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Short Communication

A modified Smoking Machine for Monitoring the Effect of Tobacco Smoke on Albino Rats

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Abstract

We describe a modified smoking machine to be used for monitoring the effects of narghile and cigarette tobacco smoke on experimental animals; a vacuum pump, a time controller, and an electronic valve that control the sequence of puff- and fresh air-inlet and exit into and out of the inhalation chamber. The design allows intake of enough tobacco smoke and prevents oxygen deprivation in the inhalation chamber.

Keywords: Smoking machine, tobacco smoke, albino rats.

1. Introduction

Tobacco smoking is practiced nowadays by over one billion people, and is deemed responsible for about five million premature deaths per year worldwide; it stands behind or is related to many health problems, which makes it a serious risk to human health (Wolfram *et al.,* 2003; Al-Safi *et al.*, 2009; Neergaard *et al.,* 2007). There are different methods of smoke tobacco, notably cigarettes, cigars, pipes, and water-pipes (narghile).

The smoke of burning tobacco is divided into mainstream and sidestream smoke. The mainstream smoke emerges from the tobacco product through mouth during puffing, whereas sidestream smoke comes from the burning cone and from the mouth during puff intermission (Hoffman and Wynder,1986). When a cigarette is smoked, the atmosphere becomes contaminated with both mainstream and sidestream smoke. Sidestream comprises about 95% of the cigarette smoke air contamination (Shephard, 1982).

The combustion of a typical cigarette involves perhaps 102-second puffs and 550 seconds of sidestream combustion; about 46% of the tobacco is burnt during the puff phase (Hoegg, 1972).

Many smoking machines have been constructed, mainly for studying chemical the composition of cigarette tobacco smoke and its effect on the human body (Baeza-Squiban *et al.,* 1999; Baker *et al*., 2004; Chen *et al.,* 2008; Counts *et al*., 2005).

Rats, mice, and guinea pigs are used as experimental mammalian animals to study the effect of smoke on the structure and function of different organ systems of tested animals. Liswi (1988) exposed albino rats to the smoke of 3 different types of Jordanian made cigarettes for 3 months. She used a simple inhalation chamber that was connected to vacuum pump, with continuous smoke flow. The inhalation time lasted between 5-6 minutes to finish the burning of the cigarettes. AL-Kurd *et al*. (2002) developed a special smoking machine to study the effect cigarette mainstream on guinea pigs. Their system of timing of the puff duration gave one (2.5 seconds)/minute. The smoking period was 3.5 and 5.5 months. The effect of smoking on the histology of animals was not obvious. There is a need for increased puff duration in hope for getting histological effects in shorter exposure time (3 months). But at the same time, it is important to supply the animals with fresh air to prevent anoxia.

2. Design of the Smoking Machine

An automated smoking machine was designed with a special smoking topography, suitable for the exposure of rats to narghile-tobacco smoke. The machine is composed of the following components:

1. Narghile/cigarettes.
2. An inhalation chamber made of plexiglass (8mm thick), with the following dimensions (30cm length x 22.5cm width x 10.5cm height) that can host up to five rats.
   Larger chambers can be made for larger animals.
3. A vacuum pump (Vacuubrand MZ 2, Germany).
4. An electronic valve made at the Electrical Workshop/ Department of Physics/ University of Jordan).
5. A time controller, made at the Electrical Workshop/ Department of Physics/ University of Jordan. It controls the sequence of operation of the pump and the valve.
6. 30% and 50% alcohol traps connected in series by rubber and glass connectors.

The whole system is illustrated in Figures 1-2.

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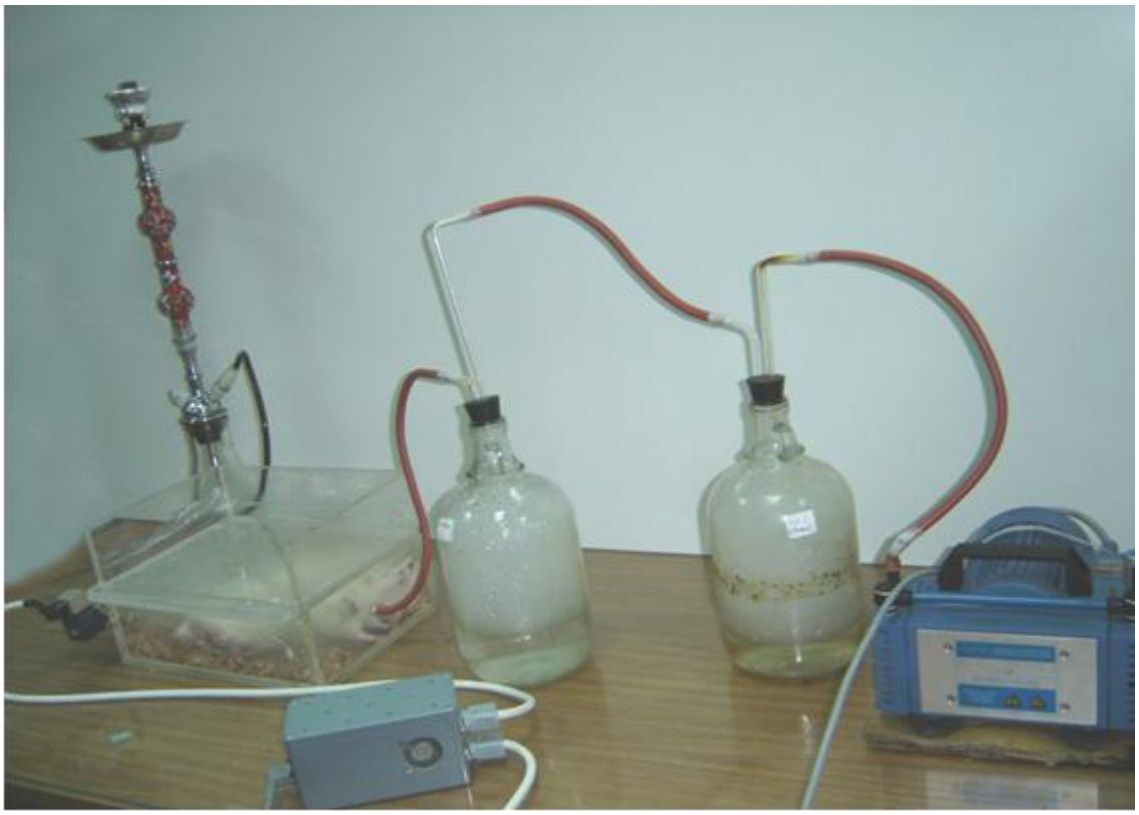

Figure1. Set-up of the automated smoking machine, used to expose the rats to narghile smoke.

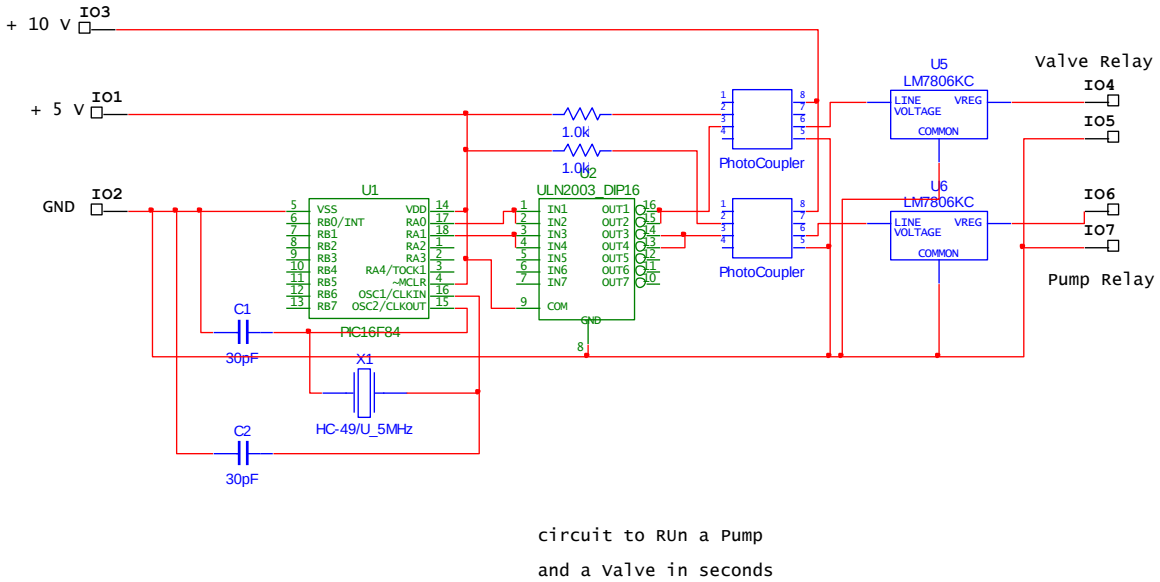

Figure 2. A circuit to run a pump and a valve in a digital smoking machine.

2.1. *The smoking regimen*

Each cycle of the smoking regimen lasts for 90 seconds and consists of three successive steps, operating as follows:

1. Narghile (cigarette) smoke is drawn through the inhalation chamber continuously for 30 sec.
2. An inlet to fresh air is then opened, allowing fresh air to be introduced instead of smoke, which will be washed out of the chamber. The washing out process will also take 30 sec.
3. In the last 30 sec, the vacuum pump will be turned off, and rats will be allowed to breathe fresh air normally.

3. Results and Discussion of the Smoking Machine

Two important points have to be stated concerning the smoking machine:

1. The design took into consideration the prevention of oxygen deprivation and poisoning by toxic gases such as CO poisoning in the inhalation chamber. This has been avoided via splitting the smoking cycle into three equal periods involving: introducing narghile

(cigarette) smoke, washing it out with fresh air, and, finally, letting the rats to breathe smokeless air normally. The 30 sec duration was chosen in accordance with the fact that narghile tobacco does not have the self-burning characteristic of a cigarette, which implies longer periods of smoke drawing, as will as with technical issues related to the time controller. Nevertheless, spacing the three parts of the smoking cycle by 30 sec, was found to be practically applicable and appropriate to readily give smoke, at the beginning of each smoking cycle.

2. Using thermometer, the temperature inside the inhalation chamber was kept at 25 °C during the smoking session. This is largely due to the aging phenomenon of narghile smoke, which results from the long distance which might be 25 times of a cigarette-covered by the narghile smoke, from the production site (the bowl), down the vertical stem, and finally its introduction into a long suction hose, preceded by bubbling through water (Chaouachi, 2009).

4. Conclusion

The smoking machine we described can be applicable for studying the effects of tobacco smoke of cigarettes, narghile and cigar on different types of experimental animals.

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