

Full Length Research Paper

Student teachers' knowledge of and attitudes toward chemical hormone usage in biotechnology

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Accepted 2 July, 2008

Application of modern technologies may be problematic especially if they possess health risks to humans and/or when humans are not aware about these technologies. In this study we investigated non-major student teachers' attitudes to and knowledge of the chemical hormone usage, a controversial topic in the field of modern biotechnology. Although students' knowledge was considered to be limited (8 of 14 items were correctly responded by more than half of participants), we failed to find any differences in mean scores with respect to age or gender. In contrast, females showed less favourable attitudes toward chemical hormones than males. These gender differences were found in topics that represented relatively higher risk to human health which supports the "gender paradox hypothesis" which proposes that females have more tentative attitudes towards new products than males because they buy food for children.

Key words: Attitudes, chemical hormone usage, biotechnology.

INTRODUCTION

Biotechnology is an important area of science and technology that has been developed rapidly in recent years. Biotechnology consists of biochemistry, immunology, genetics, chemical engineering, and molecular biology, biological systems and organizations affecting health and nutrition. The impact of biotechnologies on everyday lives (life) of citizens is therefore indisputable, so public acceptance of biotechnology is recently hotly debated (Pardo et al., 2002).

Advocates of biotechnologies predict various nutritional, health and environmental benefits for humans. However, biotechnology applications in real life raise numerous political and ethical problems which probably contribute to controversial views of biotechnology among general public. Public awareness of biotechnology would be one way on how to positively influence citizen's acceptance of genetically engineered products (Dawson, 2007). If so, a positive association between knowledge of and attitudes

toward biotechnology should be expected. To examine this, many studies have been carried out about knowledge of and attitudes toward biotechnology for different levels of students (Bell and Lederman, 2003; Heijs and Midden, 1995; Cook et al., 2004; Chen and Raffan, 1999; Choi, and Cho, 2002; Massarani and Moreira, 2005; Klop and Severiens, 2007; Luján and Todt, 2000; Dawson and Schibeci, 2003, 2004; Dawson and Soames, 2006; Pardo et al., 2002), but little consensus between them has been found (Prokop et al., 2007). Some researchers found a significant relationship between knowledge and attitudes toward biotechnology (Prokop et al., 2007; Chen and Raffan, 1999; Hill et al., 1998; Lock et al., 1995).

On the other hand, Olsher and Dreyfus (1999) have found no relationship between attitudes toward biotechnology and knowledge. Likewise, Dawson and Soames (2006) indicated that after completing a biotechnology course students' understanding increased but their attitudes remained constant with the exception of their views about human use of gene technology. Verdurne and Viaene (2003), in their interviews with 400 Belgian consumers, showed that higher levels of knowledge do

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not necessarily imply greater acceptance of genetically modified foods.

Acceptance of biotechnology is also related to gender. Females have generally different views of science and modern technologies than males (Jones et al., 2000, Cockburn and Armrod, 1995). From an evolutionary perspective, human females invest more in reproduction than males and have limited reproductive possibilities (Andersson, 1994) relative to males, so greater carefulness in females when investing in offspring is expected. Several researchers such as Hill et al. (1998), Sturgis et al. (2004), Moerbeek and Casimir (2005) or Prokop et al. (2007) showed that females have less favourable attitudes toward genetically engineered products that can be explained by the gender paradox hypothesis. This hypothesis, in line with evolutionary views of human behaviour, states that those females have more tentative attitudes towards new products than males because they buy food for children (Moerbeek and Casimir, 2005). This hypothesis can, however, work especially in such issues that are related to health risk, thus not all dimensions of attitudes are expected to be influenced by gender (Prokop et al., 2007). Alternatively, females can have simply lower understanding of biotechnology processes which (if the link between knowledge and attitudes exists) can influence their lower acceptability of biotechnology. Unfortunately, many research studies on biotechnology attitudes did not take gender differences into account (Chen and Raffan, 1999; Dawson and Schibeci, 2003a,b, 2007). Moreover, several indices suggest that gender differences in biotechnology issues in Turkey are unexpectedly weak comparing with other countries such as Slovakia (Usak et al., unpublished data) which can be influenced by low health risk issues in their research. We therefore designed our research on chemical hormone usage that possesses relatively great health risk comparing for example with attitudes toward genetic manipulations in general or economic benefits from biotechnologies that influence (if any) human health, rather indirectly.

There are many age-related researches about attitudes and knowledge of biotechnology and genetic engineering. For example, Chen and Raffan (1999) surveyed 183 Taiwanese students and 153 British 16–18 year olds (56% of the students were studying A level biology) about their understanding of biotechnology. They found that 31% could not define genetic engineering and 33% were unable to give an example of genetic engineering. Similar results were reported by Hill et al. (1999), who examined the attitudes of 778 students aged 11–18 years about using genetically engineered animals in medical research. In other study, Dawson (2007) conducted 465 12–17 years old western Australian high school students on understanding of and attitudes towards biotechnology processes. She reported that students' ability to provide a generally accepted definition and examples of biotechnology, cloning and genetically modified foods was relatively poor amongst 12–13 year old students but

improved in older students.

We have chosen non-major student teachers sample for studying knowledge of and attitudes toward chemical hormone usage in biotechnology, because it can be considered that population of general public is represented mainly by laics, biology non-majors. To date, no study has focused on the investigation of this topic in Turkey. So, the current study has tried to fill this gap. This study aimed to determine student teachers' knowledge of and attitudes toward chemical hormone usage and examine whether the relationship between knowledge of and attitudes toward chemical hormone usage and gender differences in biotechnology exist or not. We also controlled for the effect of age of participants considering that older participants can have different (more favourable) attitudes toward biotechnology than younger ones (Dawson, 2007).

Purpose of research

This study was conducted to examine student teachers' knowledge and attitudes toward chemical hormone usage with respect to grade and gender. The study focuses on the following questions:

1. What are the student teachers' knowledge and attitudes toward chemical hormone usage?
2. Is there any effect of knowledge and grade to student teachers' attitudes toward chemical hormone usage?
3. Are there any differences in knowledge and attitudes toward chemical hormone usage with respect to gender?

MATERIALS AND METHODS

Method

The study was realized with the student teachers attending 1st to 4th grades in spring semester of 2008. This study allowed us to evaluate gender differences in particular topics and examine the effect of student teachers' grade on attitudinal changes. The data for the current study were obtained from 371 student teachers ($n = 178$ girls; 193 boys) attending Adiyaman University in Turkey.

Data collection instrument

A 27-item Knowledge and Attitudes toward Chemical Hormone Usage Questionnaire (KACHUQ) was used to examine student teachers' knowledge and attitudes toward chemical hormone usage (Appendix 1). The questionnaire was prepared based on the conditions in Turkey and according to the literature and chemical hormone usage application in Turkey by the author. So, the items of the questionnaire reflect the particular topics (different grades and gender) that student teachers concentrate on in Turkey. Accordingly, items in the attitude section of the instrument were divided into three dimensions as;

1. Attitudes about the effect of chemical hormone usage on humans (6 items) (high health risk).
2. Attitudes about the effect of chemical hormone usage on plants (3 items) (low health risk).
3. Attitudes about the effect of chemical hormone usage on ecological agriculture (3 items) (low health risk).

Table 1. Students' knowledge of chemical hormone usage (n = 371): items with the most frequent correct responses.

items	Responded correctly (%)	Disagree (%)	Do not know (%)
The food with chemical hormones affect human's health in negative way (T)	94	1	5
The usage of chemical hormones in vegetables and fruits increases vitamin and nutrient (F)*	88	9	14
Chemical hormones contain harmful chemicals (T)	85	3	12
Productions with chemical hormones make carcinogenic effect (T)	83	2	15
Plants with chemical hormones affect ecological equilibrium in negative way (T)	82	5	13
There are also chemical hormones downgrading growing (T)	64	5	31
Effect of chemical hormone on vegetables and fruits does not continue in refrigerator (T)	54	31	15
Vegetables and fruits with chemical hormones are more hydrous compared to other ones (F)*	50	29	21

* Negatively worded item; reverse scoring procedure used.

The questionnaire was independently revised by three biology teachers in order to maintain validity. Selected items were then attached to a five-point Likert scale; ranging from "strongly disagree" to "strongly agree" with "neither disagree nor agree" as the pivotal point of the scale. Positive items were scored from 1 to 5, from "strongly disagree" to "strongly agree," respectively, while negative items were scored in the reverse order. The validity of the questionnaire was established through review by three experts in the field. The internal consistency of the scale was found to be 0.74 using Cronbach alpha.

RESULTS

Analysis of student teachers' knowledge toward chemical hormone usage

As can be seen in Table 1, eight of the 14 chemical hormone usage knowledge items were correctly answered by more than 50% while the remaining six items were for 1-49% of student teachers. The big generality rather worst majority of student teachers incorrectly thought that the food with chemical hormones affect human's health (Table 1).

Items with the least frequent points are shown in Table 2. Almost one-third of student teachers incorrectly thought that the usage of chemical hormones in plants increases amount of production and provides to keep stable for a long time or think that consumption of food with chemical hormones can modify structure of human's gene. Two-thirds of student teachers correctly think that chemical hormones are used in agricultural production especially in vegetable glasshouse by reason of cheapness. An interesting result is almost all of the student teachers (96%) correctly believe that there are chemical hormones in most of the vegetables and fruits bigger than normal size in the farmers market.

Independent sample t-test and one way ANOVA was per-

formed to investigate the effects of gender and grade on student teachers' knowledge on chemical hormone usage. It was found that there was no one of these variables significantly different on chemical hormone usage.

Analysis of student teachers' attitudes toward chemical hormone usage

Student teachers' attitudes toward chemical hormone usage were analyzed under three dimensions (Table 3). 2 (Gen-der) × 3 (Class level) MANOVA was performed in order to examine the effects of gender and class level on these dimensions of the instrument used. Since the assumption testing the equality of co-variance matrixes was accepted, Pillai's test results were used. Multivariate test results showed that whereas the main effect of gender was significant [Pillai's Trace = .029, F (3, 310) = 3.090, p<.05, partial eta-square = .029], the main effect class level [Pillai's Trace = .027, F (9, 936) = .943, p>.05], and interaction effect of gender and class level [Pillai's Trace = .025, F (9, 936) = .89, p>.05] were not significant. Subsequently, analyses of variances (ANOVA) on each dependent variable were conducted as follow-up tests to the MANOVA. The effect of gender was significant only on the dimension regarding the impact of synthetic hormones on human (F (1, 310) = 108.340, p<.05, partial eta square = .013) and on the dimension regarding the impact of synthetic hormones on plants (F (1, 310) = 64.834, p<.05, partial eta square = .016).

Student teachers' attitudes toward effects of chemical hormone usage on humans (ECHUH)

As can be seen from Table 4, almost half of student tea-

Table 2. Students' knowledge of chemical hormone usage (n = 371): items with the least frequent correct responses.

Items	Responded correctly (%)	Disagree (%)	Do not know (%)
All of the chemical hormones are toxic and can not be discarded from body easily (T)	49	12	39
The usage of chemical hormones in plants increases amount of production and provides to keep stable for a long time (T)	40	38	22
Consumption of food with chemical hormones can modify structure of human's gene (F)*	10	36	54
Chemical hormones used in agricultural production especially in vegetable glasshouse by reason of cheapness (F)*	9	64	27
There are chemical hormones in most of the vegetables and fruits bigger than normal size in the farmers market (F)*	1	96	3
Chemical hormones are stable and can pass from one live to another in food chain (T)	42	7	51

* Negatively worded item; reverse scoring procedure used.

Table 3. The significant and non significant effects of these factors on each dimension of ACHUQ.

Sub-dimensions of ACHUQ	Gender	Class Level	Gender xClass Level
ECHUH	+	-	-
ECHUP	+	-	-
ECHUEA	-	-	-

+ shows significant effects; - shows non-significant effects.

Table 4. Student teachers' attitudes toward effects of chemical hormone usage on humans.

Items	Mean	SD	Agree (%)	Disagree (%)
I can not distinguish production with chemical hormones from production without chemical hormones by looking at their appearance.	2.99	1.29		48
The food with chemical hormones should not be given to children.	1.38	.95	90	6
It is more suitable that a plant with chemical hormones used in sectors exclusive of human's food consumption.	3.57	1.16	55	17
I think that effects of chemical hormone appear many years later.	3.82	.92	61	5
I think that there is no effect of consumed plants with chemical hormones in terms of increasing health problems in our country.	4.01	1.19	13	75
I think that the reason of increasing carcinogenic is the production of plants with chemical hormones.	4.04	.85	77	5

chers can not distinguish production with chemical hormones from production without chemical hormones by looking at their appearance and believe that using plants

with chemical hormones in sectors exclusive of human's food consumption is more suitable. Similarly, 90 percent of student teachers think that the food with chemical hor-

Table 5. Student teachers' attitudes toward effects of chemical hormone usage on plants.

Items	Mean	SD	Agree (%)	Disagree (%)
I think that chemical hormone is used during growing vegetables and fruits in greenhouse or field.	4.43	.78		
The usage of chemical hormones in vegetables and fruits should be done with respect to scientific rules.	3.90	1.34	66	20
The usage of chemical hormones in plants should be controlled and restricted within limits.	4.68	.77	93	4

Table 6. Student teachers' attitudes toward effects of chemical hormone usage on ecological agriculture.

Items	Mean	SD	Agree (%)	Disagree (%)
Ecological agriculture should be applied as alternative to production of vegetables and fruits with chemical hormones.	4.07	1.07	69	7
I think that residue of medicine on vegetables and fruits are more dangerous than plants with chemical hormones.	3.93	.92	71	6
I think that plants with chemical hormones are the production of biotechnological applications.	3.88	.98	67	7

mones should not be given to children. Almost two thirds of student teachers believe that effects of chemical hormone appear many years later and the reason of increasing carcinogenic is the production of plants with chemical hormones. Furthermore, 75 percent of student teachers believe that there are some effects of consumed plants with chemical hormones in terms of increasing health problems in our country.

Student teachers' attitudes toward effects of chemical hormone usage on plants (ECHUP)

Almost all of the student teachers think that chemical hormone is used during growing vegetables and fruits in greenhouse or field and two thirds of them believe that the usage of chemical hormones in vegetables and fruits should be done with respect to scientific rules.

Majority of science teachers think that the usage of chemical hormones in plants should be controlled and restricted within limits as can be seen in Table 5.

Student teachers' attitudes toward effects of chemical hormone usage on ecological agriculture (ECHUEA)

The generality rather majority of student teachers (69%) think that ecological agriculture should be applied as an alternative to production of vegetables and fruits with chemical hormones. Similarly, 71 percent of participants believe

that residue of medicine on vegetables and fruits are more dangerous than plants with chemical hormones. Likewise, almost two thirds of student teachers think that plants with chemical hormones are the production of biotechnological applications as can be seen in Table 6.

DISCUSSION

In general, more than half of the knowledge questions were answered correctly by more than half of the student teachers. This result suggests that Turkish student teachers have limited knowledge and understanding of chemical hormone usage in our sample. The most correctly answered items were related to the negative effects of chemical hormones on human health and ecological equilibrium. Furthermore, the effects of chemical hormone usage on vegetables and fruits were also answered correctly by almost half or more than half of the student teachers. This result is similar to other studies on biotechnology knowledge research (Lock and Miles, 1993; Chen and Raffan, 1999; Dawson and Schibeci, 2003; Prokop et al., 2007) made in countries such as Austria, Brazil, England, Taiwan and Slovakia. In contrast, the least correctly answered items were found for the technical knowledge about usage of chemical hormones in plants, effects of chemical hormone usage on the structure of human's gene and size of vegetables and fruits. Considering these non-random differences in student teachers' knowledge among various topics relat-

Appendix 1. Knowledge and attitudes toward chemical hormone usage questionnaire.

This questionnaire contains statements about chemical hormone usage. You will be asked to express your agreement on each statement. There is no “right” or “wrong” answer. Your opinion is what is wanted. Think about how well each statement describes your willingness in participating in this class. Some statements in this questionnaire are fairly similar to other statements. Do not worry about this. Simply give your opinion about all statements. Thank you for your participation.

Name:
Section:

Gender:

Grade:
Age:

Knowledge and Attitudes toward Chemical Hormone Usage Questionnaire		completely agree	partially agree	No idea	disagree	Completely disagree
1	I think that the effect of chemical hormone on vegetables and fruits still continues in refrigerator.					
2	I think that chemical hormone is used during growing vegetables and fruits in greenhouse or field.					
3	There are also chemical hormones downgrading growing.					
4	There are chemical hormones in most of the vegetables and fruits bigger than normal size in the farmers market.					
5	I don't think that plants with chemical hormones are the production of biotechnological applications.					
6	Productions with chemical hormones make carcinogenic effect.					
7	I can not distinguish production with chemical hormones from production without chemical hormones by looking at their appearance.					
8	The usage of chemical hormones in vegetables and fruits should be done with respect to scientific rules.					
9	The usage of chemical hormones in plants increases amount of production and provides to keep stable for a long time.					
10	Chemical hormones contain harmful chemicals.					
11	The usage of chemical hormones in vegetables and fruits increases vitamin and nutrient.					
12	The usage of chemical hormones in plants should be controlled and restricted within limits.					
13	The food with chemical hormones should be given to children.					
14	The food with chemical hormones affect human's health in negative way.					
15	Consumption of food with chemical hormones can modify structure of human's gene.					
16	It is more suitable that a plant with chemical hormones used in sectors exclusive of human's food consumption.					
17	Plants with chemical hormones affect ecological equilibrium in negative way.					
18	All of the chemical hormones are toxic and can not be discarded from body easily.					
19	Chemical hormones used in agricultural production especially in especially vegetable glasshouse by reason of cheapness.					
20	Chemical hormones are stable and can pass from one live to another in food chain.					

Appendix 1. Contd.

21	Effects of chemical hormone appear many years later.					
22	Vegetables and fruits with chemical hormones are more hydrous compared to other ones.					
23	Ecological agriculture should be applied as alternative to production of vegetables and fruits with chemical hormones.					
24	There is no effect of consumed plants with chemical hormones in terms of increasing health problems in our country.					
25	The reason of increasing carcinogenic is the consumption of plants with chemical hormones.					
26	I think that residue of medicine on vegetables and fruits are more dangerous than plants with chemical hormones.					
27	I think that plants with chemical hormones are the production of biotechnological applications.					

ed to chemical hormones and the fact that all students were biology non-majors, we suggest that students' knowledge in this field reflects mostly debated issues such as effects of chemical hormones on human health in Turkish media. More research on associations between media-biased topics and students' knowledge about these topics is necessary.

The most favorable attitudes were found toward effects of chemical hormone usage on plants and ecological agriculture. On the other hand, most negative attitudes were found toward effects of chemical hormone usage on humans. The high rate of student teachers who are not able to distinguish fruits and vegetables with chemical hormones from without chemical hormones documents poor knowledge of chemical hormones resulting in negative attitudes within this dimension. In agreement with Dawson and Schibeci (2003) and Dawson (2007), we propose that greater awareness in this field can be associated with more positive attitudes. In summary, the results indicate that Turkish student teachers have not adequate positive attitudes toward effect of chemical hormone usage on humans.

Multivariate results showed significant differences in attitudes toward chemical hormone usage on humans and plants between male and female student teachers. Male student teachers have more positive attitudes toward effects of chemical hormone usage on humans and plants compared to females regardless of their class levels. These results are in fit with Prokop et al. (2007), Moerbeek and Casimir (2005), Hill et al. (1998). Gender difference in this study can be caused by female's more tentative attitudes toward new products (Moerbeek and Casimir, 2005) or less knowledge about chemical hormone usage identified in females (Prokop et al., 2007). However, our data do not support the latter explanation, because knowledge differences were not influenced by gender similar to Türkmen and Darcin (2007). With regard to the former, we showed that gender differences were greater in the attitudes toward chemical hormone usage on humans' dimension (higher health

risk) rather than in ecological agriculture dimension (low health risk). Although it is not fully clear whether the second dimension related to plants was also influenced by gender, our results mostly fit the gender paradox hypothesis (Moerbeek and Casimir, 2005). We suggest that further research involving married females with children (i.e. those that should be expected to be most cautious toward risky technologies) and without children would shed more light in the gender paradox hypothesis.

In this study, it is concerned that Turkish prospective teachers have limited knowledge and inadequate positive attitudes toward chemical hormone usage in daily life. So, science teaching programs from preschool to university should emphasize chemical hormone usage in biotechnology. In addition, teachers and prospective teachers should be educated about biotechnological applications such as usage of chemical hormones in daily life, etc. Non major teachers' views of chemical hormone usage should be considered in detail and further investigation in this area is needed.

REFERENCES

- Andersson M (1994). Sexual selection. Princeton University Press. Princeton.
- Bell R, Lederman N (2003). Understanding of the nature of science and decision making on science and technology based issues. *Sci. Educ.* 87: 352-377.
- Chen S, Raffan J (1999). Biotechnology students' knowledge and attitudes in the UK and Taiwan. *J. Biol. Educ.* 34(1): 17-23.
- Cockburn C, Ormrod S (1995). *Gender and Technology in the Making*. London: Sage Publications.
- Choi K, Cho HH (2002). Effects of teaching ethical issues on Korean school students' attitudes toward science. *J. Biol. Educ.* 37(1): 26-30.
- Cook A, Fairweather JR, Satterfield T, Hunt LM (2004). *New Zealand Public Acceptance of Biotechnology*, Research Report Agribusiness and Economics Research Unit. Lincoln University. New Zealand. 269: 93.
- Dawson V, Schibeci R (2003). Western Australian school students' understanding of biotechnology. *Int. J. Sci. Educ.* 25(1): 57-69.
- Dawson V, Schibeci R (2004). Western Australian high school students' attitudes towards biotechnology processes. *J. Biol. Educ.* 38(1): 7-12.
- Dawson V, Soames C (2006). The Effect of biotechnology education on Australian high school students' understandings and attitudes about

- biotechnology processes. *Res. Sci. Tech. Educ.* 24(2): 183-198.
- Dawson V (2007). An Exploration of high school (12–17 year old) students' understandings of, and attitudes towards biotechnology processes. *Res. Sci. Educ.* 39: 59-73.
- Heijs WJM, Midden CJH (1995). *Biotechnology: attitudes and influencing factors (Third Survey CIP-DATA)*. The Hague, The Netherlands: Royal Library.
- Hill R, Stanistreet M, Boyes E, O'Sullivan H (1998). Reactions to a new technology: students' ideas about genetically engineered foodstuffs. *Res. Sci. Tech. Educ.* 6(2): 203-216.
- Hill R, Stannistreet M, O'Sullivan H, Boyes E (1999). Genetic engineering of animals for medical research: Students' views. *Sch. Sci. Rev.* 80: 23-30.
- Jones MG, Howe A, Rua MJ (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Sci. Educ.* 84(2): 180-192.
- Klop T, Severiens S (2007). An Exploration of Attitudes towards Modern Biotechnology: A study among Dutch secondary school students. *Int. J. Sci. Ed.* 29(5): 663-679.
- Lock R, Miles C (1993). Biotechnology and genetic engineering: students' knowledge and attitudes. *J. Bio. Educ.* 27(4): 267-272.
- Lock R, Miles C, Hughes S (1995). The influence of teaching on knowledge and attitudes in biotechnology and genetic engineering contexts: implications for teaching controversial issues and the public understanding of science. *S. Sci. Rev.* 76(276): 47-59.
- Luján JL, Todt O (2000). Perceptions, attitudes and ethical valuations: The ambivalence of the public image of biotechnology in Spain. *Pub. Und. Sci.* 9: 383-392.
- Massarani L, Castro MI (2005). Attitudes towards genetics: A case study among Brazilian high school students *Pub. Und. Sci.* 14: 201-212.
- Moerbeek H, Casimir G (2005). Gender differences in consumers' acceptance of genetically modified foods. *Int. J. Cons. Stud.* 29(4): 308-318.
- Olsher G, Dreyfus A (1999). The 'ostension-teaching' approach as a means to develop junior-high student attitudes towards biotechnologies. *J. Biol. Educ.* 34(1): 24-30.
- Pardo R, Midden C, Miller J (2002). Attitudes toward biotechnology in the European Union. *J. Biotechnol.* 98(1): 9-24.
- Prokop P, Lešková A, Kubiátko M, Diran C (2007). Slovakian students' knowledge of and attitudes toward biotechnology. *Int. J. Sci. Educ.* 29(7): 895-907.
- Türkmen L, Darcin ES (2007). A Comparative Study of Turkish Elementary and Science Education Major Students' Knowledge Levels at the Popular Biotechnological Issues. *Int. J. Environ. Sci. Educ.* 2(4): 125-131.
- Verdurne A, Viaene J (2003). Consumer beliefs and attitude towards genetically modified food: Basis for segmentation and implications for communication. *Agribusiness.* 19(1): 91-113.