

Scientific literature: Hydroxyapatite in oral care (Nov. 02, 2021)

A. Books, general reviews etc.: Hydroxyapatite

1. Balhuc, S. *et al.* Dental applications of systems based on hydroxyapatite nanoparticles - an evidence-based update. *Crystals* **11**, 674 (2021).
2. Carella, F., Degli Esposti, L., Adamiano, A. & Iafisco, M. The use of calcium phosphates in cosmetics, state of the art and future perspectives. *Materials* **14**, 6398 (2021).
3. Chen, L. *et al.* Hydroxyapatite in oral care products - A review. *Materials* **14**, 4865 (2021).
4. Enax, J. Mineral für den Zahn. *Nachr. Chem.* **69**, 28-29 (February 2021).
5. Kavasi, R. M., Coelho, C. C., Platania, V., Quadros, P. A. & Chatzinikolaidou, M. In vitro biocompatibility assessment of nano-hydroxyapatite. *Nanomaterials* **11** (2021).
6. Kuchenbecker, J., Enax, J., Simader, B., & Meyer, F. Wie Zahnpasten die parodontale Gesundheit verbessern. *Dentale Implantologie* **4**, 226-227 (2021).
7. Limeback, H., Enax, J. & Meyer, F. Biomimetic hydroxyapatite and caries prevention: a systematic review and meta-analysis. *Can. J. Dent. Hyg.* **55**, 148-159 (2021).
8. Meyer, F., Enax, J., Epple, M., Amaechi, B. T. & Simader, B. Cariogenic biofilms: Development, properties, and biomimetic preventive agents. *Dent. J.* **9**, 88 (2021).
9. Simader, B., Fink, E., Enax, J., Meyer, F. & Trame, J.-P. Therapie und häusliche Zahnpflege bei Parodontitis, *Jahrbuch Prophylaxe* **21** (2021).
10. Enax, J., Fabritius, H.-O., Amaechi, B. T. & Meyer, F. Hydroxylapatit als biomimetischer Wirkstoff für die Remineralisation von Zahnschmelz und Dentin. *ZWR – Das Deutsche Zahnärzteblatt* **129**, 277-283 (2020).
11. Meyer, F. & Sztajer, H. in *Kinderzahnmedizin* (ed J. Kühnisch) (Quintessenz Publishing, 2020).
12. Steinert, S., Enax, J., Simader, B., Zwanzig, K. & Meyer, F. Prävention der periimplantären Mukositis. *Dentale Implantologie* **5**, 272-275 (2020).
13. Arifa, M. K., Ephraim, R. & Rajamani, T. Recent advances in dental hard tissue remineralization: A review of literature. *Int. J. Clin. Pediatr. Dent.* **12**, 139-144 (2019).
14. Enax, J., Fabritius, H.-O., Fabritius-Vilpoux, K., Amaechi, B. T. & Meyer, F. Modes of action and clinical efficacy of particulate hydroxyapatite in preventive oral health care – state of the art. *Open Dent. J.* **13**, 274-287 (2019).
15. Epple, M., Meyer, F. & Enax, J. A critical review of modern concepts for teeth whitening *Dent. J.* **7**, 79 (2019).
16. Kupka, T. Oral homeostasis, kill the microbiome or not? *J. Appl. Biotechnol. Bioeng.* **6**, 49-55 (2019).
17. Meyer, F. & Enax, J., Hydroxylapatit: Ein multifunktionaler Wirkstoff für die Zahnpflege, *DZW* **28**, 22 (2019).
18. Meyer, F. & Enax, J. Hydroxyapatite in oral biofilm management. *Eur. J. Dent.* **13**, 287-290 (2019).
19. Meyer, F., Enax, J. & Simader, B. Können wir dank Mundspülungen auf das Zähneputzen verzichten? *Dental Tribune* **6**, 18-19 (2019).
20. Pajor, K., Pajchel, L. & Kolmas, J. Hydroxyapatite and fluorapatite in conservative dentistry and oral implantology - A review. *Materials* **12**, 2683 (2019).

21. Enax, J. & Epple, M. Synthetic hydroxyapatite as a biomimetic oral care agent. *Oral Health Prev. Dent.* **16**, 7-19 (2018).
22. Enax, J. & Epple, M. Die Charakterisierung von Putzkörpern in Zahnpasten. *Dtsch. Zahnärztl. Z.* **73**, 100-108 (2018).
23. Epple, M. & Enax, J. Moderne Zahnpflege aus chemischer Sicht. *Chem. Unserer Zeit* **52**, 218-228 (2018). [English translation: Epple, M. & Enax, J. The chemistry of dental care (Parts 1-3). *ChemViews Mag.*, <https://doi.org/10.1002/chemv.201800053> (2018).]
24. Enax, J. & Meyer, F. Auswirkung von Xerostomie auf die Lebensqualität. *Dental Tribune, German Edition*, 8 (2018).
25. Epple, M. Review of potential health risks associated with nanoscopic calcium phosphate. *Acta Biomater.* **77**, 1-14 (2018).
26. Fabritius, H.-O., Meyer, F. & Enax, J. Biomimetik - Die Natur als Vorbild. *Spektrum der Wissenschaft* **12**, 46-53 (2018).
27. Juntavee, N., Juntavee, A. & Plongniras, P. Remineralization potential of nano-hydroxyapatite on enamel and cementum surrounding margin of computer-aided design and computer-aided manufacturing ceramic restoration. *Int. J. Nanomedicine* **13**, 2755-2765 (2018).
28. Loveren, C. v., Schmidlin, P. R., Martens, L. C. & Amaechi, B. T. Dentin hypersensitivity management. *Clin. Dent. Rev.* **2**, 6 (2018).
29. Meyer, F., Amaechi, B. T., Fabritius, H.-O. & Enax, J. Overview of calcium phosphates used in biomimetic oral care. *Open Dent. J.*, **12**, 406-423 (2018).
30. Meyer, F. & Enax, J. Early childhood caries: Epidemiology, aetiology, and prevention. *Int. J. Dent.*, 1-7 (2018).
31. Meyer, F. & Enax, J. Die Mundhöhle als Ökosystem. *Biol. Unserer Zeit* **1**, 62-68 (2018).
32. Meyer, F. & Enax, J. Demografische Entwicklung und häusliche Zahnpflege. *ZWR - Das Deutsche Zahnärzteblatt* **127**, 98-104 (2018).
33. Onwubu, S. C., Mdluli, P. S. & Singh, S. The effectiveness of nanomaterials in the management of dentine hypersensitivity - A review. *J. Clin. Rev. Case Rep.* **3**, 1-5 (2018).
34. Paszyńska, E. *et al.* Niefluorkowe systemy do remineralizacji zębów. *Dental Forum* **46**, 220-224 (2018).
35. Philip, N. State of the art enamel remineralization systems: The next frontier in caries management. *Caries Res.* **53**, 284-295 (2018).
36. Ramis, J. M., Coelho, C. C., Córdoba, A., Quadros, P. A. & Monjo, M. Safety assessment of nano-hydroxyapatite as an oral care ingredient according to the EU cosmetics regulation. *Cosmetics* **5**, 1-13 (2018).
37. Juntavee, A., Sinagpulo, A. N. & Juntavee, N. Modern approach to pediatric dental caries prevention and treatment. *Ann. Ped. Child Health.* **5**, 1127 (2017).
38. Meyer, F., Fabritius, H.-O. & Enax, J. Spezielle Zahnpflege bei Dentinhypersensibilität. *ZMK* **33**, 865-868 (2017).
39. Sanavia, C. *et al.* Remineralization strategies in oral hygiene: A position paper of Italian Society of Oral Hygiene Sciences-S.I.S.I.O. Working Group. *Open Dent. J.* **11**, 527-538 (2017).
40. Dorozhkin, S. V. *Calcium orthophosphate-based bioceramics and biocomposites.* (Wiley-VCH, 2016).

41. Dorozhkin, S. V. Calcium orthophosphates (CaPO₄) and dentistry. *Bioceram. Dev. Appl.* **6**, 1-28 (2016).
42. Habraken, W., Habibovic, P., Epple, M. & Bohner, M. Calcium phosphates in biomedical applications: materials for the future? *Mater. Today* **19**, 69-87 (2016).
43. Amaechi, B. T. Remineralization therapies for initial caries lesions. *Curr. Oral Health Rep.* **2**, 95-101 (2015).
44. Clarkson, B. H. & Exterkate, R. A. Noninvasive dentistry: a dream or reality? *Caries Res.* 49 Suppl 1, 11-17 (2015).
45. Gillam, D. G. Dentine hypersensitivity: Advances in diagnosis, management, and treatment. (Springer International Publishing, 2015).
46. Kolmas, J., Groszyk, E. & Kwiatkowska-Róhycza, D. Substituted hydroxyapatites with antibacterial properties. *Biomed. Res. Int.* **2014**, 15 (2014).
47. Pepla, E., Besharat, L. K., Palaia, G., Tenore, G. & Migliau, G. Nano-hydroxyapatite and its applications in preventive, restorative and regenerative dentistry: a review of literature. *Ann. Stomatol.* **5**, 108-114 (2014).
48. Loveren, C. v. Toothpastes. Vol. 23 (Karger, 2013).
49. Hannig, M. & Hannig, C. Nanotechnology and its role in caries therapy. *Adv. Dent. Res.* **24**, 53-57 (2012).
50. Rao, A. & Malhotra, N. The role of remineralizing agents in dentistry: a review. *Compend. Contin. Educ. Dent.* **32**, 26-33 (2011).
51. Hannig, M. & Hannig, C. Nanomaterials in preventive dentistry. *Nat. Nanotechnol.* **5**, 565-569 (2010).
52. Hannig, C. & Hannig, M. Natural enamel wear - A physiological source of hydroxylapatite nanoparticles for biofilm management and tooth repair? *Med. Hypotheses* **74**, 670-672 (2010).
53. Roveri, N. & Iafisco, M. Evolving application of biomimetic nanostructured hydroxyapatite. *Nanotechnol. Sci. Appl.* **3**, 107-125 (2010).
54. Roveri, N., Foresti, E., Lelli, M. & Lesci, I. G. Recent advancements in preventing teeth health hazard: the daily use of hydroxyapatite instead of fluoride. *Recent Pat. Biomed. Eng.* **2**, 197-215 (2009).
55. Venegas, S. C., Palacios, J. M., Apella, M. C., Morando, P. J. & Blesa, M. A. Calcium modulates interactions between bacteria and hydroxyapatite. *J. Dent. Res.* **85**, 1124-1128 (2006).
56. Dorozhkin, S. V. & Epple, M. Biological and medical significance of calcium phosphates. *Angew. Chem. Int. Ed.* **41**, 3130-3146 (2002).
57. Brown, P. W. & Constantz, B. *Hydroxyapatite and related materials*. (CRC Press, 1994).
58. Gorbunoff, M. J. & Timasheff, S. N. The interaction of proteins with hydroxyapatite. III. Mechanism. *Anal. Biochem.* **136**, 440-445 (1984).
59. Cevc, G., Cevc, P., Schara, M. & Skaleric, U. The caries resistance of human teeth is determined by the spatial arrangement of hydroxyapatite microcrystals in the enamel. *Nature* **286**, 425-426 (1980).

B. Scientific papers: Biofilms, plaque, periodontal health, caries, remineralization

60. Amaechi, B. T. *et al.* The potential of hydroxyapatite toothpaste to prevent root caries: A pH-cycling study. *Clin. Cosmet. Investig. Dent.* **13**, 315-324 (2021).
61. Amaechi, B. T. *et al.* Anti-caries evaluation of a nano-hydroxyapatite dental lotion for use after toothbrushing: An in situ study. *J. Dent.* **115**, 103863 (2021).

62. Brauner, E. *et al.* Efficacy of bio-activated anti-calculus toothpaste on oral health: a single-blind, parallel-group clinical study. *Minerva Dent. Oral Sci.*, doi:10.23736/s2724-6329.21.04606-4 (2021).
63. Butera, A. *et al.* SEM/EDS evaluation of the mineral deposition on a polymeric composite resin of a toothpaste containing biomimetic Zn-carbonate hydroxyapatite (microRepair®) in oral environment: A randomized clinical trial. *Polymers* **13**, 2740 (2021).
64. Ince, S. G. & Ermis, R. B. The in situ potential of synthetic nano-hydroxyapatite for tooth enamel repair. *Bioinspired, Biomim. Nanobiomaterials*, doi:10.1680/jbibn.21.00022 (2021).
65. Juntavee, A., Juntavee, N. & Hirunmoon, P. Remineralization potential of nanohydroxyapatite toothpaste compared with tricalcium phosphate and fluoride toothpaste on artificial carious lesions. *Int. J. Dent.* **2021**, 5588832 (2021).
66. Kasemkhun, P. & Rirattanapong, P. The efficacy of non-fluoridated toothpastes on artificial enamel caries in primary teeth: An in vitro study. *J. Int. Soc. Prev. Community Dent.* **11**, 397-401 (2021).
67. Nobre, C. M. G., König, B., Pütz, N. & Hannig, M. Hydroxyapatite-based solution as adjunct treatment for biofilm management: An in situ study. *Nanomaterials* **11**, 2452 (2021).
68. Paszynska, E. *et al.* Impact of a toothpaste with microcrystalline hydroxyapatite on the occurrence of early childhood caries: a 1-year randomized clinical trial. *Sci. Rep.* **11**, 2650 (2021).
69. Rajendran, R. *et al.* Development of strontium-doped nano hydroxyapatite dentifrice and compare its remineralising potential with a topical cream containing casein phosphopeptide- amorphous calcium phosphate - An In Vitro study. *Indian J. Dent. Res.* **32**, 92-97 (2021).
70. Salinovic, I., Schauperl, Z., Marcius, M. & Miletic, I. The effects of three remineralizing agents on the microhardness and chemical composition of demineralized enamel. *Materials* **14**, 6051 (2021).
71. Sari, Y. W. *et al.* Remineralization and antibacterial/antibiofilm effects of toothpaste containing nanohydroxyapatite and Curcuma aeruginosa extract. *Nat. Prod. Res.*, 1-5 (2021).
72. Verma, P. & Muthuswamy Pandian, S. Bionic effects of nano hydroxyapatite dentifrice on demineralised surface of enamel post orthodontic debonding: in-vivo split mouth study. *Prog. Orthod.* **22**, 39 (2021).
73. Amaechi, B. T., AbdulAzees, P. A., Okoye, L. O., Meyer, F. & Enax, J. Comparison of hydroxyapatite and fluoride oral care gels for remineralization of initial caries: a pH-cycling study. *BDJ Open* **6**, 9 (2020).
74. Badiee, M. *et al.* Comparison of the effects of toothpastes containing nanohydroxyapatite and fluoride on white spot lesions in orthodontic patients: A randomized clinical trial. *Dent. Res. J. (Isfahan)* **17**, 354-359 (2020).
75. Chandru, T. P. *et al.* Comparative evaluation of three different toothpastes on remineralization potential of initial enamel lesions: A scanning electron microscopic study. *Indian J. Dent. Res.* **31**, 217-223 (2020).
76. Cieplik, F. *et al.* Ca²⁺ release and buffering effects of synthetic hydroxyapatite following bacterial acid challenge. *BMC Oral Health* **20**, 85 (2020).
77. Geeta, R. D., Vallabhaneni, S. & Fatima, K. Comparative evaluation of remineralization potential of nanohydroxyapatite crystals, bioactive glass, casein phosphopeptide-amorphous calcium phosphate, and fluoride on initial enamel lesion

- (scanning electron microscope analysis) - An in vitro study. *J. Conserv. Dent.* **23**, 275-279 (2020).
78. Grocholewicz, K. *et al.* Effect of nano-hydroxyapatite and ozone on approximal initial caries: a randomized clinical trial. *Sci. Rep.* **10**, 11192 (2020).
 79. Ionescu, A. C., Cazzaniga, G., Ottobelli, M., Garcia-Godoy, F. & Brambilla, E. Substituted nano-hydroxyapatite toothpastes reduce biofilm formation on enamel and resin-based composite surfaces. *J. Funct. Biomater.* **11** (2020).
 80. Karumuri, S. *et al.* Efficacy of hydroxyapatite and silica nanoparticles on erosive lesions remineralization. *J. Conserv. Dent.* **23**, 265-269 (2020).
 81. Khandelwal, J. R. *et al.* Comparative evaluation of remineralising efficacy of bioactive glass agent and nano-hydroxyapatite dentifrices on artificial carious lesion in primary teeth: An in vitro study. *Adv. Hum. Biol.* **10**, 129-133 (2020).
 82. Koçyiğit, C., Yüksel, B. N. & N, Ö. Effects of nano-hydroxyapatite dentifrices with and without fluoride on primary teeth enamel: A micro-CT and a SEM study. *Cumhuriyet Dent. J.* **23**, 191-199 (2020).
 83. Körner, P., Schleich, J. A., Wiedemeier, D. B., Attin, T. & Wegehaupt, F. J. Effects of additional use of bioactive glasses or a hydroxyapatite toothpaste on remineralization of artificial lesions in vitro. *Caries Res.* **54**, 336-342 (2020).
 84. Monterubbianesi, R. *et al.* Can desensitizing toothpastes also have an effect on gingival inflammation? A double-blind, three-treatment crossover clinical trial. *Int. J. Environ. Res. Public Health* **17** (2020).
 85. Nobre, C. M. G., Pütz, N. & Hannig, M. Adhesion of hydroxyapatite nanoparticles to dental materials under oral conditions. *Scanning* **2020**, 6065739 (2020).
 86. Nobre, C. M. G., Pütz, N., König, B., Rupf, S. & Hannig, M. Modification of in situ biofilm formation on titanium by a hydroxyapatite nanoparticle-based solution. *Front. Bioeng. Biotechnol.* **8**, 598311 (2020).
 87. Polyakova, M. A. *et al.* Qualitative and quantitative assessment of remineralizing effect of prophylactic toothpaste promoting brushite formation: A randomized clinical trial. *J. Int. Soc. Prev. Community Dent.* **10**, 359-367 (2020).
 88. Rajendran, R. *et al.* Evaluation of remineralization potential and cytotoxicity of a novel strontium-doped nanohydroxyapatite paste: An in vitro study. *J. Conserv. Dent.* **23**, 330-336 (2020).
 89. Sudradjat, H., Meyer, F., Loza, K., Epple, M., Enax, J. In vivo effects of a hydroxyapatite-based oral care gel on the calcium and phosphorus levels of dental plaque. *Eur. J. Dent.* (2020).
 90. Wierichs, R. J. *et al.* Re- and demineralization characteristics of dentin depending on fluoride application and baseline characteristics in situ. *J. Dent.* **94**, 103305 (2020).
 91. Akhmedova, Z. R., Avraamova, O. G., Kulazhenko, T. V. & Zhitkov, M. Y. The possibility of enamel remineralization in adults. *Stomatologiya* **98**, 19-21 (2019).
 92. Amaechi, B. T. *et al.* Comparative efficacy of a hydroxyapatite and a fluoride toothpaste for prevention and remineralization of dental caries in children. *BDJ Open* **5**, 18 (2019).
 93. Asmari, D. A. & Almutairi, A. Clinical evaluation of zinc-carbonate hydroxyapatite nanocrystals mouthwash in controlling plaque induced gingivitis: A randomized clinical trial. *IP Int. J. Periodontol. Implantol.* **4**, 98-102 (2019).
 94. Bossu, M. *et al.* Enamel remineralization and repair results of biomimetic hydroxyapatite toothpaste on deciduous teeth: An effective option to fluoride toothpaste. *J. Nanobiotechnology* **17**, 17 (2019).
 95. Hagenfeld, D. *et al.* No differences in microbiome changes between anti-adhesive and antibacterial ingredients in toothpastes during periodontal therapy. *J Periodont. Res.* (2019).

96. Joshi, C., Gohil, U., Parekh, V. & Joshi, S. Comparative evaluation of the remineralizing potential of commercially available agents on artificially demineralized human enamel: An in vitro study. *Contemp. Clin. Dent.* **10**, 605-613 (2019).
97. Manchery, N., John, J., Nagappan, N., Subbiah, G. K. & Premnath, P. Remineralization potential of dentifrice containing nanohydroxyapatite on artificial carious lesions of enamel: A comparative in vitro study. *Dent. Res. J.* **16**, 310-317 (2019).
98. Memarpour, M., Shafiei, F., Rafiee, A., Soltani, M. & Dashti, M. H. Effect of hydroxyapatite nanoparticles on enamel remineralization and estimation of fissure sealant bond strength to remineralized tooth surfaces: an in vitro study. *BMC oral health* **19**, 92 (2019).
99. Schlagenhaut, U. *et al.* Impact of a non-fluoridated microcrystalline hydroxyapatite dentifrice on enamel caries progression in highly caries-susceptible orthodontic patients: A randomized, controlled 6-month trial. *J. Invest. Clin. Dent.*, e12399 (2019).
100. Vijayasankari, V., Asokan, S. & GeethaPriya, P. R. Evaluation of remineralisation potential of experimental nano hydroxyapatite pastes using scanning electron microscope with energy dispersive X-ray analysis: an in-vitro trial. *Eur. Arch. Paediatr. Dent.* **20**, 529-536 (2019).
101. Daas, I., Badr, S. & Osman, E. Comparison between fluoride and nano-hydroxyapatite in remineralizing initial enamel lesion: An in vitro study. *J. Contemp. Dent. Pract.* **19**, 306-312 (2018).
102. Grewal, N., Sharma, N. & Kaur, N. Surface remineralization potential of nano-hydroxyapatite, sodium monofluorophosphate, and amine fluoride containing dentifrices on primary and permanent enamel surfaces: An in vitro study. *J. Indian Soc. Pedod. Prev. Dent.* **36**, 158-166 (2018).
103. Cosola, S. *et al.* Antimicrobial efficacy of mouthwashes containing zinc-substituted nanohydroxyapatite and zinc L-pyrrolidone carboxylate on suture threads after surgical procedures. *J. Oral Science Rehabilitation* **3**, 24-30 (2017).
104. Kamath, P., Nayak, R., Kamath, S. & Pai, D. A comparative evaluation of the remineralization potential of three commercially available remineralizing agents on white spot lesions in primary teeth: An in vitro study. *J. Indian Soc. Pedod. Prev. Dent.* **35**, 229-237 (2017).
105. Ebadifar, A., Nomani, M. & Fatemi, S. A. Effect of nano-hydroxyapatite toothpaste on microhardness of artificial carious lesions created on extracted teeth. *J. Dent. Res. Dent. Clin. Dent. Prospects.* **11**, 14-17 (2017).
106. Ghallab, O. H. & Khalik, D. M. A. Remineralizing and color retrieval efficacy of different nano-apatite materials on human enamel white spot lesions: an in vitro comparative study. *Int. J. Adv. Res.* **5**, 1202-1221 (2017).
107. Kensche, A. *et al.* Efficacy of a mouthrinse based on hydroxyapatite to reduce initial bacterial colonisation in situ. *Arch. Oral Biol.* **80**, 18-26 (2017).
108. Harks, I. *et al.* Impact of the daily use of a microcrystal hydroxyapatite dentifrice on de novo plaque formation and clinical/microbiological parameters of periodontal health. A randomized trial. *PloS one* **11**, e0160142 (2016).
109. Hegazy, S. A. & Salama, I. R. Antiplaque and remineralizing effects of Biorepair mouthwash: A comparative clinical trial. *Pediatr. Dent. J.* **26**, 89-94 (2016).
110. Esteves-Oliveira, M., Meyer-Lueckel, H., Wierichs, R. J., Santos, N. M. & Rodrigues, J. A. Caries-preventive effect of anti-erosive and nano-hydroxyapatite-containing toothpastes in vitro. *Clin. Oral Investig.* (2016).
111. Makeeva, I. M. *et al.* Effect of long term application of toothpaste Apadent Total Care Medical nano-hydroxyapatite. *Stomatologija* **95**, 34-36 (2016).

112. Vyavhare, S., Sharma, D. S. & Kulkarni, V. K. Effect of three different pastes on remineralization of initial enamel lesion: an in vitro study. *J. Clin. Pediatr. Dent.* **39**, 149-160 (2015).
113. Zhang, M. *et al.* Biofilm layers affect the treatment outcomes of NaF and Nano-hydroxyapatite. *J. Dent. Res.* **94**, 602-607 (2015).
114. Nocerino, N. *et al.* Biological activity of lactoferrin-functionalized biomimetic hydroxyapatite nanocrystals. *Int. J. Nanomed.* **9**, 1175-1184 (2014).
115. Brambilla, E., Ionescu, A., Cazzaniga, G., Edefonti, V. & Gagliani, M. The influence of antibacterial toothpastes on in vitro *Streptococcus mutans* biofilm formation: a continuous culture study. *Am. J. Dent.* **27**, 160-166 (2014).
116. Comar, L. P., Souza, B. M., Gracindo, L. F., Buzalaf, M. A. & Magalhaes, A. C. Impact of experimental nano-HAP pastes on bovine enamel and dentin submitted to a pH cycling model. *Braz. Dent. J.* **24**, 273-278 (2013).
117. Hannig, C., Basche, S., Burghardt, T., Al-Ahmad, A. & Hannig, M. Influence of a mouthwash containing hydroxyapatite microclusters on bacterial adherence in situ. *Clin. Oral Investig.* **17**, 805-814 (2013).
118. Palmieri, C., Magi, G., Orsini, G., Putignano, A. & Facinelli, B. Antibiofilm activity of zinc-carbonate hydroxyapatite nanocrystals against *Streptococcus mutans* and mitis group *Streptococci*. *Curr. Microbiol.* **67**, 679-681 (2013).
119. Bikker, F. J., Cukkemane, N., Nazmi, K. & Veerman, E. C. Identification of the hydroxyapatite-binding domain of salivary agglutinin. *Eur. J. Oral Sci.* **121**, 7-12 (2013).
120. Lelli, M. *et al.* Different corrosive effects on hydroxyapatite nanocrystals and amine fluoride-based mouthwashes on dental titanium brackets: a comparative in vitro study. *Int. J. Nanomed.* **8**, 307-314 (2013).
121. Najibfard, K., Ramalingam, K., Chedjieu, I. & Amaechi, B. T. Remineralization of early caries by a nano-hydroxyapatite dentifrice. *J. Clin. Dent.* **22**, 139-143 (2011).
122. Arakawa, T. *et al.* Unique functions of hydroxyapatite with *mutans streptococci* adherence. *Quintessence Int.* **41**, e11-19 (2010).
123. Itthagarun, A., King, N. M. & Cheung, Y.-M. The effect of nano-hydroxyapatite toothpaste on artificial enamel carious lesion progression: an in-vitro pH-cycling study. *Hong Kong Dent. J.* **7**, 61-66 (2010).
124. Huang, S. B., Gao, S. S. & Yu, H. Y. Effect of nano-hydroxyapatite concentration on remineralization of initial enamel lesion in vitro. *Biomed. Mater.* **4**, 034104/034101-034104/034106 (2009).
125. Schaefer, F., Beasley, T. & Abraham, P. In vivo delivery of fluoride and calcium from toothpaste containing 2% hydroxyapatite. *Int. Dent. J.* **59**, 321-324 (2009).
126. Jeong, S. H., Hong, S. J., Choi, C. H. & Kim, B. I. Effect of new dentifrice containing nano-sized carbonated apatite on enamel remineralization. *Key Eng. Mater.* **330-332**, 291-294 (2007).
127. Lu, K., Meng, X., Zhang, J., Li, X. & Zhou, M. Inhibitory effect of synthetic nano-hydroxyapatite on dental caries. *Key Eng. Mater.* **336-338**, 1538-1541 (2007).
128. Lv, K., Zhang, J., Meng, X. & Li, X. Remineralization effect of the nano-HA toothpaste on artificial caries. *Key Eng. Mater.* **330-332**, 267-270 (2007).
129. Jeong, S. H. *et al.* Remineralization potential of new toothpaste containing nano-hydroxyapatite. *Key Eng. Mater.* **309-311**, 537-540 (2006).
130. Onuma, K., Yamagishi, K. & Oyane, A. Nucleation and growth of hydroxyapatite nanocrystals for nondestructive repair of early caries lesions. *J. Cryst. Growth* **282**, 199-207 (2005).
131. Kani, K. *et al.* Effect of apatite-containing dentifrices on dental caries in school children. *J. Dent. Health* **19**, 104-109 (1989).

132. Kani, T. et al. The effect of apatite-containing dentifrices on artificial caries lesions. *J. Dent. Health* **38**, 364-366 (1988).
133. Reynolds, E.C. and Wong, A. Effect of adsorbed protein on hydroxyapatite zeta potential and *Streptococcus mutans* adherence. *Infect. and Imm.* **39**, 1285-1290 (1983).

C. Scientific papers: Enamel, erosion, whitening

134. Bossù M, Matassa R, Relucenti M, Iaculli F, Salucci A, Giorgio G, et al. Morpho-Chemical observations of human deciduous teeth enamel in response to biomimetic toothpastes treatment. *Materials*. 13:1803 (2020).
135. Hojabri, N., Kaisarly, D. & Kunzelmann, K. H. Adhesion and whitening effects of P11-4 self-assembling peptide and HAP suspension on bovine enamel. *Clin. Oral Investig.* Online ahead of print., doi:10.1007/s00784-020-03654-1 (2020).
136. Sarembe, S., Enax, J., Morawietz, M., Kiesow, A. & Meyer, F. In vitro whitening effect of a hydroxyapatite-based oral care gel. *Eur. J. Dent.* **14**, 335-341 (2020).
137. Steinert, S. et al. Whitening effects of a novel oral care gel with biomimetic hydroxyapatite: A 4-week observational pilot study. *Biomimetics* **5**, 65 (2020).
138. Fabritius-Vilpoux, K., Enax, J., Herbig, M., Raabe, D. & Fabritius, H.-O. Quantitative affinity parameters of synthetic hydroxyapatite and enamel surfaces *in vitro*. *Bioinspir. Biomim. Nan.* **8**, 141-153 (2019).
139. Polyakova, M. et al. The effect of fluoride and hydroxyapatite in the composition of toothpastes on the remineralization and acid resistance of enamel. *Hygiene and sanitation* **98**, 885-892 (2019).
140. Bommer, C., Flessa, H.-P., Xu, X. & Kunzelmann, K.-H. Hydroxyapatite and self-assembling peptide matrix for non-oxidizing tooth whitening. *J. Clin. Dent.* **29**, 57-63 (2018).
141. Dundar, A., Sengun, A., Baslak, C. & Kus, M. Effects of citric acid modified with fluoride, nano-hydroxyapatite and casein on eroded enamel. *Arch. Oral Biol.* **93**, 177-186 (2018).
142. Reis, P. Q. et al. Effect of a dentifrice containing nanohydroxyapatite on the roughness, color, lightness, and brightness of dental enamel subjected to a demineralization challenge. *Gen. Dent.* **66**, 66-70 (2018).
143. Suryana, M., Irawan, B. & Soufyan, A. The effects of toothpastes containing theobromine and hydroxyapatite on enamel microhardness after immersion in carbonated drink. *J. Phys.: Conf. Ser.* **1073**, 032010 (2018).
144. Han, M., Li, Q.-L., Cao, Y., Fang, H., Xia, R., Zhang, Z.-H. In vivo remineralization of dentin using an agarose hydrogel biomimetic mineralization system. *Scientific Reports*. **7**:41955 (2017).
145. Nozari, A., Ajami, S., Rafiei, A. & Niazi, E. Impact of nano hydroxyapatite, nano silver fluoride and sodium fluoride varnish on primary teeth enamel remineralization: An in vitro Study. *J. Clin. Diagn. Res.* **11**, Zc97-zc100 (2017).
146. Poggio, C., Gulino, C., Mirando, M., Colombo, M. & Pietrocola, G. Protective effect of zinc-hydroxyapatite toothpastes on enamel erosion: An in vitro study. *J. Clin. Exp. Dent.* **9**, e118-e122 (2017).
147. Singh, A. et al. Evaluation of efficiency of two nanohydroxyapatite remineralizing agents with a hydroxyapatite and a conventional dentifrice: A comparative in vitro study. *J. Indian Orthod. Soc.* **51**, 92-102 (2017).
148. Zaharia, A. et al. Biomimetic chitosan-hydroxyapatite hybrid biocoatings for enamel remineralization. *Ceram. Int.* **43**, 11390-11402 (2017).

149. Ajami, S., Pakshir, H. R., Babanouri, N. Impact of nanohydroxyapatite on enamel surface roughness and color change after orthodontic debonding. *Progress in Orthodontics*, 17:11 (2016).
150. Colombo, M. *et al.* Protective effects of a zinc-hydroxyapatite toothpaste on enamel erosion: SEM study *Ann. Stomatol.* **7**, 38-45 (2016).
151. Kensche, A. *et al.* Influence of calcium phosphate and apatite containing products on enamel erosion. *Scientific World J.* **2016**, 1-12 (2016).
152. Krishnan, V., Bhatia, A. & Varma, H. Development, characterization and comparison of two strontium doped nano hydroxyapatite molecules for enamel repair/regeneration. *Dent. Mater.* **32**, 646-659 (2016).
153. Shaffiey, S. R. & Shaffiey, S. F. Surface enamel remineralization by biomimetic nano hydroxyapatite crystals and fluoride ions effects. *J. Ceram. Process. Res.* **17**, 109-112 (2016).
154. Hill, R. G., Gillam, D. G. & Chen, X. The ability of a nano hydroxyapatite toothpaste and oral rinse containing fluoride to protect enamel during an acid challenge using ¹⁹F solid state NMR spectroscopy. *Mater. Lett.* **156**, 69-71 (2015).
155. Min, J. H., Kwon, H. K. & Kim, B. I. Prevention of dental erosion of a sports drink by nano-sized hydroxyapatite in situ study. *Int. J. Paediatr. Dent.* **25**, 61-69 (2015).
156. Porcelli, H. B., Maeda, F. A., Silva, B. R., Miranda, W. G. J. & Cardoso, P. E. Remineralizing agents: effects on acid-softened enamel. *Gen. Dent.* **63**, 73-76 (2015).
157. Rezvani, M. B. *et al.* Effect of nano-tricalcium phosphate and nanohydroxyapatite on the staining susceptibility of bleached enamel. *Int. Sch. Res. Notices* **2015**, 935264 (2015).
158. Souza, B. M. *et al.* Effect of an experimental paste with hydroxyapatite nanoparticles and fluoride on dental demineralisation and remineralisation in situ. *Caries Res.* **49**, 499-507 (2015).
159. Besinis, A., Noort, R. v. & Martin, N. Remineralization potential of fully demineralized dentin infiltrated with silica and hydroxyapatite nanoparticles. *Dent. Mater.* **30**, 249-262 (2014).
160. Bonetti, G. A., Pazzi, E., Zanarini, M., Marchionni, S. & Checchi, L. The effect of zinc-carbonate hydroxyapatite versus fluoride on enamel surfaces after interproximal reduction. *Scanning* **36**, 356-361 (2014).
161. Lelli, M. *et al.* Remineralization and repair of enamel surface by biomimetic Zn-carbonate hydroxyapatite containing toothpaste: a comparative in vivo study. *Front. Physiol.* **5**, 333 (2014).
162. Lombardini, M., Ceci, M., Colombo, M., Bianchi, S. & Poggio, C. Preventive effect of different toothpastes on enamel erosion: AFM and SEM studies. *Scanning* **36**, 401-410 (2014).
163. Mielczarek, A. & Michalik, J. The effect of nano-hydroxyapatite toothpaste on enamel surface remineralization. An in vitro study. *Am. J. Dent.* **27**, 287-290 (2014).
164. Poggio, C., Lombardini, M., Vigorelli, P., Colombo, M. & Chiesa, M. The role of different toothpastes on preventing dentin erosion: An SEM and AFM study. *Scanning* **36**, 301-310 (2014).
165. Carvalho, F. G. d. *et al.* In vitro effects of nano-hydroxyapatite paste on initial enamel carious lesions. *Pediatr. Dent.* **36**, 85-89 (2014).
166. Gjorgievska, E. S., Nicholson, J. W., Slipper, I. J. & Stevanovic, M. M. Remineralization of demineralized enamel by toothpastes: A scanning electron microscopy, energy dispersive x-ray analysis, and three-dimensional stereo-micrographic study. *Microsc. Microanal.* **19**, 587-595 (2013).

167. Sadiasa, A. et al. Addition of hydroxyapatite to toothpaste and its effect to dentin remineralization. *Han'guk Chaelyo Hakhoechi* **23**, 168-176 (2013).
168. Jin, J., Xu, X., Lai, G. & Kunzelmann, K. H. Efficacy of tooth whitening with different calcium phosphate-based formulations. *Eur. J. Oral Sci.* **121**, 382-388 (2013).
169. Kutsch, V. K., Chaiyabutr, Y. & Milicich, G. Reconsidering remineralization strategies to include nanoparticle hydroxyapatite. *Compend. Contin. Educ. Dent.* **34**, 170-176 (2013).
170. Swarup, J. S. & Rao, A. Enamel surface remineralization: using synthetic nanohydroxyapatite. *Contemp. Clin. Dent.* **3**, 433-436 (2012).
171. Besinis, A., Noort, R. v. & Martin, N. Infiltration of demineralized dentin with silica and hydroxyapatite nanoparticles. *Dent. Mater.* **28**, 1012-1023 (2012).
172. Haghgoo, R., Abbasi, F. & Rezvani, M. B. Evaluation of the effect of nanohydroxyapatite on erosive lesions of the enamel of permanent teeth following exposure to soft beer in vitro. *Sci. Res. Essays* **6**, 5933-5936 (2011).
173. Huang, S., Gao, S., Cheng, L. & Yu, H. Remineralization potential of nano-hydroxyapatite on initial enamel lesions: An in vitro study. *Caries Res.* **45**, 460-468 (2011).
174. Li, L. et al. Bio-inspired enamel repair via Glu-directed assembly of apatite nanoparticles: an approach to biomaterials with optimal characteristics. *Adv. Mater.* **23**, 4695-4701 (2011).
175. Min, J. H., Kwon, H. K. & Kim, B. I. The addition of nano-sized hydroxyapatite to a sports drink to inhibit dental erosion: in vitro study using bovine enamel. *J. Dent.* **39**, 629-635 (2011).
176. Peetsch, A. & Epple, M. Characterization of the solid components of three desensitizing toothpastes and a mouth wash. *Materialwiss. Werkstofftech.* **42**, 131-135 (2011).
177. Tschoppe, P., Zandim, D. L., Martus, P. & Kielbassa, A. M. Enamel and dentine remineralization by nano-hydroxyapatite toothpastes. *J. Dent.* **39**, 430-437 (2011).
178. Poggio, C., Lombardini, M., Colombo, M. & Bianchi, S. Impact of two toothpastes on repairing enamel erosion produced by a soft drink: An AFM in vitro study. *J. Dent.* **38**, 868-874 (2010).
179. Raoufi, S. & Birkhed, D. Effect of whitening toothpastes on tooth staining using two different colour-measuring devices--a 12-week clinical trial. *Int. Dent. J.* **60**, 419-423 (2010).
180. Roveri, N. et al. Surface enamel remineralization: biomimetic apatite nanocrystals and fluoride ions different effects. *J. Nanomater.* (2009).
181. Ryu, S.-C. et al. Regeneration of a micro-scratched tooth enamel layer by nanoscale hydroxyapatite solution. *Bull. Korean Chem. Soc.* **30**, 887-890 (2009).
182. Dabanoglu, A., Wood, C., Garcia-Godoy, F. & Kunzelmann, K. H. Whitening effect and morphological evaluation of hydroxyapatite materials. *Am. J. Dent.* **22**, 23-29 (2009).
183. Hornby, K. et al. Enamel benefits of a new hydroxyapatite containing fluoride toothpaste. *Int. Dent. J.* **59**, 325-331 (2009).
184. Jiang, T. et al. Beneficial effects of hydroxyapatite on enamel subjected to 30% hydrogen peroxide. *J. Dent.* **36**, 907-914 (2008).
185. Li, L. et al. Repair of enamel by using hydroxyapatite nanoparticles as the building blocks. *J. Mater. Chem.* **18**, 4079-4084 (2008).
186. Roveri, N. et al. Synthetic biomimetic carbonate-hydroxyapatite nanocrystals for enamel remineralization. *Adv. Mater. Res.* **47-50**, 821-824 (2008).

187. Park, Y.-D., Kim, J.-H. & Hwang, K.-S. Research about tooth whitening and bacteria sticking capability with using dentifrice including nano-hydroxyapatite, sodium metaphosphate. *Key Eng. Mater.* **330-332**, 283-286 (2007).
188. Kim, B. I. *et al.* Tooth whitening effect of toothpastes containing nano-hydroxyapatite. *Key Eng. Mater.* **309-311**, 541-544 (2006).
189. Yamagishi, K. *et al.* Materials chemistry: a synthetic enamel for rapid tooth repair. *Nature* **433**, 819 (2005).
190. Niwa, M. *et al.* Polishing and whitening properties of toothpaste containing hydroxyapatite. *J. Mater. Sci. Mater. Med.* **12**, 277-281 (2001).
191. Aoki, H. *et al.* Clinical study of teeth whitening properties of toothpastes containing hydroxyapatite. *Bioceram., Proc. Int. Symp. Ceram. Med.* **11**, 575-577 (1998).

D. Scientific papers: Sensitive teeth

192. Amaechi, B. T., Lemke, K. C., Saha, S., Luong, M. N. & Gelfond, J. Clinical efficacy of nanohydroxyapatite-containing toothpaste at relieving dentin hypersensitivity: an 8 weeks randomized control trial. *BDJ Open* **7**, 23 (2021).
193. Seong, J., Newcombe, R. G., Foskett, H. L., Davies, M. & West, N. X. A randomised controlled trial to compare the efficacy of an aluminium lactate/potassium nitrate/hydroxylapatite toothpaste with a control toothpaste for the prevention of dentine hypersensitivity. *J. Dent.*, 103619 (2021).
194. Degli Esposti, L., Ionescu, A. C., Brambilla, E., Tampieri, A. & Iafisco, M. Characterization of a toothpaste containing bioactive hydroxyapatites and in vitro evaluation of its efficacy to remineralize enamel and to occlude dentinal tubules. *Materials* **13** (2020).
195. Ding, P. H. *et al.* Efficacy of nano-carbonate apatite dentifrice in relief from dentine hypersensitivity following non-surgical periodontal therapy: a randomized controlled trial. *BMC oral health* **20**, 170 (2020).
196. Mathew, M. G. *et al.* Efficacy of remineralizing agents to occlude dentinal tubules in primary teeth subjected to dentin hypersensitivity in vitro: SEM study. *J. Family Med. Prim. Care* **9**, 354-358 (2020).
197. Steinert, S. *et al.* Daily application of a toothpaste with biomimetic hydroxyapatite and its subjective impact on dentin hypersensitivity, tooth smoothness, tooth whitening, gum bleeding, and feeling of freshness. *Biomimetics* **5**, 17 (2020).
198. de Melo Alencar, C. *et al.* Clinical efficacy of nano-hydroxyapatite in dentin hypersensitivity: A systematic review and meta-analysis. *J. Dent.* **82**, 11-21 (2019).
199. Ghafournia, M. *et al.* In vitro evaluation of dentin tubule occlusion by three bioactive materials: A scanning electron microscopic study. *Dent. Res. J. (Isfahan)* **16**, 166-171 (2019).
200. Hu, M. L. *et al.* Network meta-analysis on the effect of desensitizing toothpastes on dentine hypersensitivity. *J. Dent.* **88**, 103170 (2019).
201. Pei, D., Meng, Y., Li, Y., Liu, J. & Lu, Y. Influence of nano-hydroxyapatite containing desensitizing toothpastes on the sealing ability of dentinal tubules and bonding performance of self-etch adhesives. *J. Mech. Behav. Biomed. Mater.* **91**, 38-44 (2019).
202. Yuan, P. *et al.* Effect of a dentifrice containing different particle sizes of hydroxyapatite on dentin tubule occlusion and aqueous Cr (VI) sorption. *Int. J. Nanomedicine* **14**, 5243-5256 (2019).

203. Amaechi, B.T., Lemke, K., Saha, S., Gelfond, J. Clinical efficacy in relieving dentin hypersensitivity of nanohydroxyapatite-containing cream: A randomized controlled trial. *Open Dent. J.* **12**, (2018).
204. Hiller, K.-A., Buchalla, W., Grillmeier, I., Neubauer, C. & Schmalz, G. In vitro effects of hydroxyapatite containing toothpastes on dentin permeability after multiple applications and ageing. *Sci. Rep.* **8**, 4888 (2018).
205. Hu, M. L. *et al.* Effect of desensitizing toothpastes on dentine hypersensitivity: A systematic review and meta-analysis. *J. Dent.* **75**, 12-21 (2018).
206. Vano, M. *et al.* Reducing dentine hypersensitivity with nano-hydroxyapatite toothpaste: a double-blind randomized controlled trial. *Clin. Oral Investig.* **22**, 313-320 (2018).
207. Anand, S. *et al.* Comparative evaluation of effect of nano-hydroxyapatite and 8% arginine containing toothpastes in anaging dentin hypersensitivity: Double blind randomized clinical trial. *Acta medica (Hradec Kralove)* **60**, 114-119 (2017).
208. Jena, A., Kala, S. & Shashirekha, G. Comparing the effectiveness of four desensitizing toothpastes on dentinal tubule occlusion: A scanning electron microscope analysis. *J. Conserv. Dent.* **20**, 269-272 (2017).
209. Tempesti, P., Nicotera, G. S., Bonini, M., Fratini, E. & Baglioni, P. Poly(N-isopropylacrylamide)-hydroxyapatite nanocomposites as thermoresponsive filling materials on dentinal surface and tubules. *J. Colloid Interface Sci.* **509**, 123-131 (2018).
210. Oliveira, D. W. D. d. *et al.* Effectiveness of three desensitizing dentifrices on cervical dentin hypersensitivity: A pilot clinical trial. *J. Int. Acad. Periodontol.* **18**, 57-65 (2016).
211. Wang, L. *et al.* Treatment of dentin hypersensitivity using nano-hydroxyapatite pastes: A randomized three-month clinical trial. *Oper. Dent.* (2016).
212. Kulal, R., Jayanti, I., Sambashivaiah, S. & Bilchodmath, S. An In-vitro comparison of nano hydroxyapatite, novamin and proargin desensitizing toothpastes - a SEM study. *J. Clin. Diagn. Res.* **10**, Zc51-zc54 (2016).
213. Amaechi, B. T., Mathews, S. M., Ramalingam, K. & Mensinkai, P. K. Evaluation of nanohydroxyapatite-containing toothpaste for occluding dentin tubules. *Am. J. Dent.* **28**, 33-39 (2015).
214. Amin, M., Mehta, R., Duseja, S. & Desai, K. Evaluation of the efficacy of commercially available nano-hydroxyapatite paste as a desensitizing agent. *Adv. Hum. Biol.* **5**, 34-38 (2015).
215. Farooq, I., I. A. Moheet, I. A. & E. AlShwaimi, E. In vitro dentin tubule occlusion and remineralization competence of various toothpastes. *Arch. Oral Biol.* **60**, 1246-1253 (2015).
216. Genovesi, A. M. *et al.* In vitro comparison of three desensitizing prophylaxis pastes: a morphological analysis. *J. Oral Hyg. Health* **3**, 1000186 (2015).
217. Gopinath, M. M., John, J., Nagappan, N., Prabhu, S. & Kumar, E. S. Evaluation of dentifrice containing nano-hydroxyapatite for dentinal hypersensitivity: A randomized controlled trial. *J. Int. Oral Health.* **7**, 118-122 (2015).
218. Jena, A. & Shashirekha, G. Comparison of efficacy of three different desensitizing agents for in-office relief of dentin hypersensitivity: A 4 weeks clinical study. *J. Conserv. Dent.* **18**, 389-393 (2015).
219. Vano, M., Derchi, G., Barone, A., Genovesi, A. & Covani, U. Tooth bleaching with hydrogen peroxide and nano-hydroxyapatite: a 9-month follow-up randomized clinical trial. *Int. J. Dent. Hyg.* **13**, 301-307 (2015).
220. Hill, R. G., Chen, X. & Gillam, D. G. In vitro ability of a novel nanohydroxyapatite oral rinse to occlude dentine tubules. *Int. J. Dent.* **2015**, 153284 (2015).

221. Arnold, W. H., Prange, M. & Naumova, E. A. Effectiveness of various toothpastes on dentine tubule occlusion. *J. Dent.* **43**, 440-449 (2015).
222. Low, B. S., Allen, E. P. & E. D. Kontogiorgos. Reduction in dental hypersensitivity with nano-hydroxyapatite, potassium nitrate, sodium monofluorophosphate and antioxidants. *Open Dent. J.*, 92-97 (2015).
223. Al-maliky, M. A. *et al.* The effects of CO₂ laser with or without nano-hydroxyapatite paste in the occlusion of dentinal tubules. *Sci. World J.* **2014**, 1-8 (2014).
224. Pinojj, A., Shetty, D., Shetty, S. & Shetty, S. A comparison of clinical efficacy of dentifrices containing calcium sodium phosphosilicate, nanoparticle hydroxyapatite and a dentifrice containing casein phosphopeptide amorphous calcium phosphate on dentinal hypersensitivity - a comparative triple blind randomized study. *Adv. Hum. Biol.* **4**, 57-64 (2014).
225. Vano, M., Derch, G., Barone, A. & Covani, U. Effectiveness of nano-hydroxyapatite toothpaste in reducing dentin hypersensitivity: a double-blind randomized controlled trial. *Quintessence Int.* **45**, 703-711 (2014).
226. VJ, N. & Thakur, S. An in-vivo comparative study of the efficacy of propolis, nano-hydroxyapatite and potassium nitrate containing desensitizing agents. *Research and Reviews: Journal of Dental Sciences* **2**, 113-118 (2014).
227. Wang, R. *et al.* Enhancement of nano-hydroxyapatite bonding to dentin through a collagen/calcium dual-affinitive peptide for dentinal tubule occlusion. *J. Biomater. Appl.* **29**, 268-277 (2014).
228. Orsini, G. *et al.* A 3-day randomized clinical trial to investigate the desensitizing properties of three dentifrices. *J. Periodontol.* **84**, 65-73 (2013).
229. Verma, P., Gupta, U., Dodwad, V., Kukreja, B. J. & Arora, K. Evaluation of the clinical efficacy of a new desensitizing tooth paste containing nano-crystalline hydroxyapatite in dentine hypersensitivity patients: A double blind randomized controlled clinical trial. *J. Dent. Specialities* **1**, 47-54 (2013).
230. Browning, W. D., Cho, S. D. & Deschepper, E. J. Effect of a nano-hydroxyapatite paste on bleaching-related tooth sensitivity. *J. Esthet. Restor. Dent.* **24**, 268-276 (2012).
231. Yuan, P. *et al.* Effects of dentifrice containing hydroxyapatite on dentinal tubule occlusion and aqueous hexavalent chromium cations sorption: a preliminary study. *PloS one* **7**, e45283 (2012).
232. Orsini, G. *et al.* A double-blind randomized-controlled trial comparing the desensitizing efficacy of a new dentifrice containing carbonate/hydroxyapatite nanocrystals and a sodium fluoride/potassium nitrate dentifrice. *J. Clin. Periodontol.* **37**, 510-517 (2010).
233. Shetty, S., Kohad, R. & Yeltiwar, R. Hydroxyapatite as an in-office agent for tooth hypersensitivity: a clinical and scanning electron microscopic study. *J. Periodontol.* **81**, 1781-1789 (2010).
234. Kim, S.-H. *et al.* The clinical effects of a hydroxyapatite containing toothpaste for dentine hypersensitivity. *J. Korean Acad. Periodontol.* **39**, 87-94 (2009).
235. Lee, S. Y., Kwon, H. K. & Kim, B. I. Effect of dentinal tubule occlusion by dentifrice containing nano-carbonate apatite. *J. Oral Rehabil.* **35**, 847-853 (2008).
236. Rimondini, L. *et al.* The remineralizing effect of carbonate-hydroxyapatite nanocrystals on dentine. *Mater. Sci. Forum* **539-543**, 602-605 (2007).
237. Hüttemann, R. W. & Dönges, H. Untersuchungen zur Therapie überempfindlicher Zahnhälse mit Hydroxylapatit. *Dtsch. Zahnärztl. Z.* **42**, 486-488 (1987).