

Microbiologic effects of irrigation using functional waters (the strongly acidic electrolyzed water and the strongly alkaline electrolyzed water) in peri-implant sulcus

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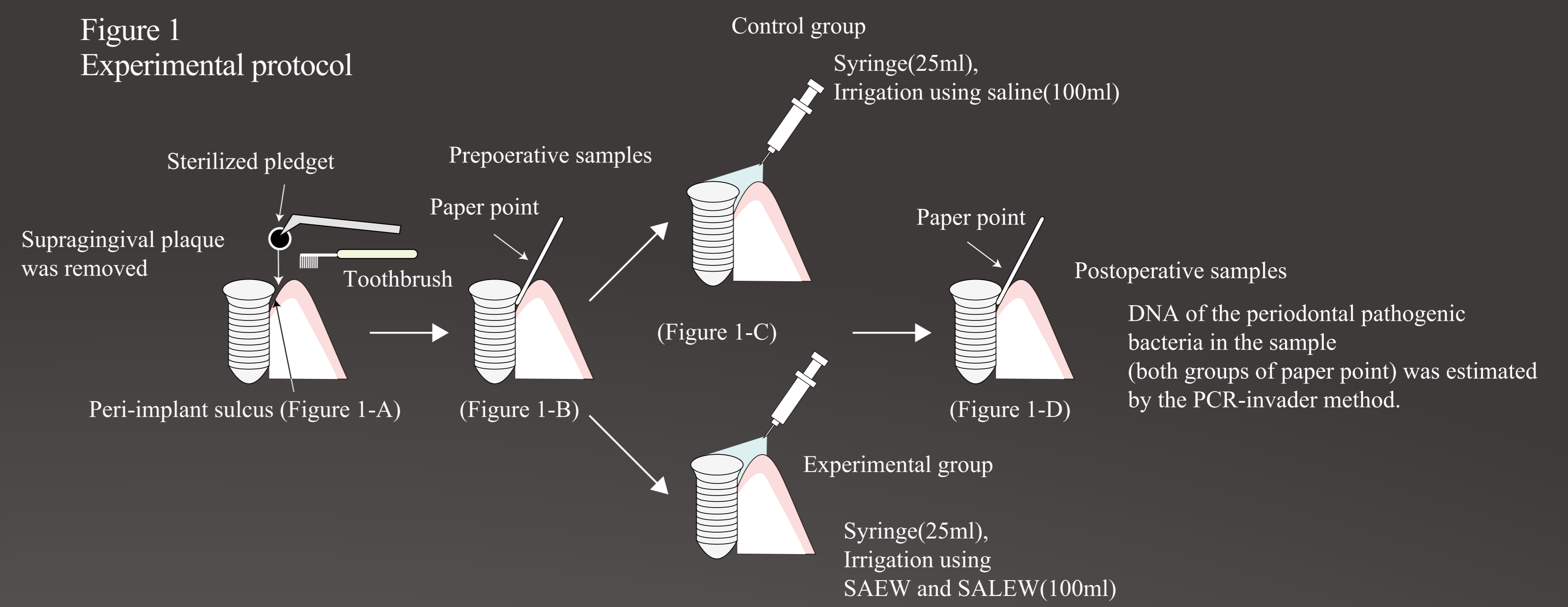


I Purpose :

Peri-implant mucosa does not have connective tissue adhesion with implants and its epithelial attachment is weaker than that of natural teeth and therefore deep epithelial proliferation around implants easily occurs¹. Recently, the excellent sterilization potential and irrigation power of functional waters {the strongly acidic electrolyzed water(SAEW) and the strongly alkaline electrolyzed water(SALEW)} has gotten a lot of attention and its use is widely increasing^{2,3,4}. The purpose of this study was to investigate the existence of periodontal pathogenic bacteria in peri-implant sulcus and effects of irrigation by functional waters (Table 1).

Specialized electrolysis processing (0.05% NaCl solution) High disinfection effect of high oxidoreduction potential (ORP) (pH 2.7, ORP 1100mV)		
Broad antibacterial spectrum	Strong virucidal effect (including HIV, HBV)	Reasonably cheap (240L/S only)
No allergy No side effect No residue	Maintains high safety level No resistant bacteria	Environment friendly

Figure 1 Experimental protocol



II Material and method :

17 subjects treated with implant therapy for single tooth gaps were included in this study, and randomly assigned to the experimental group and the control group. The experimental group consisted of 10 subjects (age 57±13) and the control group consisted of seven subject (age 69±7) (Table 2,3). Supragingival plaque on implants was removed with sterilized pledget and toothbrush and paper points were inserted at the deepest site of the peri-implant sulcus(Figure 1-A). These paper points were used as preoperative samples(Figure 1-B). Next, the sulcus was washed with the functional water (100ml) in the experimental group, meanwhile the sterilized saline water (100ml) was applied in the control group(Figure 1-C). Further, paper points were inserted at the same site and used as postoperative samples(Figure 1-D). The functional water was generated with three cylinder-type electrolyte lonize water device {PH2.7(SAEW), PH11~12(SALEW),density of effective chlorine;30ppm}(Figure 2) . DNA of the periodontal pathogenic bacteria in the samples was estimated by the PCR-invader method{PRISM 7900 Sequence Detection System (A.Applied.Biosystems)}. Investigated periodontal pathogenic bacteria were *Aggregatibacter actinomycetemcomitans (Aa)*, *Porphyromonas gingivalis (Pg)*, *Tannerella forsythensis (Tf)* and *Treponema denticola (Td)*. The study design was approved by the dental ethics committee of the general implant research center and informed consent was obtained from each subjects.

Table 2 Experimental group (Using strong alkaline electrolyzed water, strong acid electrolyzed water)

Subject	Age	Sex	Site	The average period of function (month)	Implant	Perio-test Value	Probing depth (mm)	L	B	D	Bone resorption (mm)
A	69	male	36	41	Straumann SLA WN10mm	-5	5	5	3	2	4
B	55	female	14	3	Straumann SLA BL RC10mm	-2	3	5	3	3	0
C	44	female	12	42	Straumann SLA RN3.3 12mm	1	3	2	1	1	1
D	57	female	22	53	Straumann SLA RN3.3 12mm	-2	2	1	2	3	2
E	63	female	36	39	Straumann SLA WN10mm	-4	4	2	4	4	3
F	61	male	36	120	Straumann SLA WN10mm	-4	1	1	1	3	1
G	77	female	15	9	Straumann SLA RN4.1 12mm	-6	4	3	3	2	1
H	64	male	17	94	Straumann SLA WN10mm	-5	4	3	3	4	2
I	48	female	22	15	Straumann BL RC4.1 10mm	-4	3	4	4	4	0
J	32	female	25	9	Straumann SLA RN4.1 10mm	-3	1	1	1	1	0

♂: three ♀: seven
Average age : 57±13
The average period of function : 42.5±38.5 months

Table 3 Control group (Using sterilized saline)

Subject	Age	Sex	Site	The average period of function (month)	Implant	Perio-test Value	Probing depth (mm)	L	D	B	Bone resorption (mm)
K	67	male	36	22	Straumann SLA WN10mm	-5	2	3	1	1	0
L	60	female	35	60	Straumann SLA WN10mm	-5	4	2	3	2	1
M	83	female	35	76	Straumann SLA RN4.1 10mm	-4	3	2	3	3	1
N	67	female	24	59	Straumann SLA RN4.1 10mm	-4	2	1	2	1	1
O	68	male	24	41	Straumann SLA RN4.1 10mm	-5	1	1	1	1	1
P	64	female	24	43	Straumann SLA RN4.1 10mm	1	1	1	1	1	0
Q	75	male	36	76	Straumann SLA WN10mm	-3	2	1	1	2	2

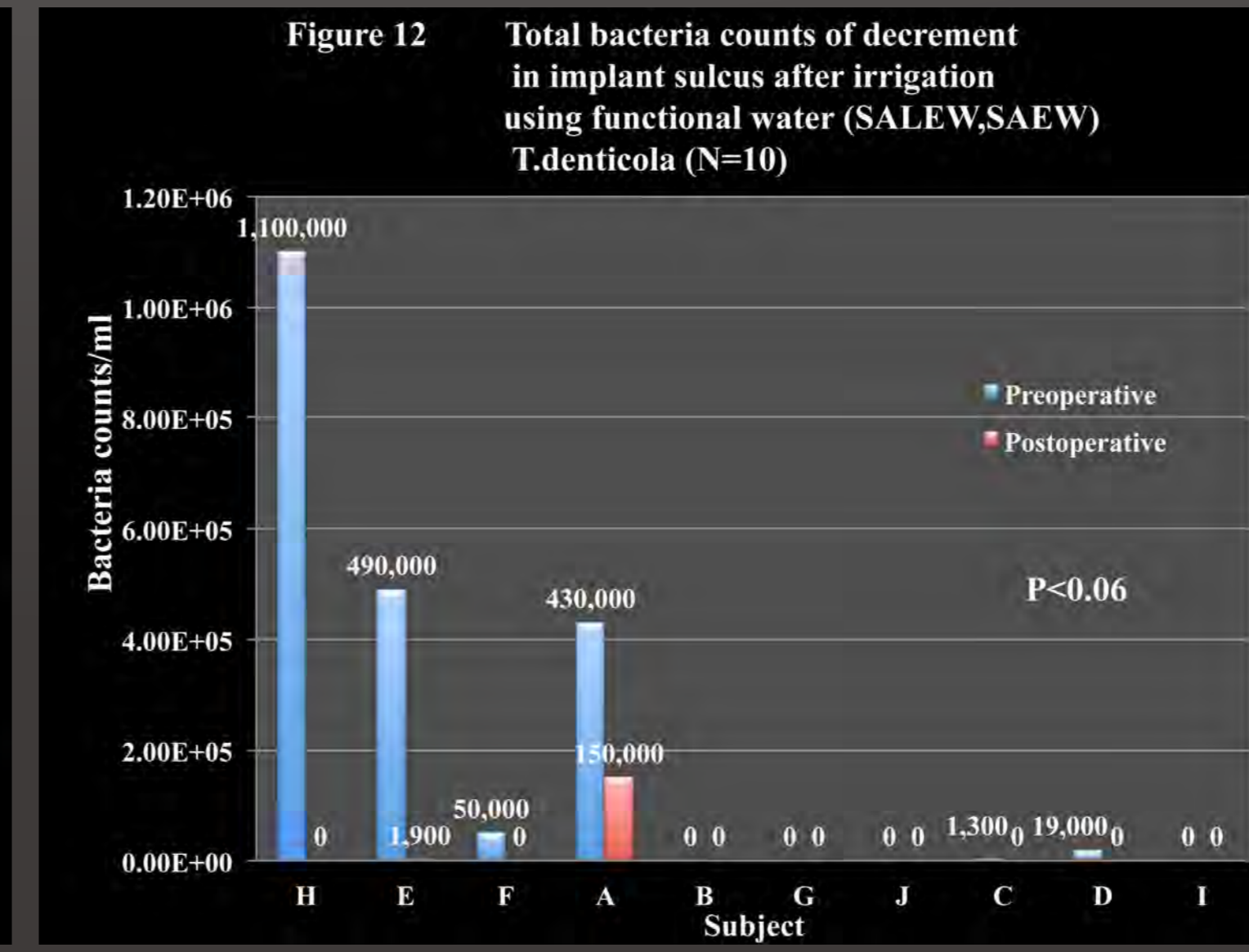
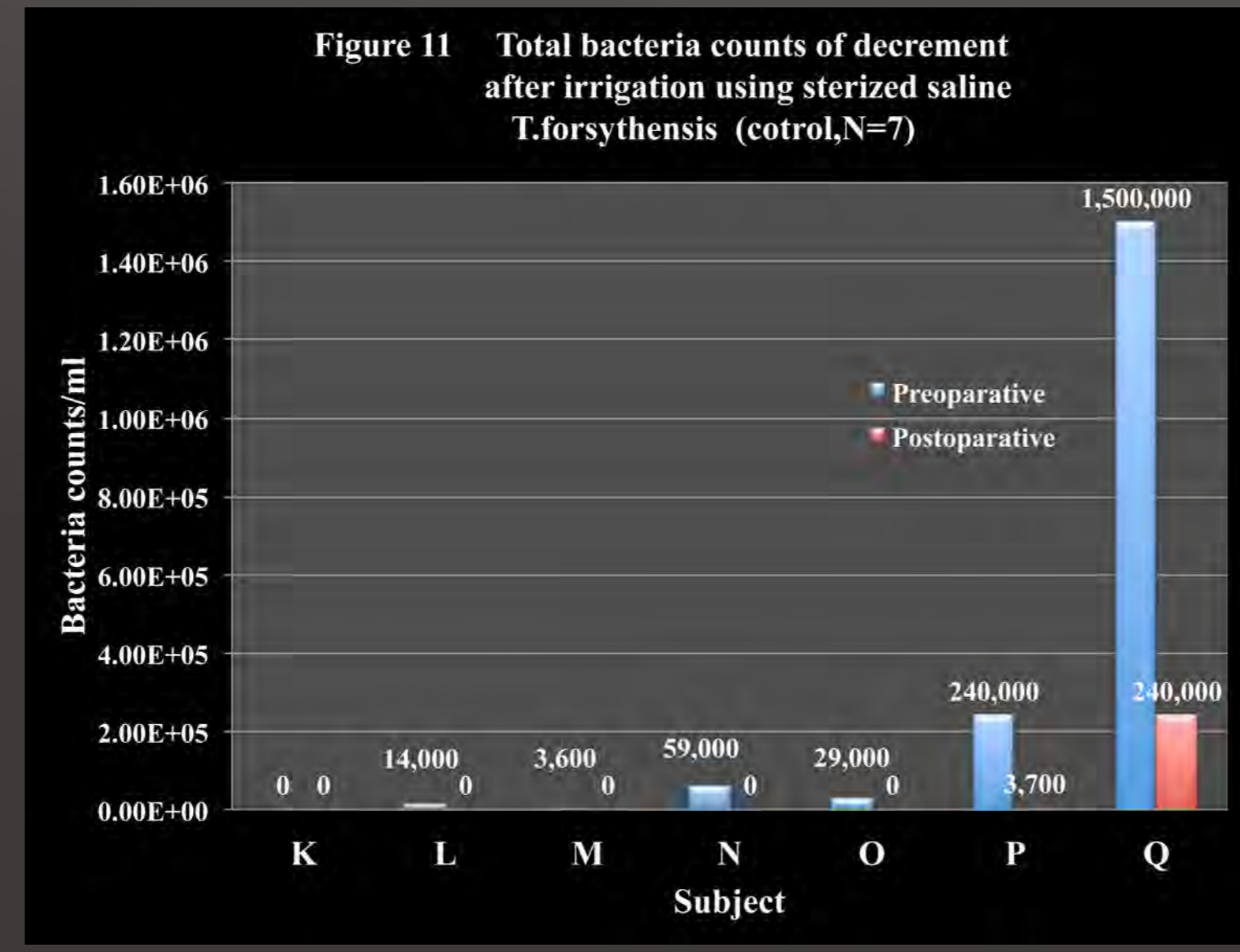
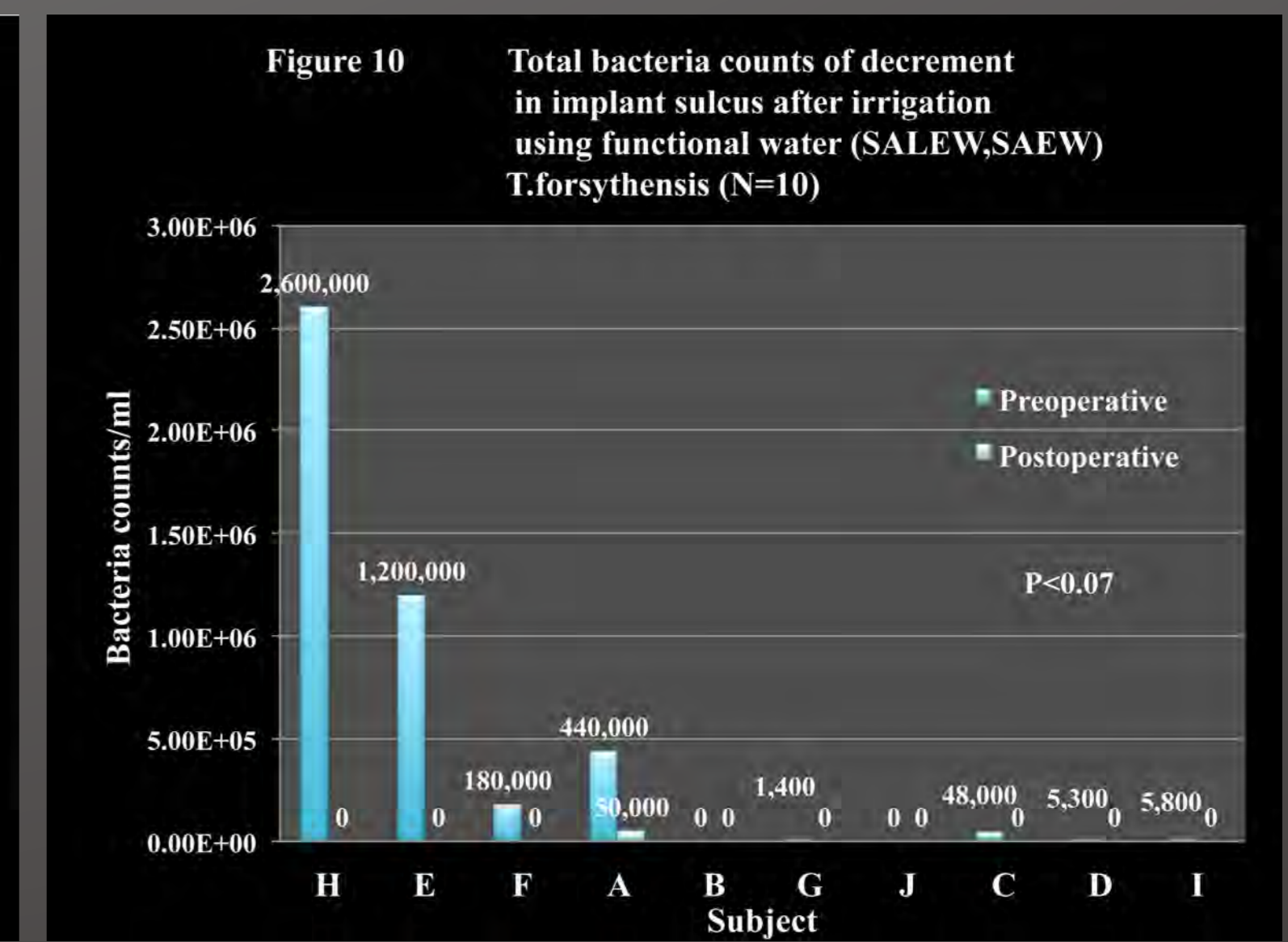
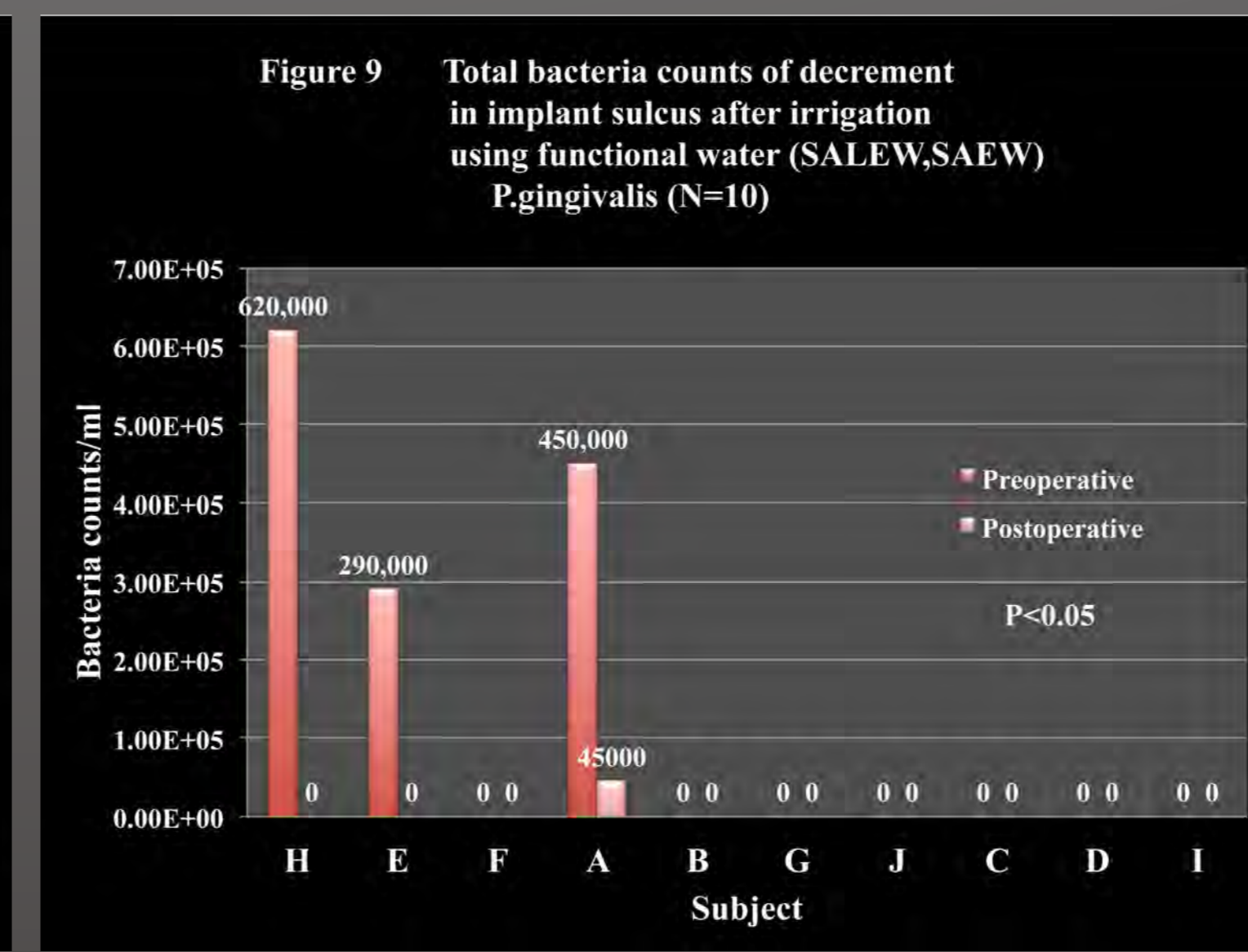
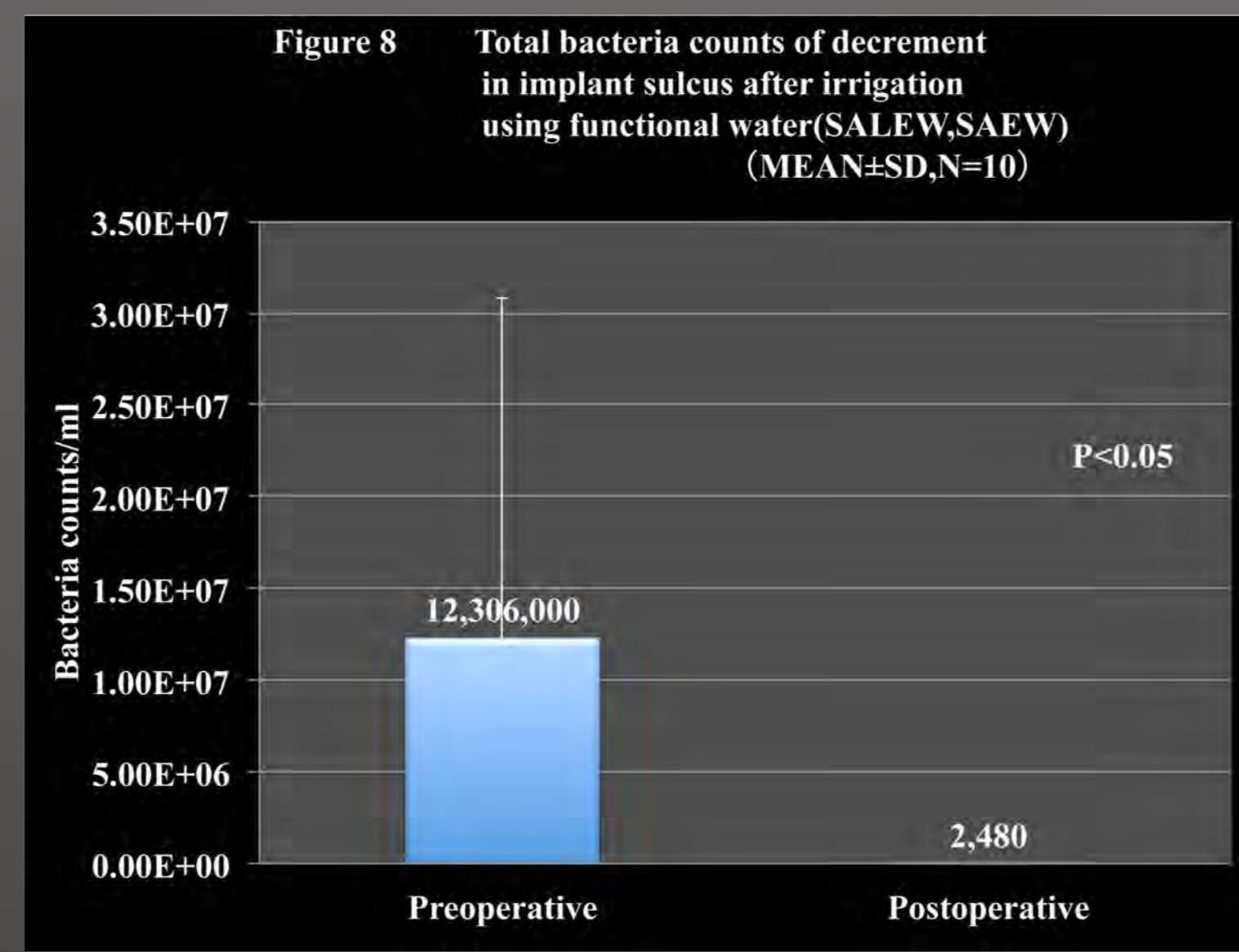
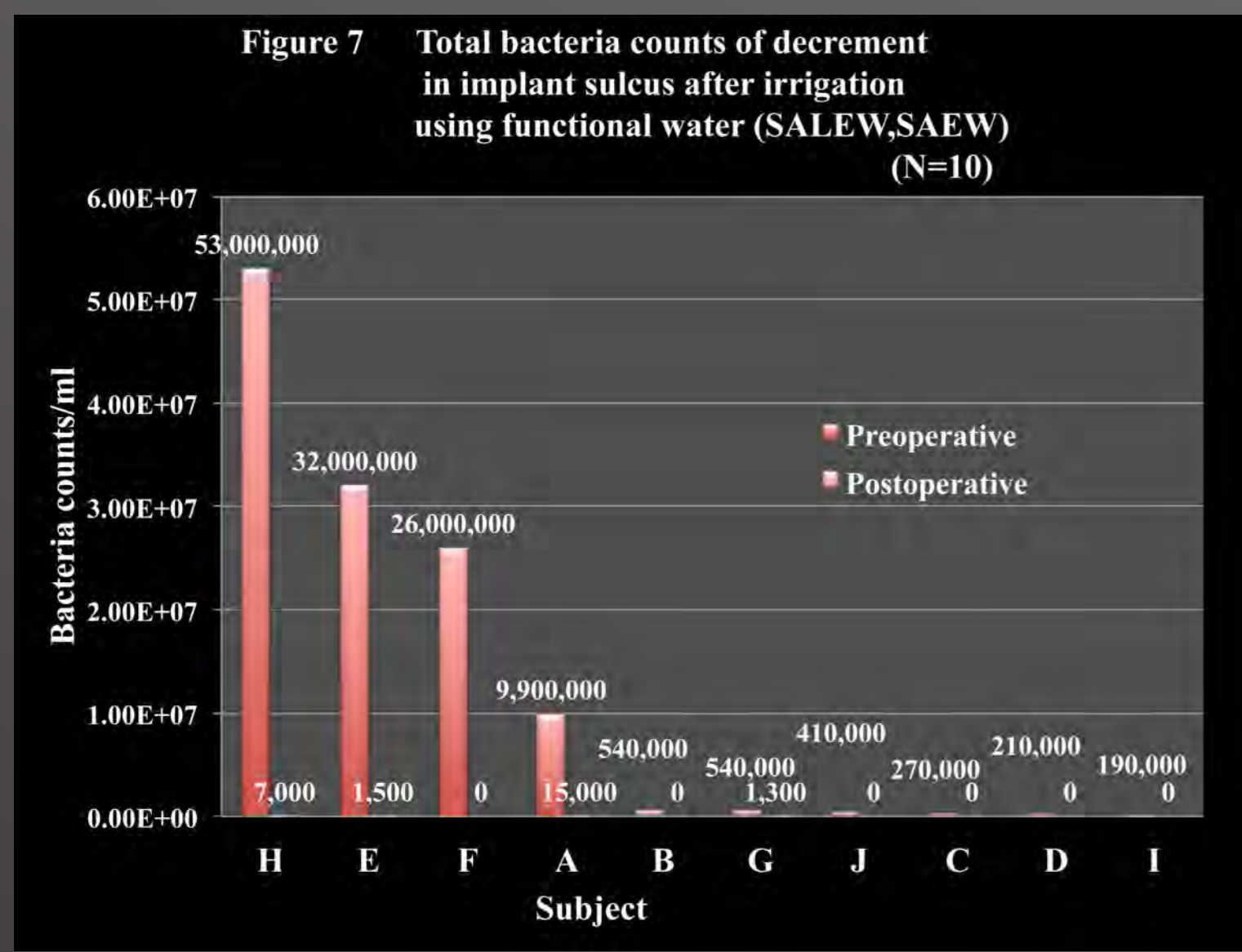
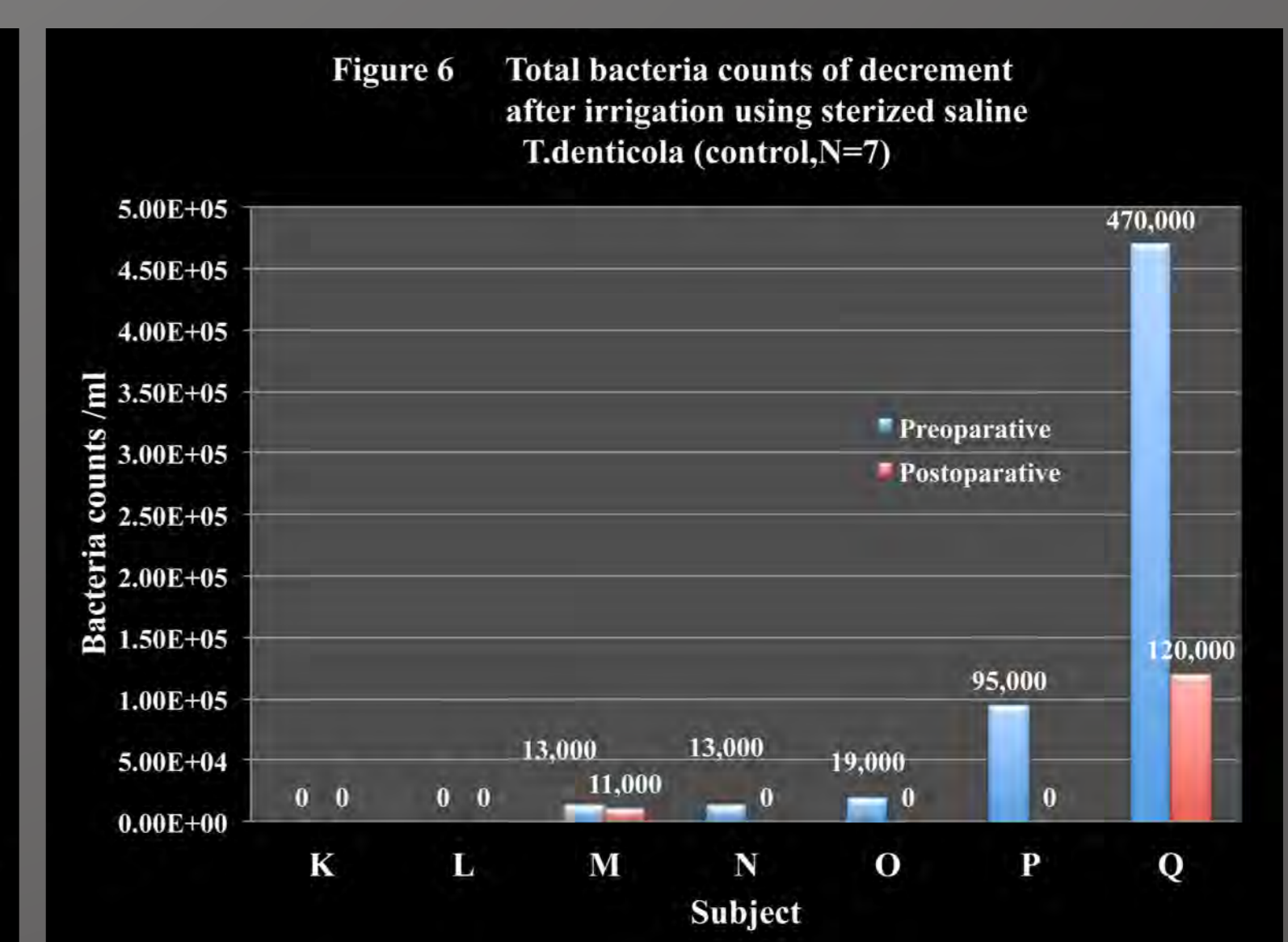
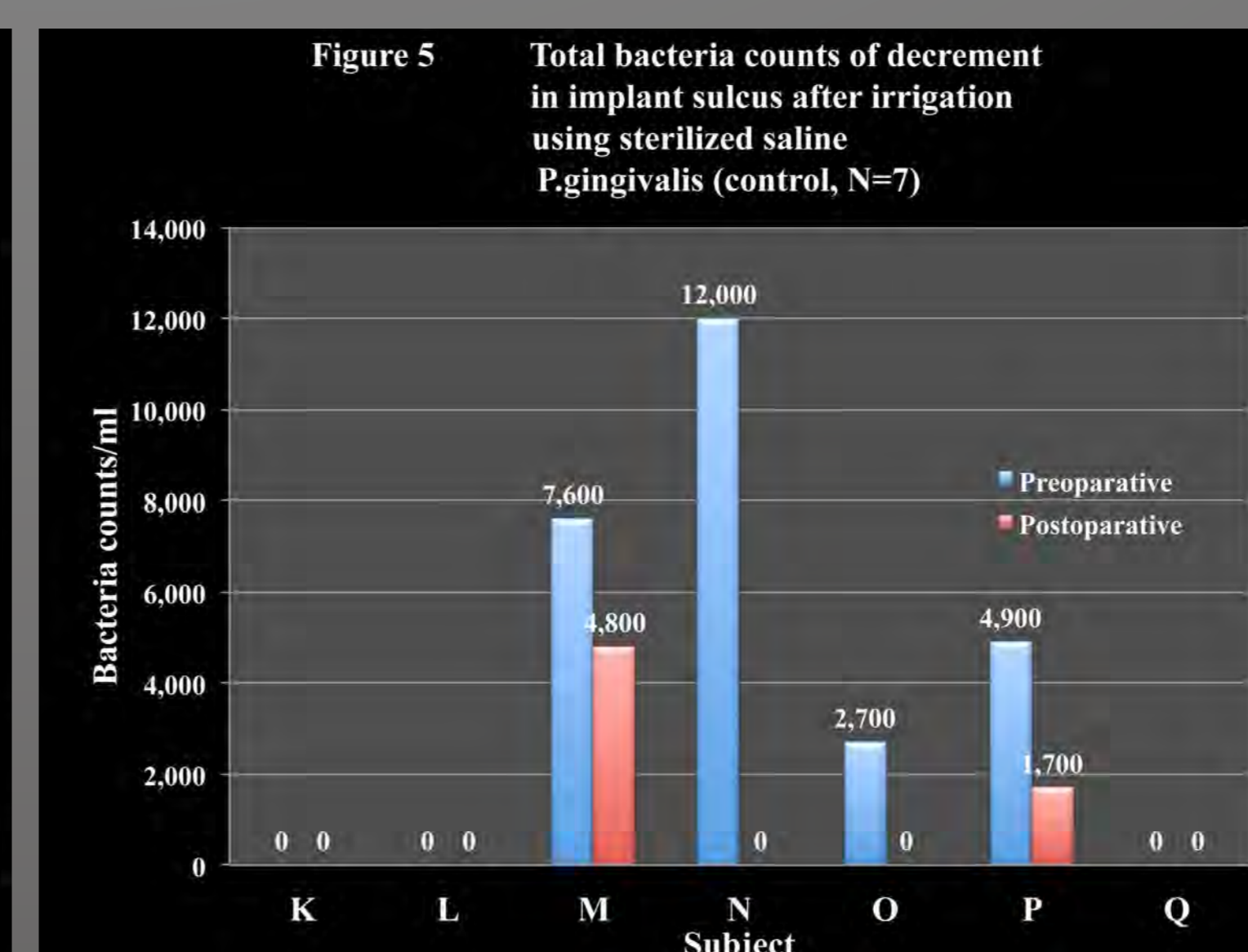
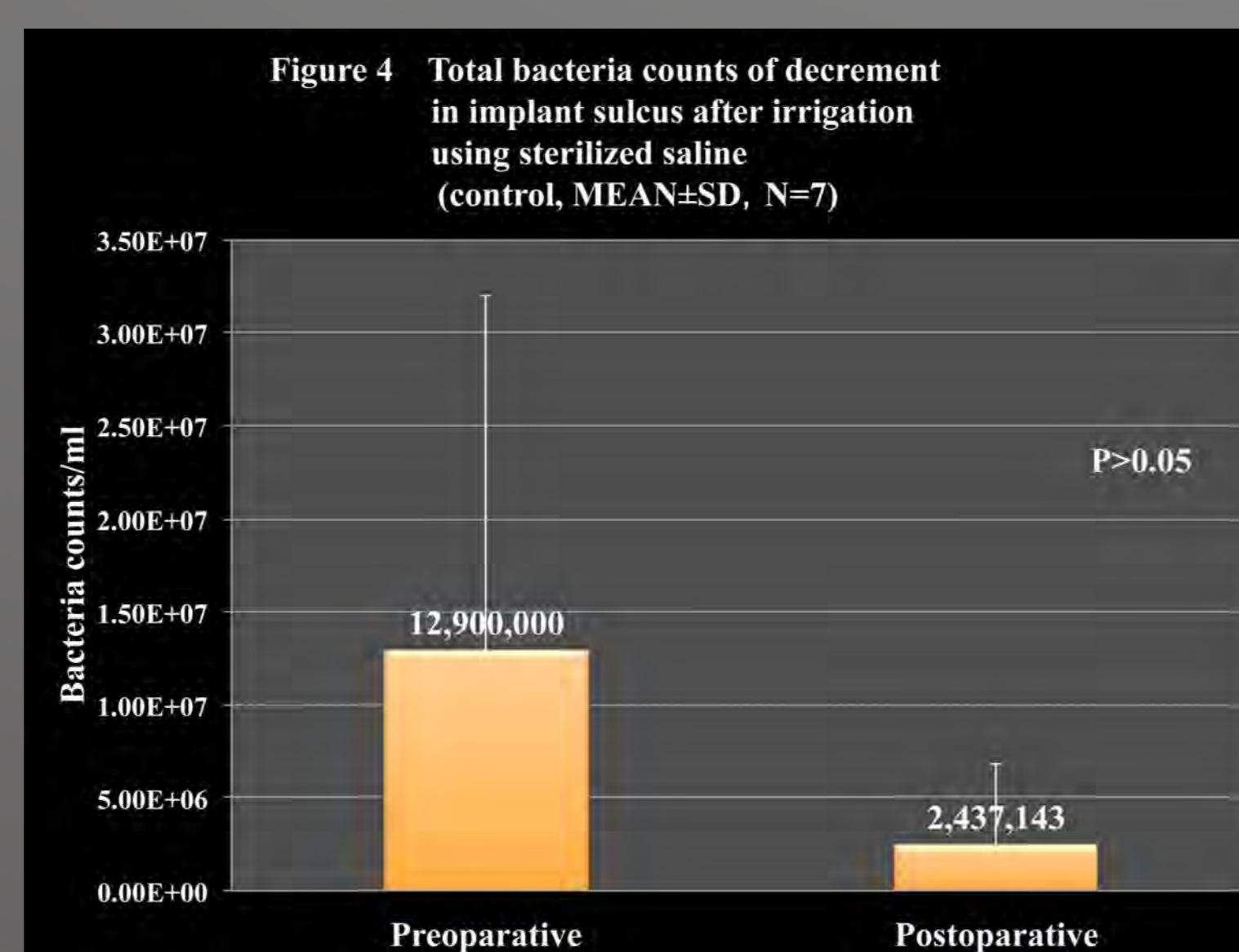
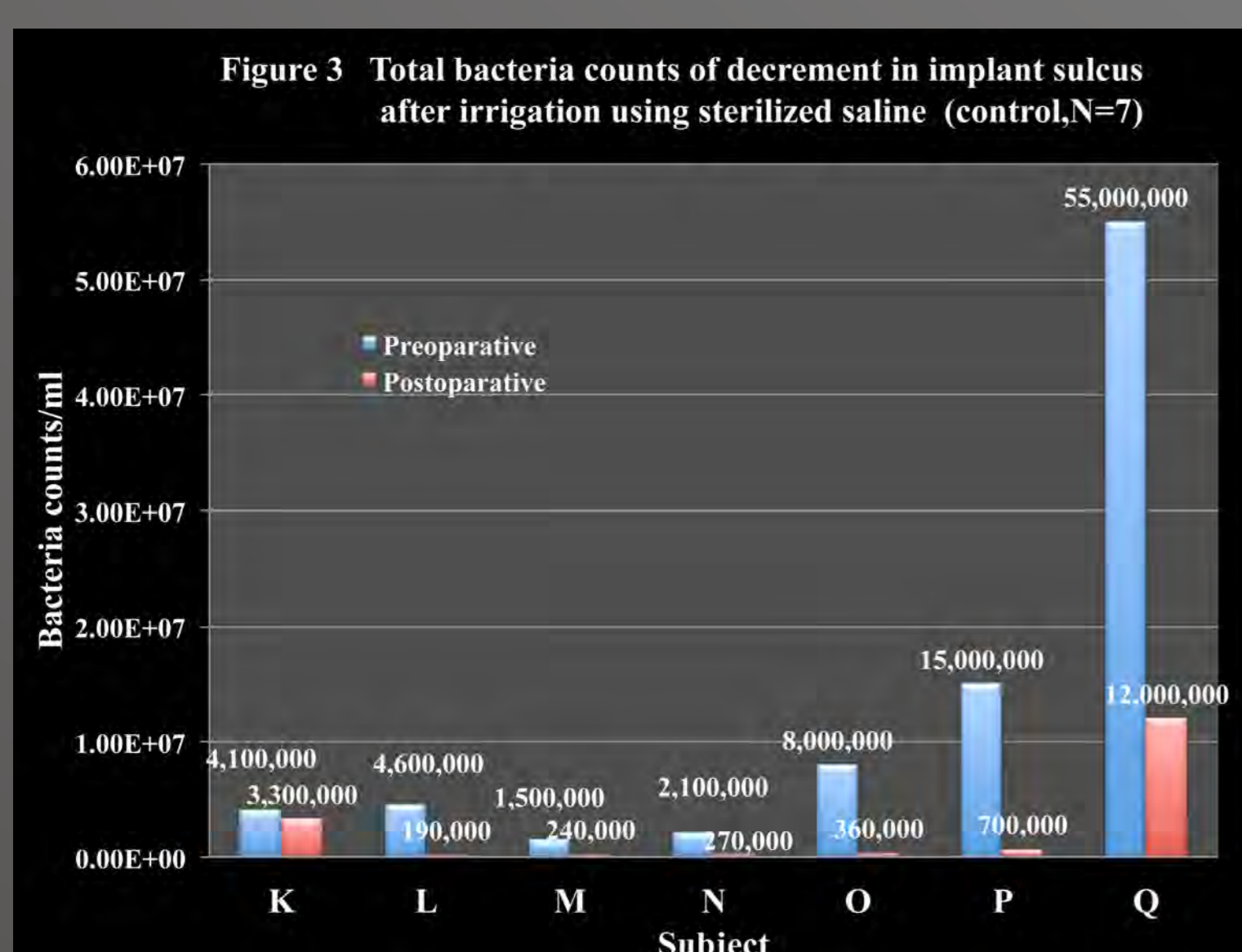
♂: three ♀: four
Average age : 69.1±7.6
The average period of function : 53.9±19.8 months

Figure 2 Three cylinder-type electrolyte lonize water device (FINEOXER Fo-1000, FIRSTOCEAN Ltd, Yokohama, Japan)



III Result :

In the control group, the average number of total bacteria count was 12,900,000 before the irrigation and 2,437,143 after the irrigation (P > 0.05, Figure 3,4). With regard to the average number of periodontal pathogenic bacteria, PCR analysis showed no significant decrease respectively (P > 0.05, Figure 5,6,11). In the experimental group, the individually total bacteria count decreased sharply (Figure 7). The average number of total bacteria count was 12,306,000 before the irrigation and 2480 after the irrigation. There was a significant decrease (P < 0.05, Figure 8). Among four bacteria, *Pg* decreased significantly from an average of 453,333 to an average of 15,090 (P < 0.05, Figure 9). *Tf* decreased significantly from an average of 659,871 to an average of 7142 (P < 0.07, Figure 10). *Td* decreased significantly from an average of 348,383 to an average of 25,316 (P < 0.06, Figure 12).



IV Discussion and conclusion :

In this study, although the subjects did not have periodontal diseases, existence of red complex was confirmed in peri-implant sulcus. Further, it has been suggested that the irrigation with functional waters (SAEW and SALEW) for peri-implant sulcus is effective for reduction of periodontal pathogenic bacteria.

V References :

- 1) Ito H, Enomoto S, Kobayashi K: Electron microscopic study of the human epithelial attachment. Bull Tokyo Med Dent Univ. 1967 Jun;14(2):267-77.
- 2) Shimizu Y, Hurusawa T: The sterilization action and fungal disinfection action of high oxidation potential water made from electrolysis. Shika Journal. 37 :1055-1060,1993 (in Japanese).
- 3) Shimizu Y: Microbiological effects of electrolyzed oxidizing water. The Medical & Test Journal Special Issue Jan.1,1994.
- 4) INOUE K, ENDO T, MIURA H, IMAI S, HANADA N, SENPUKU H, SATO T: Comparison of Washing and Antiseptic Properties between Strong Alkaline Electrolyzed Water and Alkaline Cleaning Agent in Dentistry. Journal of The Japan Society for Oral Functional Water, Volume12-1,2011:40-41.