

The Physiological Effect Of Chewing Khat Leaves On Human Spermatogenesis

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Abstract

Background: It was estimated that several million people are frequent users of khat, living in countries between South East Africa and Arabian Peninsula.

Khat (*Catha Edulis* Forsk) is described as an evergreen shrub of the species plant family celastraceae.

Chewing of khat leaves and ingesting the juices that contain the psychoactive substance, Cathinone, produces sympathomimetic and CNS stimulation.

It has deleterious effects on the rate of spermatogenesis, decreasing the sperm count; percentage of sperm motility and increase the number of abnormal sperm forms.

Objective: To prove that chewing khat affects the human spermatogenesis and sexual behavior; and to emphasize the cathinone effect on the human spermatogenesis and to explore the sexual behavioral changes due to khat use.

Materials and methods: A fifty healthy Yemeni khat chewers aged between 20 to 50 years were randomly selected. A questionnaire survey method was used to investigate their sexual behavior and a routine semen analysis was done.

Result: The study showed that 94% of the khat chewers have sperm counts below the normal range while 6% above the normal range; about

72% of the khat chewers have less than 60% active motile sperms and abnormal sperm forms while 28% of the khat chewers have more than 60% active motile sperm and abnormal sperm forms.

A correlation was found between the period of khat consumption and an initial decrease in sperm count and the percentage of active motile sperm with subsequent increase in the numbers of abnormal sperms.

A strong association was found in chewer's using high quality of khat and a decrease in sperm counts and the percentage of active motile sperms with increase the numbers of abnormal sperms when compared with low quality of khat.

Conclusion: In Yemen, the habit of chewing khat affects human spermatogenesis. Khat chewing affects elderly people more than younger ones and the high quality of khat affects spermatogenesis more than low quality of khat variety due to its higher content of cathinone.

Keywords: Khat, *Catha Edulis*, Cathinone, spermatogenesis.

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Introduction

It was estimated that several million people are frequent users of khat, living in countries between South-East Africa and South-West Arabia. Nowadays, due to the development of road networks and the availability of air transport, habitual use of khat spread to remote regions and countries for example US, and UK^(1, 2).

There are a variety of different names for khat in different countries. In Yemen more than 40 different khat types are known⁽³⁾.

Khat is plant of an evergreen shrub, family (celastraceae), genus (*Catha*), Species (*Edulis*), and parts used (leaves)⁽⁴⁾.

Khat grows best at 3000 - 6000 feet above sea level. The height of the khat tree varies from small to large; it may reach 20 feet in height. Khat tree is a seedless plant; this may explain its limitation to Yemen and nearby Ethiopia and eastin Africa. Its leaves and twigs can be harvested many times throughout the year⁽⁵⁾.

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Traditionally, khat leaves are chewed in the company of others as a social and cultural activity. During the chewing of khat leaves, the juice is swallowed with the saliva. The residue is not spit out but gathered in the cheek, usually for the whole period of chewing. During khat chewing, considerable amounts of liquids as tea and soft drinks, are also ingested.

The swallowed juices contain the psychoactive substance *cathinone*, which produces sympathomimetic activity and CNS stimulation analogous to those produced by amphetamine⁽⁶⁾.

Historically, the original source of khat was first observed in Ethiopia and from there it was transferred to Yemen in the thirteenth century.

The earliest scientific report on khat presented to western literature was written in the eighteenth century when the botanist *Peter Forskal* identified the plant in Yemen (*Catha edulis*)⁽⁷⁾.

Several investigations and research works have been done in attempt to expose the harmful effects of khat chewing on the health of the consumers.

Khat was found to contain many chemicals, among which are alkaloids including (cathinone, cathine, ephedrine), tannic acids, amino acids, choline, minerals, and vitamins⁽⁸⁾.

In view of this finding arises a question concerning the extent to which each of the different substances present in khat contributed to the effects observed after khat chewing.

Some reports said that khat was used historically for medical purposes; other reports associate khat to socio-medical problems⁽⁹⁾, and even other reports mention psychiatric disorders secondary to khat-chewing⁽¹⁰⁾.

Several authors report that the cultivation of khat in Yemen has increased considerably over the years. Because its net return per unit area is greater than that of coffee, khat is

currently being grown in many areas previously used to grow coffee.

It was recently reported in Yemen that khat represents about 12.5% of the gross domestic product and that the consumer spends about 19% of his income on khat.

In Yemen, the law does not prohibit the use of khat. However, and over the last few years, khat consumption by the public task force is being advised against⁽¹¹⁾.

The chemical aspects of Khat are Cathinone, the alkaloid present in khat leaves, is quite similar to structure to amphetamine. The only structural difference between the two is that the methylene group found in the a position in amphetamine is replaced by a carbonyl group in cathinone. However, cathinone has a shorter duration of action in comparison to amphetamine. Cathinone is estimated to be one third as potent as amphetamine and ten times as potent as cathine⁽¹²⁾.

It was found that during the decomposition of the plant through drying and storage, cathinone contained within the plant is enzymatically converted to cathine.

Cathinone was placed into *Schedule I* of the controlled substances; Cathine is ruled as *Schedule IV* substance.

The amount of khat chewed is variable. It depends on the consumer and the duration of the party. The average amount per person is one bundle of khat.

Pharmacological aspect of Khat; the most common route of use of khat is chewing.

However it can be smoked or drunk like tea. The khat-chewer prefers fresh leaves and shrubs filling his/her mouth to capacity, chewing intermittently to release the active component, cathinone, which is rapidly absorbed after oral administration, in contrast to cathine⁽¹³⁾.

Cathinone is lipophilic; it penetrates into CNS with more ease than cathine.

The peripheral effect induced by khat can thus be considered to be predominantly due to cathine while the central effects are due to cathinone.

It was found that the maximal effects of cathinone are observed 30 min after initiation of chewing, whereas the maximal effects of cathine are seen after 3 hrs⁽¹²⁾.

Cathinone is metabolized rapidly in the liver into norephedrine and is almost entirely excreted in this form. Only 2% of cathinone appears in the unchanged form in urine.

The results of various studies in vitro and in vivo experiments suggest that the effects of khat alkaloids are due to amphetamine-like effect at the cellular level and that cathinone is the main psychoactive constituent of khat.

Khat has various effects on each of the following systems: CNS, alimentary system, liver, CVS, respiratory system, eyes, pregnancy and lactation, genitourinary system, metabolism and endocrine system, sexual potency^(13, 14, 15, 16, and 17).

In 1973 the WHO expert committee on drug dependence included khat type « *Catha Edulis Frosk* » in their group of *dependence-producing drugs*.

The categories of drug dependence they produced were:

1. Morphine type.
2. Barbiturate - alcohol type
3. Cocaine type
4. Cannabis type
5. Amphetamine type.
6. Khat type.
7. Hallucinogen type (18)

Material and methods

Fifty Yemeni volunteers, who aged twenty to fifty years, were selected randomly from khat chewers. Before signing the application form, the volunteers were informed about the aims of the research.

First, the volunteers have to give over their semen, each participant was asked to perform masturbation in the bathroom of the laboratory and give over his semen sample in a clean container that was labeled using numbers by the laboratory technician.

A routine semen analysis to investigate three basic parameters (sperm count, percentages of active motile sperms, and abnormal formed sperms) was done immediately after of liquefaction of the semen, the results of the three basic semen parameters were documented. These three parameters were chosen because of their importance in the evaluation of spermatogenesis. The results of semen parameters that were obtained in the present study were compared with normal values stated by the most recent textbooks of physiology. **Second**, the volunteers were asked to answer to certain questions concerning their sexual behaviors in private

Results

The study showed that 94% of the khat chewers have sperm counts below the normal range while 6% above the normal range; about 72% of the khat chewers have less than 60% active motile sperms and abnormal sperm forms while 28% of the khat chewers have more than 60% active motile sperm and abnormal sperm forms. Show in (Table 1, 2, 3)

A correlation between the period of khat consumption and an initial decrease in sperm count and the percentage of active motile sperm with subsequent increase in the numbers of abnormal sperms. Show in (Table 4,5,6,7)

A strong association was found in chewer's using high quality of khat and an decrease in sperm counts and the percentage of active motile sperms with increase the numbers of abnormal sperms when compared with low quality of khat (Table 8).

Table 1: The variation in the average sperm count between normal people and khat chewers.

Normal averaged sperm count	120 million / ml	
Average sperm count in khat chewers	40 million /ml	33 %
Chewers with less than 120 million / ml	47	94%
Chewers with more than 120 million / ml	3	6%

Table 2: The variation in the average percentage of active motile sperm between normal people and khat chewers.

Normal average percentage of active motile sperm.	More than 60 %	
Average percentage of active motile sperm in khat chewers.	35 %	
Chewers with less than 60 %	36	72%
Chewers with more than 60 %	14	28%

Table 3: The variation in the average percentage of abnormal sperm forms between normal people and khat chewers.

Normal average percentage of abnormal sperm form.	10 % or less	
Average percentage of abnormal sperm form in khat chewers.	26 %	
Chewers with more than 10%	36	72%
Chewers with 10% or less	14	28%

Table 4: Relation between khat consumption periods and chewer's sperm count and chewer's percentage of active motile sperm and chewer's percentage of abnormal sperm forms.

Years	0-5			6-11			12-17			19-23		
Basic semen parameters *	A	B	C	A	B	C	A	B	C	A	B	C
Number	18	18	18	19	19	19	7	7	7	6	6	6
Average	49.84	44.72	24.16	36.72	30.20	25.00	38.32	33.57	25.71	20.50	25.00	35.0
Standard deviation	43.10	26.64	9.11	36.30	23.44	10.27	32.17	19.30	10.96	17.25	14.14	4.47

* Basic semen parameters (A= sperm count, B= percentage of active motile sperm, C= abnormal sperm forms)

Table 5: Relation between khat chewing weekly frequency and chewers sperm count and chewer's percentage of active motile sperm, and chewer's percentage of abnormal sperm forms.

Hours	2 – 3			4-5			6-7		
Basic semen parameters	A	B	C	A	B	C	A	B	C
Number	8	8	8	27	27	27	15	15	15
Average	73.02	55.00	18.12	38.08	32.40	26.29	26.09	30.66	31.00
Standard deviation	56.45	29.76	8.42	30.34	20.44	9.66	29.94	23.21	6.86

Table 6: Relation between khat chewing daily frequency and chewers' sperm count and chewer's percentage of active motile sperm, and chewer's percentage of abnormal sperm forms

Days	2 – 3			4 – 5			6 – 7		
Basic semen parameters	A	B	C	A	B	C	A	B	C
Average	59.72	48.00	19.00	41.50	38.75	24.06	30.68	28.12	30.20
Standard deviation	55.27	32.93	11.25	33.91	22.84	9.34	27.02	22.18	8.53
Number	10	10	10	16	16	16	24	24	24

Table 7: Relation of sperm count between Khat chewer's age groups. and chewer's percentage of active motile sperm and chewer's percentage of abnormal sperm forms

Years	20 - 25			26 - 31			32 - 37			38 - 43			>43		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Basic semen parameters															
Number	16	16	16	15	15	15	10	10	10	7	7	7	2	2	2
Average	50.12	45.6	21.9	41.0	33.7	25.0	34.3	33.5	27.0	25.2	25.0	30.7	14.5	20.0	37.5
Standard deviation	46.78	27.9	9.8	33.3	23.4	7.3	27.6	22.9	8.2	23.8	15.5	13.0	16.3	7.1	3.5

Table 8: Relation ship between khat quality and chewers sperm count, percentage of active motile sperm and percentage of abnormal sperm forms

Basic semen parameters	Sperm count		Abnormal sperm motile		Abnormal sperm forms	
	High quality	Low quality	High quality	Low quality	High quality	Low quality
Number	22	28	22	28	22	28
Average	11.54	61.31	18.40	48.92	31.13	22.67
Standard deviation	9.80	35.49	11.89	22.62	7.54	9.37

Discussion

Our discussion on khat-chewing effects on the human spermatogenesis is based on the following:

To prove that the habit of chewing khat leaves affects the three basic semen parameters. The total average sperm count and total percentages of active motile sperms were found to be significantly decreased, while the total percentage of abnormal form sperms was found to be significantly increased in the volunteers' spermogram indicators.

To emphasize the results of the research we classified all khat-chewers into different groups according to their consumption duration and frequency of khat chewing. A significant negative correlation was found between these factors and all the three basic semen

parameters. The effects of khat desired by the chewers are those associated with stimulation of the CNS. Cathinone, the principle active substance from khat leaves, was found in much higher levels in the high quality of khat than in the low quality of khat.

For this reason, we grouped the khat chewers according to the quality of khat. The group including the high quality of khat chewers showed more worsening in the average values of the three basic semen parameters as compared with the group including the low quality of khat chewers.

We observed a high percentage of the chewers were complaining of:

- Increased sexual desire (libido) (90%).
- Spermatorrhea (70%)
- Decrease sexual potency (56%).

- Wet dreams (emission) (36%).
- Testicular pain (26%).

Recommendation

- 1- People education through mass media about the adverse effect of khat on male reproductive system.
- 2- Prohibit the use of khat among our people though law legislation.

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