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Investigation of the effect of water temperature on water consumption of cats

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ABSTRACT

Cats can naturally obtain their water requirements on the water content of their food. However, if the water level of the food is less than 60%, cats need additional drinking water. Otherwise, they will be easily dehydrated and chronic dehydration can lead some health problems such as bladder and renal diseases and circulatory problems. Any practical method that could increase cats water consumption, would have a reducing effect on the before mentioned diseases. Regarding the water consumption, the taste of water has been found as effective as the other physiological stimulants such as mouth dryness, plasma osmolality and blood volume. Temperature is considered to be very important for the taste perception of animals. The preference for the water temperature varies among the animal species. So we hypothesized that, cooling the drinking water can encourage cats to drink more water and we aimed to investigate the effect of the water temperature on water consumption of cats. This research has conducted with 8 domestic, mature and healthy pet cats (Felis domesticus) that live indoor. We measured the water consumption of cats for two weeks. During the first week, temperature of water has not been intervened, and the cats' normal water consumption were measured. On the 1st day, 500 ml water, measured with graduated cylinder, was provided in a standard water bowl. After 24 hours, the remained water has been measured and noted. After each measurement, cat owners refreshed the drinking water. In the 2nd week, we started to add four ice cubes to the water bowl, three times in a day. First week, cat's average normal water consumption has found 142.26±8.09 ml/kg/day. ($p<0.05$) In the second week, water consumption increased to 203.97±12.52 ml/kg/day after water cooling. In conclusion, cooling the water resulted with an increase in the water consumption in cats. These results will contribute to develop new water cooling practices to help increasing water consumption in cats and minimizing the clinical risks caused from inadequate water consumption.

Keywords: cat, water consumption, cold water, urinary system

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Introduction

Water is the most important source of nutrients required for the normal functioning of all living cells, with many important functions such as its leading role in the circulatory system and thermoregulation (Brown, 1998; Noyan, 2011; Rogers et al., 1986). Water can be obtained from drinking water and from food, and is also produced during protein, carbohydrate and fat metabolism (metabolic water, oxidation water). This exogenous or produced water is also lost from the body through the lungs, urine, skin, milk and feces. The body water content is thus maintained at a certain level through a balance between water gain and water loss (Reece, 2012; Zanghi, 2017).

Cats have evolved to meet their water needs from the food they eat; in the wild, cats generally do not need to take in water from outside, as they utilize the body fluids of the creatures they hunt and the bodies of these creatures contain 70-75% water (Hall et al., 2003; Myrcha and Pinowski, 1970). Although cats are slightly more resistant to acute dehydration than dogs and other omnivores with water losses of up to 20% of

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their body weight, they must maintain body water balance in the long term like all living things (Debra, 2002 ; Rogers et al., 1986).

A cat needs approximately 50-60 ml of water for one kilogram of body weight (National Research Council, 2006). If sufficient water is not taken, dehydration may occur (Houpt, 1991). When dehydration is mild, the thirst mechanism is activated to restore water balance (Reece, 2012). If dehydration becomes chronic, health problems such as stone formation in the bladder, kidney failure and circulatory problems may occur (Houpt, 1991). Feline Lower Urinary Tract Disease (FLUTD) is one of the most common health problems related to water intake among domestic cats (Little, 2012).

Chronic kidney disease (CKD) is the most common kidney disease in cats. Normally, waste products are filtered from the blood by the kidneys and excreted in the urine, but in cats with CKD, these waste products begin to accumulate in the bloodstream as the filtering function of the kidneys deteriorates (Bartlett et al., 2010). Establishing the habit of adequate fluid intake or increasing water intake (by encouraging the cat to drink more water than it normally consumes) will increase urination and minimize the risk of FLUTD and CKD (Alipourmazandarani, 2021).

There are many environmental factors that affect drinking water intake. Since the way water is presented can affect the amount of water consumption in cats, methods that can encourage water intake are being investigated to reduce the risks of these diseases (Handl and Fritz, 2018).

Feeding with canned foods or moistened dry foods to increase the moisture content of food in the diet to improve water intake can increase the accumulation of dental tartar and resulting periodontal disease (Debra, 2002).

Another method to increase the water intake and decrease the possibilities of urinary system risks was considered as modifying the diet (Chew and Buffington, 2007). Although one study showed that cats' water intake can be increased by adding sodium to the diet, it is questionable whether such a procedure is healthy in the long term, as high amounts of sodium in the diet can cause different diseases such as hypertension (Forrester and Roudebush, 2007; Hawthorne and Markwell, 2004 ; Nguyen et al., 2017). In order to increase water intake voluntarily, water fountains are commercially advocated in recent years (Turner and Bateson, 2013). A study by Grant, (2010) investigated the effect of different water sources (water bowl or water fountain) on water intake and urine concentration in cats and the results showed that the fountain caused an increase in water intake compared to the water bowl. On the other hand, 1 in 12 cats was recorded to experience stress due to the dynamic water source, with symptoms of excessive cleaning, vomiting and aggression. In another survey that performed with 549 cat owners, more than 80% of cats who had access to both a static/standard water bowl and a moving/dynamic water bowl at the same time preferred the static water bowl, so currently, this is a contradictory solution (Handl and Fritz, 2018 ; Pachel and Neilson, 2010). In studies conducted in different animal species, it has been understood that temperature may be an important factor in the formation of taste sensation in animals, as in humans (Nesheim et al., 1993; Turner and Bateson, 2013). For example, it has been observed that chickens prefer to suffer from acute thirst rather than drink water warmer than their body temperature, whereas they are happy to consume water close to freezing (Reece, 2009). In another study, it was found that chickens preferred cooled water in both seasons (summer and winter), but the reason was not known (Degen and Kam, 1998). Based on this information, it is suggested that cooling of drinking water may be one of the methods that can encourage water intake in cats and reduce the risks of urinary system diseases which are mentioned above. In our literature review, no scientific studies on the subject was found. The aim of this project is to investigate the effect of cooling the drinking water on water consumption in cats.

Materials and Methods

Before the start of the study, approval was obtained from the Local Ethics Committee for Animal Experiments. 8 adult cats with no known health problems and with a certain level of activity due to living in a stabilized home environment, were included in this study. Age, gender, body weight and body condition scores (9-point scale) for each cat were noted and given in Table 1 (Bjornvad, 2011 ; Teng et al., 2018).

Table 1. Age, gender, body weight and body condition scores of the cats

	Age	Gender	Body weight (kg)	Body condition score
Patron	5	Male	4.39	5
Miyu	1.5	Female	4.6	6
Dennis	5	Male	4.49	5
Eda	4	Female	8.54	8
Sassy	3	Female	4.79	6
Prenses	3	Female	2.9	3
Aslan	2	Male	6.19	7
Maya	1	Female	3.2	3

All of the cats were feeding with dry commercial pet food. Ad libitum feeding was applied and, instead of tap water, drinking water was served as their normal, daily practices. The cats observed in the study were selected as their owners are veterinary students who were familiar with the research and measurement processes.

Since performing daily water consumption measurements in a different environment may cause stress on the cats and accordingly, differences in feeding and water intake behaviors may be observed, the measurements were performed by the owners in their own living environment without any change in the daily routine of the cats.

In order to minimize measurement errors, the measurement procedure was simplified, a standard water bowl was provided for all cats, and owners were provided with detailed and applied information about the measurement. The consumption of water at room temperature and the consumption of cooled water were measured and compared on 8 adult cats.

Water consumption measurements lasted for 2 weeks and performed between same dates for each cat. Consumption of the water at the room temperature was measured in the first week and cooled water consumption was measured in the second week. For the first week, a standard water container that could hold 900 mL of water, a 500 mL graduated cylinder that could be used to measure water volume, a funnel to be used to empty the water from the standard water container into the graduated cylinder, a standard chart to note the amount of consumed water, and 12 standard ice cubes for each 24 hours were provided to each cat owner. In the first week, all of the cat owners served to cat 500 mL of fresh water at room temperature in a standard water container once every 24 hours, while measuring and taking notes of the volume of water left from the previous day.

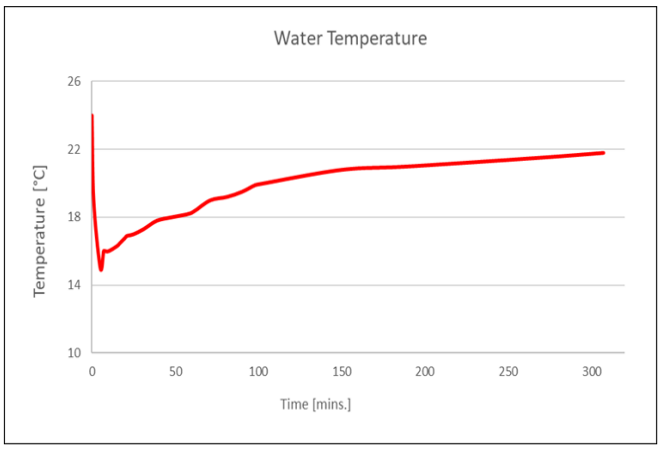

Figure 1. The changes in water temperature after 4 ice cubes added.

In the second week, all of the cat owners served 500 mL of fresh water at room temperature with 4 ice cubes added, in a standard water container three times a day. After 4 standard ice cubes were added to the water at room temperature served in a standard water container, the changes in water temperature were measured and given in Figure 1.

Measurements performed once every 24 hours, while the volume of water left from the previous day was measured with a graduated cylinder and noted. When evaluating the measurement results, it was taken into account that each of the standard ice cubes provided 12.96 mL of water volume when they are completely defrosted.

"The Paired Samples T-test", which is developed to compare the mean of two matched groups or cases, or compares the mean of a single group, examined at two different points in time, was used to compare normal and cooled water consumptions of 8 cats on the first and second week (Ross and Willson, 2017). Statistical analysis has been done with the SPSS program (Ver. 17.0).

Results

In the first week, the average water (at room temperature) consumption of the cats was 142.26±8.09 mL/kg/day. In the second week, the average water consumption (cooled water) increased to 203.97±12.52 mL/kg/day.

The average daily water consumption of the cats is given in Table 2. When the water consumption at room temperature in the first week was compared with the cooled water consumption in the second week, it was observed that the increase in the water consumption of 4 out of 8 cats was statistically significant.

Table 2. Average daily water consumption

	First Week			Second Week			Dif.	*P*
Patron	113.3	±	5.29	113.4	±	12.55	0.14	0.99
Miyu	8.6	±	3.15	91.3	±	9.47	9.71	0.46
Dennis	99.7	±	11.70	187.9	±	18.77	88.14	0.01
Eda	478.6	±	9.99	575.6	±	23.38	97.00	0.00
Sassy	80.4	±	14.00	170.6	±	3.83	90.20	0.00
Prenses	104.6	±	6.40	149.9	±	15.14	45.29	0.06
Aslan	101.7	±	6.22	243.0	±	3.55	141.3	0.00
Maya	78.3	±	7.97	100.1	±	13.44	21.86	0.31

Dif = Difference

Discussion

In a study conducted with broiler chickens, it was concluded that broilers preferred cooled water more

regardless of the season, but the reason for this preference was not fully understood (Degen and Kam, 1998). Our findings suggest that cats preferred to consume cooled water in parallel with the role of temperature in the differentiation of taste sensation. Warm water saturates with dissolved oxygen faster, while cold water carries more dissolved oxygen (Michaud, 1991). This may be why cold water is perceived by many of us as fresher than warm water. In the light of the discussion that the freshness of water is one of the water-related factors that can affect water intake preferences in cats, it is conceivable that cats may also have a tendency towards cold water for this very reason (Turner and Bateson, 2013). Although some pet owners provide information based on observation that cooling drinking water increases water consumption, however there are not enough studies on this subject.

Conclusions

In the 2-weeks study, it was observed that serving the water that cooled at a certain level, increased the voluntarily water consumption of indoor cats, and this increase in the consumed water volume, was found to be statistically significant in 4 out of 8 cats. We believe that the results of a more detailed study with more cats, using a more advanced method that will allow more controlled processes of cooling the water and keeping the cold constant within a certain temperature will contribute to increasing water consumption in cats and minimizing the disease risks that may be encountered in inadequate water consumption.

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