**More detailed Table 1 for supplementary informations (S2 Table)**

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| --- | --- | --- | --- | --- | --- |
| **Authors****Year** | **Microorganisms** | **Planktonic****Or****Biofilm**  | **Light source** | **Irradiation parameters (output power/intensity, wavelength, applied energy/irradiation time)** | **Main outcomes**  |
| **Bumah *et al.*, 2015 [49]\*** | *MRSA* | Planktonic | LED | - 30 mW/cm²- 470nm- 55 J/cm², 110 J/cm², 165 J/cm², 220 J/cm² | - 5x106 cells/ml: 55 J/cm² resulted in 92% inactivation, - 7x106 cells/mL: 86% for 110 J/cm² - total suppression for 220 J/cm² for both concentrations  |
| **Bumah *et al.*, 2015 [50]\*** | *MRSA* | Planktonic | LED | - 100 mW/cm²- 405 and 470 nm- 1 to 60 J/cm² | - 100% of *MRSA*-colonies (3x106 cells/ml) suppressed by single exposure to 55 or 60 J/cm² of 470 nm light; double treatment of 405nm light with a 6 hours interval at 50, 55 or 60 J/cm² resulted in same result- double treatment with 6 hours interval in between (5x106 CFU/ml) with 50, 55 or 60 J/cm²: complete bacterial suppression. - 7x106 CFU/ml: either once with 220 J/cm² of 470nm blue light or twice with 220 J/cm² using 405 nm blue light- for denser bacterial concentrations repeated illumination necessary for complete bacterial growth suppression, especially in the case of lower doses |
| Chebath-Taub *et al.*, 2012 [54] | *S. mutans* | Biofilm |  | - 1,1 W/cm²- 400 – 500 nm68 – 680 J/cm² | - significant decrease in bacterial viability after 6 hours of reorganisation- amount of dead bacteria increased compared to the situation before irradiation- blue light might have a delayed antibacterial influence although there was no effect upon capability of reforming new biofilm.  |
| **Cieplik *et al.*, 2014 [11]\*** | *A actinomycetem-comitans (Aa), E coli* | Planktonic | LED light curing unit | - 1360±50 mW/cm²- 460 nm- 25, 50, 120 J/cm² | - inactivation >5log10 for *Aa* (120 J/cm²)- no effect for *E coli*- different flavins and prophyrins in *Aa* |
| Cohen-Benneron et al, 2016 [55] | *S. mutans* | Biofilm  | LED | - 0,62 W/cm²- 460 – 480 nm- 37, 112 and 262 J/cm² | - tests concerning pathogenicity of new formed biofilms by bacteria from dispersed biofilms- Although bacterial total growth increased in regrown biofilms, amount of dead bacteria outweighed; polysaccharide production decreased- Regrown biofilms after illumination showed less acidogenicity as well as lower aciduricity |
| De Sousa *et al.*, 2015 [39] | *E. coli, P. aeruginosa, S. aureus* | Planktonic  | Laser | - 70 mW- 450 nm- 6 J/cm², 12 J/cm², 18 J/cm², 24 J/cm² | - Inhibition of growth at fluences higher than 6 J/cm²- S. aureus: CFUs 2.39 log10 when not irradiated, 1,86 log10 CFUs in the case of irradiation ( 6 J/cm²)- higher fluences (12, 18, 24 J/cm²), no higher inhibition rates detected- inhibition of *S. aureus* higher compared to *P. aeruginosa* and *E. coli*.  |
| De Sousa *et al.*, 2015 [57] | *S. mutans* | Biofilm | Non-coherent blue light (Lumacare) | - 99,5 mW/cm²- 420nm blue-light- 72 J/cm²; | - Bacterial viability, dry-weight and intra- and extracellular polysaccharides (IPS and EPS) were measured- CHX and NaCl as controls- CFU reduced to the highest amount in the CHX-group (around 4 log10-steps)- only minimal reduction when irradiated with blue light (around 1 log10-step)- Reduction of insoluble EPS highly affected by twice-daily blue light-irradiation, suggesting that this might be a proper treatment modality in prevention of biofilm-development |
| De Sousa *et al.*, 2016 [45] | *S. aureus, E. coli, P. aeruginosa*  | Planktonic | Laser | - 30 mW (660 nm), 30 mW (830 nm), 40 mW (904 nm)- 660 nm, 830 nm, 904 nm- 3 J/cm², 6 J/cm², 12 J/cm², 18 J/cm²,, 24 J/cm² | - Inhibition of growth observed for fluences higher than 12 J/cm²- At of 24 J/cm² (660nm red light), inhibition rate was nearly 80% for S. aureus- Red light more effective than infrared light. - *S. aureus* more susceptible to irradiation with all tested wavelength with all fluences than *P. aeruginosa* and *E. coli*. |
| Enwemeka *et al.*, 2008 [48] | *MRSA* | Planktonic | SLD | - 100 mW/cm²- 390-410 nm (405nm peak)- 1 to 60 J/cm² | . Maximum eradication achieved applying light for 9.2 or 8,4 minutes - 55 J/cm² resulted in nearly 90% eradication.  |
| Enwemeka *et al.*, 2009 [47] | *MRSA* (two strains) | Planktonic  | SLD | - 30 mW/cm²- 470 nm- 1 to 60 J/cm² | - At 3 J/cm², nearly 30% of both strains were killed. - 55 J/cm² killed more than 90% of both strains. |
| Feuerstein *et al.*, 2005 [26] | *P. gingivalis, F. nucleatum* | Planktonic | Two halogen lamps, xenon light source, LED | - 260 and 416 mW/cm² (halogen), 520 mW/cm² (LED), 1144 mW/cm² (xenon)- 400-500nm (halogen), 450-498nm (LED), 450-490nm (xenon)- 31, 47, 62, 78, 94 J/cm² (LED); xenon and halogen only for experiments with scavangers | - no significant reduction under anaerobic conditions- significant reduction under aerobic conditions: nearly complete killing for illumination for 2.5 and 3 minutes with LED (P. gingivalis)- Effect for *F. nucleatum* smaller compared to *P. gingivalis* - only partial protection of phototoxicity in presence of scavangers due toinefficient access into the cell, but results show, that inactivation might be due to photodynamic processes- no phototoxic effect anaerobic conditions 🡪 oxygen is necessary  |
| Feuerstein et. Al, 2004 [25] | *P. gingivalis, F. nucleatum, S. faecalis, S. mutans* | Planktonic  | Two halogen lamps, xenon light source, LED | - 260 and 416 mW/cm² (halogen), 520 mW/cm² (LED), 1144 mW/cm² (xenon)- 400-500 nm (halogen), 450-480 nm (LED), 450-49 0nm (xenon)- 16-75 J/cm² (halogen), 31-94 J/cm² (LED), 69-206 J/cm² (xenon) | - less survival when irradiation of bacteria on agar plates compared to bacteria in suspension- nearly no survival for 2,5 minutes with halogen lamp 2 on agar, whereas survival rate of 40% when performed in suspension-higher inactivation rates for *P. gingivalis* compared to *F. nucleatum* (99.6% for 1 minute with plasma arc)- minimal fluence required for inhibiting bacterial lawn from growing into biofilm (MID) 16-62 J/cm² for *P. gingivalis* and *F. nucleatum*- MID for *S. mutans* and *S. faecalis* 159-212 J/cm² |
| Fontana *et al.*, 2015 [27] | F. nucleatum ss. nucleatum, F. nucleatum ss. polymorphum, F. nucleatum ss. vincentii, F. periodonticum, P. gingivalis, P. intermedia, P. nigrescens, P. melanogenica | Planktonic | LED | - 80mW/cm²- 455 nm - 4.8 J/cm². | - . Survival fractions * 53,1% *F. nucleatum ss nucleatum*
* 33,4% *F. nucleatum ss peridonticum*
* 32,6% *F. nucleatum ss vincentii*
* 6,4% *F. nucleatum ss polymorphium*
* *79,7% P. gingivalis*
* 46.2% for *P intermedia*,
* 32.5% for *P nigrescens*
* 21.3% for *P melanogenica*

- 80-200 times higher amounts of endogenous porphyrins for Prevotella species compared to Fusobacterium species |
| Fukui *et al.*, 2008 [33] | *P. gingivalis* | Planktonic | Okazaki large spectrograph | - 50-400 mW/cm²- 400-700nm (10 nm steps)- 15 J/cm² | - Significant inhibition of *P. gingivalis* between 400 and 410nm - no significant growth inhibition at wavelengths longer than 500nm. - irradiation using 400-410nm light for 38 seconds at 400 mW/cm² resulted in more than 75%  |
| Ghate *et al.*, 2013 [53] | *S. aureus, E. coli, S. typhimurium, L. monocytogens* | Planktonic  | LED | - 16 mW/cm²(521 nm), 22.1 mW/cm²(461 nm), 25.4 mW/cm² (624 nm)- 461 nm, 521 nm, 624 nm- 597 J/cm² (461 nm), 432 J/cm² (521 nm), 686 J/cm² (624 nm) | - approximately 5log10-inactivation observed using 461nm light at 10 and 15°C- inactivation rates for 521nm light only 1,0-2,0 log10-steps - no antibacterial effect for 642nm  |
| Gomez et al, 2016 [56] | *S. mutans*  | Biofilm  | Xenon arc lamp | - 13 mW/cm²- 380 – 440 nm (405 nm peak)- 9,26 J/cm² | - Biofilms grown either in Tryptic Soy Broth (TSB) or in TSB containing 1% sucrose (TSBS)- Percentage of bacteria killed was 70% in case of biofilm grown in TSB and 50% in case of biofilm grown in TSBS - addition of sucrose leads to more resistant biofilms- killing of bacteria not only depends on the microorganism by itself, but also on other factors |
| Guffey *et al.*, 2006 [42] | *S. aureus, P. aeruginosa, P. acnes* | Planktonic | SLD | - 160 mW (405 nm), 170 mW (470 nm)- 405 nm and 470 nm - 1, 3, 5, 10 and 15 J/cm² | - 405nm light killed *S. aureus* at all the tested doses- 470nm effect only at 10 and 15 J/cm² for S. aureus( 62% of killing at 15 J/cm²) - Irradiation of *P. aeruginosa* resulted in higher inactivation rates at all doses (95.1% maximum killing rate for 405nm, 96.5% for 470nm) - no bactericidal effect with *anaerobic P. acnes* |
| Henry *et al.*, 1995 [29] | *Prevotella and Porphyromonas strains* | Planktonic | Argon Laser | - 0,58 W- 488-514nm- 20-200 J/cm² | - argon laser able to inactivate different *Prevotella* and *Porphyromonas* strains- MID for *Prevotella* and *Poprhyromonas* strains 20-50 J/cm² (minimal inhibitory dose for inhibition of biofilm growth)- not primarily protoporphyrin IX content inside the microorganism but rather oxygen in the environment required- Replacement of hemin against haemoglobin in inoculation medium lead to lower inactivation rates.- Black-pigmented bacteria (Prevotella and Porphyromonas species) most susceptible to visible-light irradiation, while non-black-pigmented bacteria were much less sensitive. |
| Henry *et al.*, 1996 [30] | *Prevotella and Porphyromonas strains, Bacillus Candida, Enterobacter, Proteus, Psuedomonas, Staphylococcus and Streptococcus* | Biofilm | Argon laser  | - 0,58 W- 488-514 nm- 35 – 80 J/cm² | - Fluences of 35 to 80 J/cm² inhibited biofilm growth of *Pr. denticola, Pr. intermedia, Pr. melaninogenica* and *Pr. nigrescensas* and growth of different Porphyromonas strains- no effect for *Bacillus Candida, Enterobacter, Proteus, Psuedomonas, Staphylococcus* and *Streptococcus* for 70 J/cm²- Biofilm age, presence of atmospheric oxygen, medium used for bacterial inoculation etc. crucial parameters level of inactivation.  |
| Hope *et al.*, 2013 [31] | *P. gingivalis, E. faecalis* | Planktonic  | Toothcare device, laser pointer | - 3,2 mW for toothcare device, 42,7 mW for laser pointers- 405nm- 0,34 J/cm², 0,68 J/cm², 3,42 J/cm² (toothcare); 9,86 J/cm², 19,71 J/cm² and 98,55 J/cm² (laser pointer) | - 0,34 J/cm² with toothcare device: killing rate of 63,41% for P gingivalis- killing rate at 3,42 J/cm² 94,11% for P gingivalis with toothcare device- laser pointer: 90.21% for 9,86 J/cm², 94.50% for 98,55 J/cm²- no effect for E. faecalis  |
| **Hope *et al.*, 2016 [38]\*** | *P. intermedia, P. nigrescens, S. aureus, E. coli, E. faecalis* | Planktonic  | LED, laser | - 19,1 mW/cm² (LED), 346,2 mW/cm² (laser)- 405 nm-1,7 J/cm², 3,5 J/cm², 10,3 J/cm², 20,6 J/cm² (laser); 0,19 J/cm², 0,57 J/cm², 1,14 J/cm², 5,7 J/cm² (LED)) | - *P nigrescens*: 64.1% killing rate for 30 seconds, 94.26% for 300 seconds (LED)- *P intermedia*: 75.62% killing rate for 10 seconds, 96.51% for 60 seconds, 99.75% for 300 seconds (LED)- P. intermedia 99.56% killed after 5 seconds, 99,996% after 60 seconds (laser)- Higher inactivation rates for laser might be due to the much higher output power - control organisms: only *S aureus* statistically significant effect (36,73% after 300 seconds) |
| Imamura *et al.*, 2014 [37] | *P. intermedia, P gingivalis, E coli, C. albicans* | Planktonic  | laser | - 0.05 W, 0.1 W, 0,15 W, 0,2 W- 405 nm- 1,5 J, 3 J, 4,5 J, 6 J | - Inhibition rates for P. intermedia and P. gingivalis similar- 40% for 0.05 W, ~70% for 0.1 W, and ~80% for 0.15 W and 0.2 W for *P. intermedia*- 50% for 0,1 W and 0,15 W, 60% for 0,2 W for *P. gingivalis* - no effect for suspensions of *E. faecalis*- effect on *C. albicans* for times>600 seconds |
| Izzo *et al.*, 2004 [35] | *P. gingivalis* | Planktonic | two different LEDs  | - 125 mW (625±20nm), 197 mW (455±20nm)- 455±20nm and 625±20nm- 1,5 kJ/cm² (455±20nm) or 978 J/cm² (625±20nm) | - Temperature under irradiation 39-40°C for blue light and 41-42.5°C for red light. - Experiments suggested that temperature increase was responsible for suppression of *P. gingivalis* and not phototoxic effect - - 45°C were cidal for P. gingivlais. |
| Kim *et al.*, 2013 [28] | *P. gingivalis, S. aureus, E. coli* | Planktonic | LED | - 6 mW/cm²/h- 425 nm, 525 nm, 625 nm- 0, 8, 12 and 24 hours/ 21,6 J, 43,2 J, 86,4 J, 172,8 J | - 425 nm had the strongest effect followed by 525 nm- 625 nm light showed no effect - especially *P. gingivalis* and *E. coli* killed by 425nm light- *S. aureus* growth suppressed using 525 nm light |
| König *et al.*, 2000 [23] | *A odontolyticus, P acnes, P gingivalis, S mutans*, wild type germs (patient isolates) | Planktonic  | Helium-neon laser  | - 60 mW- 632,8 nm- 360 J/cm² | Survival rates:- 3±4% for *A odontoylticus*;- 58±10% for *P acnes*;- 50±10% for *P. gingivalis*; - no effect for *S. mutans*- survival rates in patient probes 45±5% for anaerobic and 41±6% for aerobic species- PPIX for *A odontolyticus* and *P acnes* |
| **Kotoku *et al.*, 2009 [34]\*** | *P. gingivalis* | Planktonic | LED | - 200-800 mW/cm²- 405 nm- 2.0-16,0 J/cm² | - 4.0 J/cm²: growth inhibition of more than 97%- 16.0 J/cm² (20 seconds of irradiation): complete eradication of *P. gingivalis*- higher output powers resulted in higher inactivation rates: 400mW for 5 seconds resulted in significant higher inactivation rates than 200mW for 10 seconds |
| Lipovsky *et al.*, 2009 [46] | *S. aureus strains (one methicillin-resistant, one methicillin-sensitive)* | Planktonic  | Halogen lamp | - 300 mW/cm²- 400 - 800 nm (white light) - 18-180 J/cm² | - methicillin-sensitive strain more susceptible to white light irradiation than the methicillin-resistant strain (maximum inactivation rate of 99.8% at a fluence of 180 J/cm² in contrast to 55.5%)- higher hydroxyl and superoxide radical production and porphyrin synthesis for methicillin-sensitive strain- resistant strain able to adapt to oxidative stress to a higher extent; caritinoid production higher for resistant strains |
| MacKenzie *et al.*, 2013 [52] | *S. aureus, L. monocytogenes, P. aeruginosa* | Biofilm | LED | - 141 mW/cm²- 405 nm- 42 – 504 J/cm² | - Inactivation rates for *S. aureus* 0. 0.61, 1.87, 2.75 log10-steps for 0, 5, 10 and 20 minutes - Most rapid and effective inactivation for *E. coli* monolayer biofilms (3.55log10-reduction for 20 minutes)- mixed-species biofilms formed by strains of *S. aureus* and *E. coli*: 2.19 log10-reduction (total viable counts) for 30 minutes  |
| **MacLean *et al.*, 2008 [40]\*** | *S. aueus, MRSA, E. coli* | Planktonic | Xenon light source | - 350 mW/cm²- 400 nm longwave pass filter- 630 J/cm² (maximum) | - 5-log10-reduction at a total dose of 630 J/cm² (30 minutes)- no effects for wavelengths longer than 430nm- Maximum reduction observed at 405nm at a total dose of 23,5 J/cm² (2,4log10-steps)- similar results for S. aureus and MRSA- nearly no effect for E. coli |
| **MacLean *et al.*, 2009 [41]\*** | *S. aureus, MRSA, S. pyogenes, E. faecalis, C. perfringens, A. baumanii, P. aeruginosa, E. coli, P. vulgaris, K. pneumoniae*  | Planktonic  | LED | - 10 mW/cm²- 405 nm- 36 - 54 J | approximately 5 log10 reduction following irradiations between 60 and 90 minutes- 5 log10-steps for *S. pyogenes* for 54 J/cm²- lower doses required for gram-positive bacteria, with the exception of *E. faecalis*, which was least susceptible to irradiation |
| Masson-Meyers et al, 2015 [51] | *MRSA* | Planktonic | LED, Laser | - 100 mW/cm² (LED), 135 mW/cm² (laser)- 390-420 nm (405 nm peak) (LED); 405 nm (laser- 40 J/cm², 54 J/cm², 81 J/cm², 121 J/cm² (LED and laser) | - significant growth suppression for each fluence for both light sources with no statistical difference for LED and laser in 35 of the 36 experimental trials- Irradiation in two or three intervals increased bacterial suppression- 54 J/cm² triple irradiation with laser (intervals of 15 minutes)- 405nm light antimicrobial against *MRSA*, regardless if using LED or laser light |
| **Song *et al.*, 2013 [24]\*** | *Aa, F. nucleatum, P. gingivalis* | Planktonic and biofilm | Halogen lamp | - 500 mW/cm²- 400-520 nm- 15,30,60,90,120 s/0,75 J/cm², 1,5 J/cm², 3 J/cm², 4,5 J/cm², 6 J/cm² | *-* no effect for *Aa* neither in planktonic nor in biofilm-state-100% killing for 15 seconds in the case of *P. gingivalis*- 99,1% for 60 seconds in the case of F nulceatum- effect in biofilm-state statistically significant only for *P. gingivalis*.  |
| **Soukos *et al.*, 2005 [32]\*** | *P. intermedia, P. nigrescens, P. melanogenica), P. gingivalis, S. constellatus,* | Planktonic  | Halogen lamp | - 70 mW/cm²- 380-520nm- 0-42 J/cm² | - Survival fractions for *P. gingivalis* were 77.25% (4,2 J/cm²), 12.55% (21 J/cm²) and 1.48% (42 J/cm²)- 1 minute of irradiation (4.2 J/cm²) resulted in complete killing of *P intermedia* and *P nigrescens*, while *P melanogenica* was reduced by 70%.- 100% killing for *P. melanogenica* after 5 minutes (21 J/cm²)- no effect for *S. constellatus*- HPLC analysis showed different endogenous porphyrins for *Prevotella* strains |

**\*** In these studies a reduction of 3log10–steps or more (antibacterial effect [22]) was achieved. Details are presented in Table 2.