

# Comparison of Bacterial Count in Tap Water between First Burst and Running Tap Water

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**Objective:** To compare the number of bacterial counts in tap water at first burst and running tap water.

**Material and Method:** The present study was performed in thirty-two first burst water samples and twenty-nine running tap water samples after two minutes, collected from an operation room at one standard hospital and analyzed for the mean, median, and 95% achieved confidence interval of CFU/ml. All water samples were cultured and investigated for total bacterial counts, which were expressed as colony forming unit per milliliter (CFU/ml).

**Results:** The bacterial count was statistically significantly about three times higher in the samples of the first burst tap water in comparison with the group of samples after letting the tap water run for two minutes 98.7, 78.5, 60.5-120.0 vs. 29.1, 25.8, 16.6-33.2 CFU/ml.

**Conclusion:** Two minutes running tap water contains about three times less bacterial count than first burst tap water.

**Keywords:** Tap water; First burst tap water; Running tap water; Bacterial count; Water contamination

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Now, water safety is a stressing issue as it has a direct impact on life quality among the population. It is recognized that tap water is part of routine life. Many daily activities are water dependent such as tooth brushing, bathing, washing, cleaning, and cooking. Metropolitan Waterworks Authority (MWA) takes care of tap water in the aspect of quality control, transmission, and delivery to consumers. Tap water treatment process, certified ISO/IEC 17025:2005 by Thai industrial standard institute, are elaborately regulated by MWA for safety before distribution to the public<sup>(1)</sup>. Even although the municipal treatment of tap water is provided with approved modern technology, contaminated tap water is still detected. This problem should not be overlooked as it could bring many adverse effects to health<sup>(2-4)</sup>. Nevertheless, contamination might not be due only to pathogens in the water itself. The source of contamination also

could be water delivery tools as well as the release instruments such as water pipes, water cocks, reservoirs, and water pumps possessed by the consumers<sup>(5)</sup>. Moreover, the types and the virulence of pathogens as well as the host susceptibility will certainly play a more significant role in pathogenesis. The economic recession nowadays has great effect on the fast increase of living costs especially the public utility namely electricity and tap water. People are very concerned and their reaction to tap water usage is safety as well as worthwhile use. Hence, they do not let tap water running for a long time. Thus, almost every drop of water will be used. In the present communication, the results of bacterial counts in tap water at the first burst and in running tap water after it was turned on for two minutes are reported. It is advisable to wait for a while before starting to use running water.

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**Material and Method**

Sixty-one tap water samples were collected from the taps in an operation room of one standard hospital between May and July 2010. At the collection

site, the water cock was closed for two minutes before collection of the first burst tap water to control the time the water was trapped within the cock. Then thirty-two samples of first burst water were collected at the zero minute (group I) and the remaining twenty-nine samples were taken from running water collected at the second minute after opening the water cock (group II). All water samples were kept in aseptic glass bottles and 0.1 milliliter of 1.80% (W/V) Sodium thiosulphate were added to 100 milliliters of all water samples. The samples were then sent to a Microbiology Laboratory at Siriraj Hospital for further examination. Bacterial contamination was assessed by the total pour plate count method<sup>(6)</sup>. Each sample was examined in triplicate and one dilution. The cultured plates were incubated at  $35 \pm 2^\circ\text{C}$  for 72 hours. Then the bacterial count was done on the cultured plates and the routine measurement of total bacteria was expressed as colony-forming unit per milliliter (CFU/ml) according to the standardized measurements<sup>(6,7)</sup>. Data were collected as well as analyzed by calculating the mean, median, and the 95% achieved confidence interval (95% CI) for both groups. The statistical difference of bacterial colony-forming units per milliliter between the two groups was assessed by the Mann-Whitney U test and p-value less than 0.05 was set for statistically significant difference.

## Results

Table 1 shows the results of the determination of the bacterial count of tap water at the first burst and after running for two minutes.

Mean, median and 95% CI of the bacterial counts in colony forming-unit per milliliter of group I and group II were 98.7, 78.5, 60.5-120.0, and 29.1, 25.8, 16.6-33.2 CFU/ml respectively. The statistical analysis revealed that the bacterial contamination in group I was significantly higher than in group II by about three times ( $p = 0.00$ ).

## Discussion

Tap water is one health threat and usually related to environmental aspects. Contamination in water could be found in many forms *i.e.* organic and inorganic substances, heavy metals, which usually came out as residues in waste products from industries, nitrate found in most fertilizer, bacteria, virus, and parasites. Correlation between contaminated water and many diseases, for example cancer, asthma, learning disabilities become obvious and have been studied in many researches<sup>(3,4)</sup>. The contaminated water should not be overlooked as it could cause many adverse effects to health. The cooperation between MWA and Mahidol University took place in 1999, to investigate tap water quality in various areas of water distribution and the announcement was officially made that the tap water quality met the World Health Organization criteria and standard<sup>(5)</sup>. Nevertheless, tap water contamination could also arise after water treatment as well as during water distribution to the clients' houses, which is beyond the official care of MWA. The cause to worsen the quality of tap water are usually in the consumers' possession *i.e.* the rusty and leaked pipe, dirty pump, reservoir, cock and faucet that could result in tap water contaminations by some chemical substances and even pathogens. Thus, MWA has main activities to provide knowledge and understanding to encourage the consumers to take good of care for their possessions to assure the tap water quality in their households<sup>(5)</sup>. The result of the present investigation points towards the fact that even if the tap water from the production process is clean, contamination is possible from water released by the gadgets and flushed down with the first burst of water after opening the gadgets. It is advisable to wait for a while, here two minutes was selected, to reduce microbial-contamination in water. The amount of bacterial count in tap water might not be the only factor to worsen the tap water quality and harm the health. Actually, the

**Table 1** Bacterial count (CFU/ml) derived from first burst of tap water and after running for 2 minutes given as median (mean  $\pm$  standard deviation in parenthesis [ ]), 95% CI, minimum and maximum values

	n	CFU/ml				p-value*
		Median	95% CI	Minimum	Maximum	
Group I (first burst) [mean $\pm$ SD]	32	78.5 (98.7 $\pm$ 56.7)	60.5-120.0	35.3	240.0	0.0000
Group II (after 2 minutes) [mean $\pm$ SD]	29	25.8 (29.1 $\pm$ 21.3)	16.6-33.2	5.8	79.2	

\* Mann-Whitney test between group I and group II adjusted for ties

types, the virulence of pathogens, and especially the host susceptibility to each pathogen will certainly play a more important role in pathogenesis. The study in Switzerland revealed bacterial contamination namely *Pseudomonas aeruginosa* were positive in three out of 50 standstill water samples whereas it was found negative in running water<sup>(8)</sup>. Another research reported from Germany on washing hands with tapwater before usual disinfectant procedure before entering the operation room in the hospital. It was found that the number of spores of *Bacillus stearothermophilus* detected on hands of 14 volunteers were reduced from  $\log_{10}$  3.84 before hand wash to  $\log_{10}$  1.99 (p-value = 0.001) after hand wash when the duration of handwash is at least 15 seconds<sup>(9)</sup>. The necessary safety of tap water for health care institutions is usually defined by local regulations. In France for instance, the indicators for water quality in health care settings are set for *Pseudomonas aeruginosa* to be < 1 CFU/ml and for total coli forms < 1 CFU/100 ml<sup>(10)</sup>. The criteria for good drinking water quality for the European Union for total bacteria at 22°C is 100 CFU/ml and for 36/37°C 20 CFU/ml. However, the indicators are meant to be valid for bottled water only and are 0 CFU/100 ml for potable tap water as far as *Escherichia coli* is concerned and 0 CFU/250 ml for *Pseudomonas aeruginosa* and *Enterococci*<sup>(2)</sup>. In Thailand, the action level of drinking water, which is based on a review of processed data and an assessment of product sensitivity to microbiological contamination, is 500 CFU/ml<sup>(5)</sup>. The values obtained from the author investigation are far from those strict standards from the above reports that support the safety of tap water usage. However, improvements could be achieved by letting the tap water run for a while before tap water is used. Thus, it is significant to discard the first burst tap water. The authors' finding can be useful for daily activities that are water dependent. However, the authors did not study the type and the virulence of bacteria, as well as the host susceptibility to bacterial agent. Therefore, a further study is recommended.

### Conclusion

Sixty-one tap water samples of an operation room of one standard hospital were collected from the first burst and from running tap water after two minutes. Total bacteria count expressed as colony-forming unit per milliliter (CFU/ml) had been determined. Mean, median, and 95% achieved confidence interval in the unit CFU/ml was statistically significantly three times higher in the first burst tap water than in the running

tap water after letting it run for two minutes. It is suggested that the usage of tap water after letting the water run for a while can reduce the amount of bacterial contamination and thus promote water safety.

### Potential conflicts of interest

None.

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## การศึกษาเปรียบเทียบจำนวนแบคทีเรียในน้ำประปาขณะหยุดไหล (นาทิตี่ 0) และขณะน้ำไหล (นาทิตี่ 2)

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**วัตถุประสงค์:** น้ำประปาถือเป็นปัจจัยสำคัญในการดำรงชีวิต กิจกรรมหลายชนิดเกี่ยวข้องกับการใช้น้ำประปา เช่น การทำความสะอาดร่างกาย การซักล้าง การทำอาหาร น้ำประปาที่ไหลจากก๊อกน้ำประปาอาจมีการปนเปื้อนของเชื้อแบคทีเรียได้ แม้การประปาได้ควบคุมระบบการผลิตเป็นอย่างดีภายใต้มาตรฐานสากลที่ได้รับการรับรอง เนื่องจากการปนเปื้อนเกิดขึ้นหลังการจ่ายน้ำประปาไปสู่ท่อและก๊อกน้ำในความครอบครองของผู้บริโภคซึ่งอยู่นอกเหนือการควบคุมของการประปา

**วัสดุและวิธีการ:** คณะผู้นิพนธ์ได้ทำการเก็บน้ำจากก๊อกประปาในห้องผ่าตัดของ โรงพยาบาลแห่งหนึ่ง จำนวน 61 ตัวอย่าง โดยแบ่งเป็นน้ำประปาที่เก็บตอนเปิดก๊อกประปาทันที (นาทิตี่ 0) จำนวน 32 ตัวอย่าง และเป็นน้ำประปาที่เก็บขณะน้ำไหลในนาทิตี่ 2 จำนวน 29 ตัวอย่าง จากนั้นนำตัวอย่างทั้งหมด ส่งห้องปฏิบัติการจุลชีววิทยา โรงพยาบาลศิริราชทันที เพื่อศึกษาจำนวนแบคทีเรีย โดยแสดงผลเป็นค่ามีซเค็มเลขคณิต ค่ากลางทางคณิตศาสตร์ และ 95% ช่วงความเชื่อมั่น และมีหน่วยวัดเป็นหน่วยก่อก่อนโคโลนี/มิลลิลิตร แล้วนำผลมาเปรียบเทียบกันทางสถิติ

**ผลการศึกษา:** พบว่าจำนวนแบคทีเรียในน้ำประปาขณะนาทิตี่ 0 มีจำนวนสูงกว่าในน้ำประปาขณะนาทิตี่ 2 อย่างมีนัยสำคัญทางสถิติประมาณสามเท่า 98.7, 78.5 (60.5-120.0) กับ 29.1, 25.8 (16.6-33.2) หน่วยก่อก่อนโคโลนี/มิลลิลิตร

**สรุป:** การทดลองพบว่าน้ำประปาขณะไหลนาทิตี่ 2 มีจำนวนแบคทีเรียน้อยกว่านาทิตี่ 0 ประมาณ 3 เท่า จึงแนะนำให้เปิดน้ำไว้สักครู่ก่อนใช้

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