadorn, M. & Eggenberger Hotz, P. DNA-Mediated Self-Assembly of Artificial Vesicles. PLoS One 5 (3), e9886 (2010).Article ADS CAS PubMed PubMed Central Google Scholar Weissenbacher, S., Riond, B., Hofmann-Lehmann, R., & Lutz, H. Evaluation of a novel haematology analyser for use with feline blood. Vet. J. 187 (3), 381–387 (2011).Article CAS PubMed Google Scholar Janssen, J. & Laatz, W. Statistische Datenanalyse mit SPSS für Windows. (Springer, 2005).Page 2 Comparability of automatic haemocytometric and manual counting of vesicles prepared in the presence of alkali metal halides at a concentration of 500 mM. An unpaired 2-tailed Welch's t test did not reveal any significant differences at the $p < 0.05$ level. Sample sizes see text. The dashed lines represent the mean values of the positive control group, i.e. in the absence of electrolytes, of the automatic vesicle counting mautomatic = 7337 vesicles/µL and the manual vesicle counting mmanual = 10675 vesicles/µL. Please be aware that resources have been published on the website in the form that they were originally supplied. This means that procedures reflect general practice and standards applicable at the time resources were produced and cannot be assumed to be acceptable today. Website users are fully responsible for ensuring that any activity, including practical work, which they carry out is in accordance with current regulations related to health and safety and that an appropriate risk assessment has been carried out. Qualitative analysis is used to identify and separate cations and anions in a sample substance. Unlike quantitative analysis, which seeks to determine the quantity or amount of sample, qualitative analysis is a descriptive form of analysis. In an educational setting, the concentrations of the ions to be identified are approximately 0.01 M in an aqueous solution. The "semimicro" level of qualitative analysis employs methods used to detect 1-2 mg of an ion in 5 mL of solution. While there are qualitative analysis methods used to identify covalent molecules, most covalent compounds can be identified and distinguished from each other using physical properties, such as refractive index and melting point. It's easy to contaminate the sample through poor laboratory technique, so it's important to adhere to certain rules: Do not use tap water. Rather, use distilled water or deionized water. Glassware must be clean prior to use. It's not essential that it be dried. Don't put a reagent dropper tip into the mouth of a test tube. Dispense reagent from above the test tube lip to avoid contamination. Mix solutions by flicking the test tube. Never cover the test tube with a finger and shake the tube. Avoid exposing yourself to the sample. If the sample is presented as a solid (salt), it's important to note the shape and color of any crystals. Reagents are used to separate cations into groups of related elements. Ions in a group are separated from each other. After each separation stage, a test is performed to confirm certain ions truly were removed. The test is not performed on the original sample! Separations rely on different characteristics of ions. These may involve redox reactions to change oxidation state, differential solubility in an acid, base, or water, or precipitating certain ions. First, ions are removed in groups from the initial aqueous solution. After each group has been separated, then testing is conducted for the individual ions in each group. Here is a common grouping of cations: Group I: Ag+, Hg22+, Pb2+Precipitated in 1 M HCl Group II: Bi3+, Cd2+, Cu2+, Hg2+, (Pb2+), Sb3+ and Sb5+, Sn2+ and Sn4+Precipitated in 0.1 M H2S solution at pH 0.5 Group III: Al3+, (Cd2+), Co2+, Cr3+, Fe2+ and Fe3+, Mn2+, Ni2+, Zn2+Precipitated in 0.1 M H2S solution at pH 9 Group IV: Ba2+, Ca2+, K+, Mg2+, Na+, NH4+Ba2+, Ca2+, and Mg2+ are precipitated in 0.2 M (NH4)2CO3 solution at pH 10; the other ions are soluble Many reagents are used in the qualitative analysis, but only a few are involved in nearly every group procedure. The four most commonly used reagents are 6M HCl, 6M HNO3, 6M NaOH, 6M NH3. Understanding the uses of the reagents is helpful when planning an analysis. Reagent Effects 6M HCl Increases [H+] Increases [Cl-] Decreases [OH-] Dissolves insoluble carbonates, chromates, hydroxides, some sulfates Destroys hydroxo and NH3 complexes Precipitates insoluble chlorides 6M HNO3 Increases [H+] Decreases [OH-] Dissolves insoluble carbonates, chromates, and hydroxides Dissolves insoluble sulfides by oxidizing sulfide ion Destroys hydroxo and ammonia complexes Good oxidizing agent when hot 6 M NaOH Increases [OH-] Decreases [H+] Forms hydroxo complexes Precipitates insoluble hydroxides 6M NH3 Increases [NH3] Increases [OH-] Decreases [H+] Precipitates insoluble hydroxides Forms NH3 complexes Forms a basic buffer with NH4+