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Low-dose cucumber juice improved spermatozoa motility of Albino rats in the short term only

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Abstract

The status of spermatozoa characteristics is often a strong consideration for the use or rejection of an ejaculate at breeding stations. The reproductive effects of several plant materials on animal species have been documented. Cucumber is widely consumed by man for its numerous health benefits however, literature is scant on its reproductive effects in mammals. This research examined the impacts of oral delivery of cucumber juice on some spermatozoa characteristics in the albino rat. Fresh cucumber fruit (300g) was rinsed in water, thoroughly blended, and sieved using a muslin bag to obtain the filtrate. Sixty male albino rats (150-170g) were equally randomized into four groups. A, B, C, and D and administered with 1.5, 1.0, 0.5mls (of filtrate), and 1.0ml distilled water, respectively, during days 0 – 6 of the study. On days 7 (short-term), 14 (moderate term), and 21 (long-term), spermatozoa were collected from the caudal epididymides of the rats to assess the motility (SM %), viability (SV %), and morphological abnormalities (SA %). Results for Group A rats showed that the SM on days 7 (72.00±2.00%) and 21 (70.00±4.08%) were not significantly ($P>0.05$) different but were higher ($P<0.05$) than 65.00±2.89% obtained on day 14. For group B rats, the SM on days 14 and 21 were the same (80.00±0.00%) and comparatively higher ($P>0.05$) than (76.67±3.33%) obtained on day 7. For group C rats, the SM on days 14 (66.00±2.45%) and 21 (68.00±2.00%) were comparable but lower ($P<0.05$) than 93.00±1.22% obtained on day 7. For group D rats, the SM obtained on days 7 (88.00±4.64%) 14, (86.09±0.41%), and 21 (89.00±1.02%) did not differ significantly ($P>0.05$). The values obtained for SV and SA on days 7, 14, and 21 for all rats in these studies were only comparable ($P>0.05$). Findings suggest that oral administration of cucumber juice did not cause any significant changes in spermatozoa viability and morphological abnormalities, however, its low dose improved spermatozoa motility in the short term.

Keywords: Cucumber juice, Male albino rats, Spermatozoa Characteristics

Introduction

Fertility of the spermatozoa is one of the vital determinants of fertilization and pregnancy in livestock breeding stations. All other factors such as herd fertility, oestrus detection accuracy, and inseminator efficiency must be kept at optimal levels, just as semen/spermatozoa fertility, to ensure optimum pregnancy rate and livestock profitability (Hook and Fisher 2020). Individual spermatozoons in each ejaculate dose usually

differ in their activity. In every fertilization process that is left to chance, spermatozoa competition and selection naturally occur such that the 'most fit' ends up uniting with an ovum (Vaughan and Sakkas 2019). To enhance the chances of every fertilization producing a viable embryo, therefore, assisted Reproduction now employs techniques that select spermatozoa with the best characteristics for procedures such as IVEP and ICSI. (Paramio and Izquierdo 2014, Unnikrishnan et al., 2021). Regardless of the invitro selection of spermatozoa, there are scanty reports of in vivo improvement in spermatozoa characteristics in certain animal species following the administration of some plant concoction or extract. For example, Citrullus lanatus i.e. watermelon (Khaki et al., 2013, Kolawole et al., 2014) has been observed to improve spermatozoa characteristics. Cucumber (Cucumis sativus) is a plant belonging to the family known as Cucurbitacaea (Adesanya et al., 2011). The fruit of cucumber is widely consumed by man and it is well known to possess numerous health benefits, among which are antioxidant (Rahman et al., 2013), free radical scavenging (Kumar et al., 2010), and anti-urolithiatic properties (Abubakar et al., 2014). Similarly, Lee et al., (2007) have also observed stimulation of reproductive hormones following the administration of cucumber fruit. This paper reports our observations of an improvement in spermatozoa motility following the administration of a low dose of fresh cucumber juice to albino rats. It is hoped that the report will be useful in future clinical use of cucumber as a prophylactic or therapeutic in reproductive medicine.

Materials and method

Animal and management

For this investigation, sixty (60) mature male albino rats weighing between 150 and 170 grams were procured from the University of Ibadan's experimental animal section in Nigeria. The rats were housed in well-ventilated and transparent plastic cages, that were bedded with wood shavings. A week of acclimatization preceded the start of the trial, during which they were given rat pellets and unlimited water.

Study Design

Preparation of Cucumber Juice

Fresh cucumber fruit (300g) was sourced from a reputable grocery store within the University Of Ibadan, Nigeria. The cucumber was rinsed in water, chopped into smaller pieces, and thoroughly blended using an electric Binatone® blender for ten minutes. The resulting mixture was then emptied into a muslin bag and left to stand for 10 minutes to obtain the juice. (Adeyemo et al., 2007). This procedure was repeated daily to obtain fresh filtrate of cucumber juice.

Juice administration

The rats were dosed orally by gavage, as specified below, and were randomly allocated into four equal groups (A-D), each consisting of fifteen rats.:

Group A: 1.5 ml filtrate of fresh cucumber juice
Group B: 1.0 ml filtrate of fresh cucumber juice
Group C: 0.5 ml filtrate of fresh cucumber juice
Group D: (Control) 1.0ml distilled water

Duration of treatment

Every treatment was given every day for seven (7) days, from 7:00 to 8:00 in the morning.

Semen collection and analysis

Following sedation in a chloroform chamber, the rats were given anaesthesia and put into a dorsal recumbent position, and the testicles were retrieved by making an incision in the lower abdomen. Following a scalpel incision made in the cauda, the epididymides of the testes were removed, and samples were taken with a Pasteur pipette. Semen was analysed to assess spermatozoa motility, viability, and abnormalities in morphology using methods described by Oyeyemi et al., (2011). Briefly, one drop of the semen sample and 2.9 percent sodium citrate buffer were used to evaluate motility, which was then observed under an X40 microscope coverslip, while Wells and Awa stain was employed for morphology, Eosin-Nigrosin was utilized to stain semen smears for viability ratio.

Ethical approval

The research was carried out strictly under the Canadian Council on Animal Ethics guidelines for the use and care of laboratory animals (CCAC, 1993).

Data analysis

Values obtained for motility, viability, and morphology were recorded as Mean ± S.E.M. Analysis of variance (ANOVA) was used to compare the parameter means using Turkey's Post hoc test and Graph Pad Prism Version 5.0 for Windows. P-values less than 0.05 were regarded as significant.

Results

The results are presented in Tables 1-3. Table 1 shows the mean spermatozoa motility (SM) of rats in the study. The SM obtained on day 7 for rats in Group C (93.00±1.22%) was higher ($P<0.05$) as opposed to values obtained for rats in groups A (72.00±2.00%) and B (76.67±3.33%) as well as D (88.00±4.64%). On day 14, values of SM obtained for rats in Group A (65.00±2.89%) and Group C (66.00±2.45%) were comparable ($P>0.05$) and lower ($P<0.05$) to values acquired for rats in Groups D (The findings are shown in Tables 1-3. The mean spermatozoa motility (SM) of the study's rats is displayed in Table 1.86.09±0.41%) and B (80.00±0.00%). On day 21, SM obtained for rats in Group C (68.00±2.00%) was lower ($P<0.05$) compared to values obtained for rats in Groups D (89.21±1.02%) and B (80.00±0.00%) but were comparable with the value obtained for Group A (70.00±4.08%). Table 1 also shows the differences in the SM values of rats in the same treatment groups. In rats administered 0.5ml of cucumber juice (CJ) i.e. Group C, SM obtained on days 14 and day 21 were comparable ($P>0.05$) but lower ($P<0.05$) than that obtained on day 7. In rats administered 1.5ml of CJ i.e. Group A, the SM obtained on day 14 was lower ($P<0.05$) compared to the values obtained on days 7 and 21. There were no differences in the values of SM obtained on days 7, 14, and 21 in control rats as well as those administered 1.0ml CJ i.e. Group B. Table 2 shows the mean percentage viability (MV) of rats in this study. On day 7 the difference in MV obtained of rats in Group A (96.80±0.73%), B (97.00±1.00%), C (98.40±0.60%) and Group D (97.00±0.60%) were not significant ($P>0.05$). Also, on day 14 the difference in the MV values obtained in rats in groups A (93.25±2.84%), B (95.03±0.60%), C (94.80±2.52%), and D (96.13±0.24%) were not significant ($P>0.05$). On day 21, the difference in the MV values obtained in rats in groups A (96.50±0.87%), B (95.00±1.00%), C (96.20±0.73%) and D (95.40±0.62%) were not significant ($P>0.05$). The variation in the mean

sperm morphological abnormalities (SA) of the research rats is displayed in Table 3. On day 7 the difference in the SA values obtained from rats in groups A (20.65±0.49%), B (19.45±1.07%) C (18.38±1.73%), and D (16.32±0.33%) were not significant (P>0.05). Rats in groups A, B, C, and D had SA values on days 14 and 21 that were not statistically significant (P>0.05).

Table 1 Mean spermatozoa Motility (%) across the four groups on Days 7, 14, and 21 post-treatment with Cucumber juice

	GROUP A 1.5ml CJ	GROUP B 1.0ml CJ	GROUP C 0.5ml CJ	GROUP D Control
DAY 7 (short term)	72.00±2.00[a]	76.67±3.33[a]	93.00±1.22[c]	88.00±4.64[a]
DAY 14 (moderate)	65.00±2.89[b]	80.00±0.00[a]	66.00±2.45[a]	86.09±0.41[a]
DAY 21 (long term)	70.00±4.08[a]	80.00±0.00[a]	68.00±2.00[a]	89.00±1.02[a]

*Values with different superscripts in columns differ significantly @ P<0.05

Table 2 Mean spermatozoa viability (%) across the four groups on Days 7, 14, and 21 post-treatment with Cucumber juice

	GROUP A	GROUP B	GROUP C	GROUP D
DAY 7 (short term)	96.80±0.73[a]	97.00±1.00[a]	98.40±0.60[a]	97.00±0.60[a]
DAY 14 (moderate)	93.25±2.84[a]	95.03±0.60[a]	94.80±2.52[a]	96.13±0.24[a]
DAY 21(long term)	96.50±0.87[a]	95.00±1.00[a]	96.20±0.73[a]	95.40±0.62[a]

*In the same row, values with the same superscript do not differ significantly (P>0.05).

Table 3 Mean Spermatozoa abnormality (%) across the groups on Days 7, 14, and 21 post-treatment with Cucumber juice

	GROUP A	GROUP B	GROUP C	GROUP D
Day 7 (short term)	19.65±0.49[a]	19.45±1.07[a]	18.38±1.73[a]	16.32±0.33[a]
DAY 14 (moderate)	18.85±1.06[a]	18.21±0.31[a]	18.92±1.17[a]	16.74±0.91[a]
DAY 21 (long term)	16.74±0.49[a]	16.75±0.12[a]	17.85±0.60[a]	15.14±0.18[a]

*Values with the same superscript in the same row do not differ significantly (P>0.05)

Discussion

Observations in this study, especially about motility appear to be dose-dependent. The low dose (0.5ml) administered to Group C rats on (day 7) produced a higher (P<0.05) motility compared to all other rat groups on day 7. This increase may be due to the presence of phytonutrients such as phenolic and carotenoid compounds in cucumber that have anti-oxidative abilities thus, increasing the activities of the spermatozoa (Stratil et al., 2006; Shahidi, 2009). This effect however lasted within a short- term (i.e. day 7) following cucumber juice administration which may suggest that cucumber juice is quickly metabolized and its effects wade

off in the body system. During the moderate (day 14) and long term (day 21), however, the motility of the ejaculate dropped in Group C rats, and this was comparable to the observations with the short, moderate, and long term for rats administered higher doses (i.e. 1.0ml and 1.5mls). These findings suggest that low doses (0.5mls) of cucumber juice significantly improved spermatozoa motility in the short term. Although differences between the treatment groups as well as within groups were not significant ($P>0.05$), spermatozoa viability at moderate and long term for Groups A- C were comparatively lower compared with the control as well as short-term values. It may not be ascertained if this observation will exert any clinical significance because none of the values obtained for viability during the period was below 90% (Oyeyemi et al. 2015). However similar findings were reported with the use of crude aqueous extract of Ocimum gratissimum in the albino rats (Leigh et al., 2008). Additionally, Oyeyemi et al. (2015) found no significant variation in the percentage viability between the groups of rats administered Vernonia amygdalina saponin extract. The differences between and within the treatment groups (A-C) were not significant ($P>0.05$), and short-term and moderate-term values of spermatozoa abnormalities for groups A-C (except for Group B moderate-term value) were comparatively higher compared with the control values. Since an increase in spermatozoa abnormalities increases the tendency for infertility of various degrees it may be proper to suggest caution in the consumption of cucumber juice. However, going by the numerous health benefits reported in the literature, and the observations that none of the spermatozoa abnormalities were above 20%, cucumber consumption may be regarded as safe until the availability of further findings. These observations suggest that oral cucumber juice did not cause any significant changes in spermatozoa viability and morphological abnormalities, however, its low dose improved spermatozoa motility in the short term.

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