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Western Australian Consumers' Attitudes Towards Genetically Modified Canola (*Brassica napus*)

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Annette Baumann

*School of Agricultural and Resource Economics, University of Western Australia, 35 Stirling Hwy, WA 6009
Tel: +61 8 9380 2536, Fax: +61 8 9380 1098, Email: baumaa01@agric.uwa.edu.au*

Sarah Lumley

*School of Agricultural and Resource Economics, University of Western Australia, 35 Stirling Hwy, WA 6009
Email: slumley@agric.uwa.edu.au*

Dennis Rumley

*School of Social and Cultural Studies, University of Western Australia, 35 Stirling Hwy, WA 6009
Email: drum@cyllene.uwa.edu.au*

Alan Fenna

*School of Social Sciences, Curtin University of Technology, GPO Box U1987, WA 6845
Email: a.fenna@exchange.curtin.edu.au*

ABSTRACT

Products made from GM canola need wide consumer acceptance to be commercialised. This study aims to investigate whether or not Western Australian consumers would be willing to consume GM canola products, and how much they would be willing to pay for them. A survey covering 500 randomly selected Western Australians was made. Preliminary results show that more than 50% of consumers would buy non-GM canola oil, even if it costs one dollar more than the GM canola oil. It was suggested that the Australian Commonwealth and State Governments should establish adequate labelling of GM products, in order to increase consumers' awareness. Further socio-economic research is required on GM crops.

Keywords : herbicide tolerant canola; choice; willingness; labeling; regulations

1. Introduction and statement of the problem

Products made from genetically modified (GM) food crops, like other new agricultural technologies, need wide consumer acceptance to be commercialised. However, the pending introduction into the Australian market of GM herbicide tolerant canola (*Brassica napus*) has sparked intensive debate across all sectors of the community, scientists, agricultural policy makers and industry. The debate has considerably slowed down the commercialisation of genetically modified crops in Australia, compared to other countries such as the USA, Argentina and Canada, where commercial GM crops have been widely grown for several years (James 1999, James 2001). At present, GM pest resistant cotton is the only GM crop grown at significant commercial scale in Australia.

In contrast to the GM cotton which is predominantly processed and used by the textile industry, GM canola will be the first genetically modified crop that is mainly aimed at human consumption - canola oil - and for animal feed as canola meal. The GM canola has been genetically modified in such a way that it can tolerate numerous applications and high amounts of a particular herbicide (weedkiller) that could previously only be applied onto the field prior to sowing. Therefore, the most obvious benefit of the GM herbicide tolerant canola is its potential to support and improve the weed management strategies of grain growers, because they can apply herbicides onto the mature canola crop that they could not use before.

GM herbicide tolerant canola has been classified a “first generation” GM crop. First generation GM crops are those which have producer benefits only. They include crops that are either herbicide tolerant, pest resistant, virus or fungal disease resistant, or a combination of the above. “Second generation” GM crops are crops that are changed in such a way that the crops or the food made from the crops tastes better, has longer shelf life, a different texture, colour or nutritional value. These crops carry an obvious benefit for the consumer.

In his assessment of public perceptions of genetic engineering in Australia, Kelley (1995) used a second generation GM tomato as a case study. In the study design, the tomato had a better texture, costed less than non-GM tomatoes, and might make a valuable export. Lähteenmäki *et al.* (2002) tested the acceptability of GM cheese that had taste and health benefits. While a lot of research has been carried out in the area of consumer acceptance or perceptions of second generation GM crops and GM food (see, for example, Lähteenmäki *et*

al. 2002; da Costa *et al.* 2000; Frewer *et al.* 1995), there is a knowledge gap with regard to consumer attitudes towards GM canola, a typical first generation GM crop. This study is trying to fill this knowledge gap, by taking Western Australian consumers as a case study.

It is important to investigate Western Australian consumers' perceptions of GM canola specifically and in detail, because the canola, being a first generation GM crop, does not confer any direct benefits for the consumers and, hence, consumers might have different attitudes towards the GM canola than they would have towards a second generation GM crop, such as the tomato described by Kelley (1995) or the cheese used by Lähteenmäki (2002).

The aim of this study is to find out whether or not Western Australian consumers would be willing to consume or to buy genetically modified canola, and how much they would be willing to pay for the GM canola. In addition, we would like to learn what type of regulations or controls of genetically modified food crops is most favoured by Western Australian consumers.

2. Methods

This study was conducted in the Western Australian State. The survey area lies between latitudes 13.6°S to 35.0°S and between longitudes 112.9°E to 129.0E°. Fig. 1 depicts the study area.

A comprehensive pilot study was undertaken with a deliberate sample prior to questionnaire design. Questionnaires were sent by postal mail to 500 Western Australians during December 2002. Survey participants were randomly selected without replacement from the four Telstra telephone directories that cover the whole of the Western Australian State. The titles of the directories are:

- White pages : Central & Eastern (WA) : area code 08 (2002/2003)
- White pages: Christmas Island, Cocos (Keeling) Islands, Great Northern (WA) : area code 08 (2002/2003)
- White pages: South Western, Western Australia : area code 08 (2002/2003)
- White pages: Perth, Western Australia : area code 08 (2002/2003)

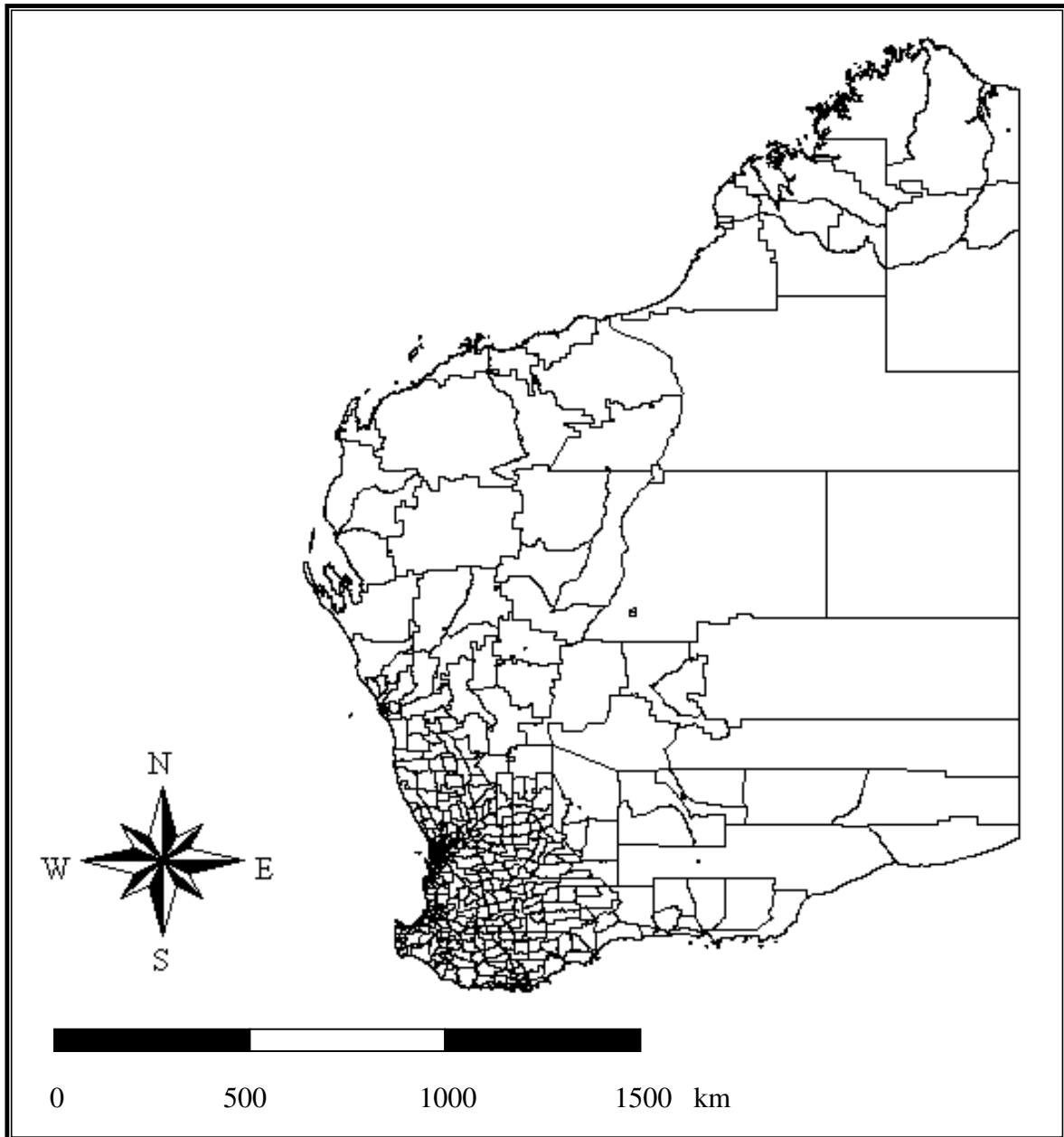


Fig.1: The study area: Western Australian State

A random number generator was used to select the survey participants randomly. For each address, three random numbers were generated: one for the page number, the second for column number, and the third for the line number.

In order to take into account the population distribution of Western Australia, 400 of the 500 addresses were selected from the Perth Metropolitan area. The remaining 100 addresses were selected from the South Western Region (50 addresses), Central and Eastern (25) and Great

Northern (25). Questionnaires consisted of 17 questions split into three parts with separate headings. The headings were:

1. Canola and other food
2. Growing herbicide tolerant canola
3. Regulation of genetically modified food crops.

Questions about personal details of the respondents were included at the end of the questionnaire, together with questions about their Internet access and an optional question asking whether religious beliefs influenced the respondent's attitude towards GM canola. The last page of the questionnaire was left blank, and participants were invited to freely express their comments and suggestions on the empty page.

Of the questionnaires dispatched, 41 could not be delivered to their destination, due to incomplete addresses or relocated recipients. Of the 459 questionnaires that could be delivered to their destination, 99 were completed and returned by respondents, resulting in a return rate of 22%. Personal discussions with experienced social researchers revealed that this is a good return rate for Western Australian circumstances. The demographic and socio-economic characteristics of the survey sample are shown in Tab.1.

All 99 respondents answered the question about their gender. As is illustrated by Tab.1, there are more male than female respondents in this survey, with 59% of the 99 respondents being male and the remaining 41% female.

As can be observed from Tab. 1, 98 of the 99 respondents provided information about their age category. The age groups 25-34, 35-44, 45-54 and 55-64 are nearly equally strongly represented by the survey participants, with 18%, 23%, 19% and 16% of respondents belonging to the age categories, respectively. Slightly fewer (11%) of the survey participants are between 65 and 74 years of age (Tab. 1). The least strongly represented age groups are age groups 75-84 (7% of respondents) and the under 25's (5%). No respondent was older than 84 years.

The question about the educational level of the survey participant was answered by 97 respondents. Tab. 1 shows that all educational levels are represented in the survey sample,

including primary education, secondary education, TAFE certificates / diploma and university education as the highest educational level completed. The largest proportion of respondents (38%) has TAFE certificates / diploma as highest educational level completed. About the same proportions of the survey sample have secondary or university education, with 28% and 27%, respectively. It was also noted that 7% of the survey respondents have primary education as the highest educational level completed (Tab. 1).

Tab.1: Demographic and socio-economic characteristics of survey sample

Demographic and socio-economic characteristics	Count	% of total*
<i>1. Gender (N=99)</i>		
male	58	59
female	41	41
<i>2. Age groups (N=98)</i>		
<25	5	5
25-34	18	18
35-44	22	23
45-54	19	19
55-64	16	16
65-74	11	11
75-84	7	7
<i>3. Education (N=97)</i>		
primary	7	7
secondary	27	28
TAFE certificates / diploma	37	38
university	26	27
<i>4. Income groups (N=91)</i>		
up to \$ 9,999	6	7
\$ 10,000 to 19,999	20	22
\$ 20,000 to 29,999	9	10
\$ 30,000 to 49,999	32	35
\$ 50,000 to 69,999	7	8
\$ 70,000 to 79,999	9	10
\$ 80,000 to 99,999	4	4
\$ 100,000 to \$ 150,000	2	2
\$ >150,000	2	2

* percentages may not add to 100, due to rounding

Of the survey participants, 91 respondents revealed to which income category they belong (annual income before tax). Tab. 1 illustrates that more than two thirds of the survey sample belong to very low to middle income categories, with 22% of respondents earning A\$ 10,000 to 19,999 annually, 10% earning A\$ 20,000 to 29,999, and 35% generating an income of A\$ 30,000 to 49,999 per annum (Tab. 1). There are 8% of survey participants in the income class

A\$ 50,000 to 69,999, and a further 10% receive an income of A\$ 70,000 to 79,999 each year. The remaining 15% of respondents are distributed over the extremely low and extremely high income classes, with 7% of survey participants in the income category up to A\$ 9,999, 4% in the category A\$ 80,000 to 99,999, and 2% in each of the income classes A\$ 100,000 to 150,000 and more than 150,000 annual income before tax (Tab. 1).

The calculation of frequencies and percentages, as a method of analysing qualitative observations, is a widely used method in research for the evaluation of consumer perceptions of genetically modified food (Roy Morgan Research 2002; Sittenfeld and Espinoza 2002; Oda and Soares 2000; Kelley 1995). In accordance with those methods, data obtained from the questionnaires were evaluated using standard spreadsheet and database softwares, and results were presented as percentage distributions or as total frequencies.

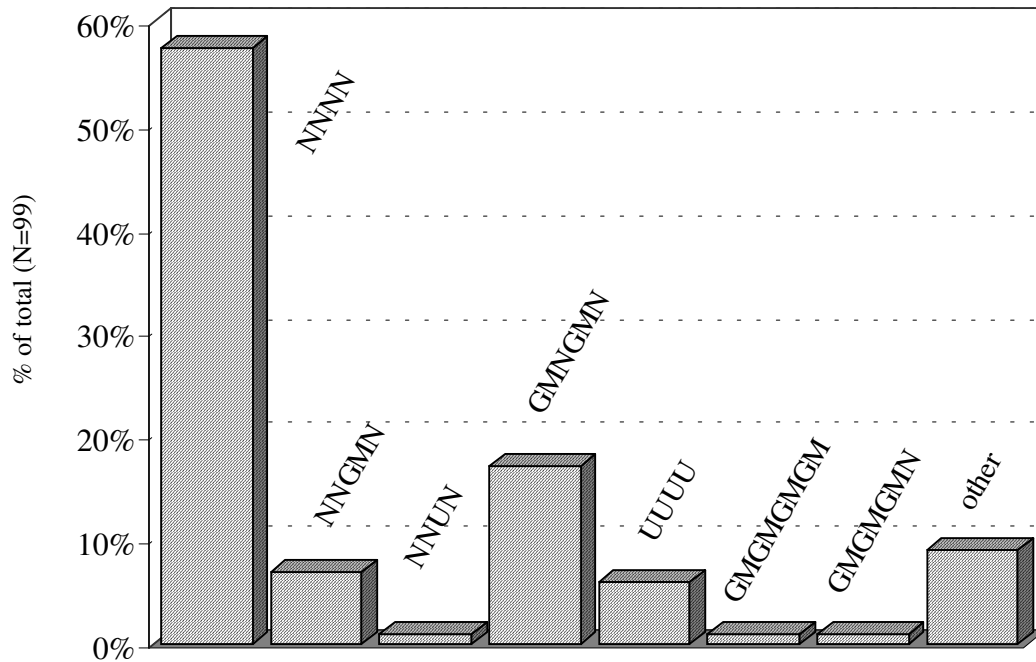
3. Results

3.1 Answers to the question: Assume that you had the choice between a GM canola oil and a non-GM canola oil. Which one of the two would you choose if...

Respondents were given four hypothetical query scenarios. In each scenario, the respondents were asked to choose between a 750 ml bottle of GM canola oil and a 750 ml bottle of non-GM canola oil which had price differences of 50 cents and 1 dollar (Australian). In each scenario, respondents were given the option of selecting either the GM canola oil (GM), the non-GM canola oil (N), or remaining undecided (U). The four scenarios are elaborated as follows:

Scenario 1)	Cost of the GM canola oil:	\$ 2.50
	Cost of the non-GM canola oil :	\$ 3.00
Scenario 2)	Cost of the GM canola oil:	\$ 3.00
	Cost of the non-GM canola oil:	\$ 2.50
Scenario 3)	Cost of the GM canola oil:	\$ 2.50
	Cost of the non-GM canola oil:	\$ 3.50
Scenario 4)	Cost of the GM canola oil:	\$ 3.50
	Cost of the non-GM canola oil:	\$ 2.50

Respondents chose various combinations of GM canola oil (GM), non-GM canola oil (N) and undecided (U) in the four scenarios. The percentage distribution of respondents in various combinations of choice preferences in the four scenarios is illustrated in Fig. 2.



Preferences for GM canola oil (GM), non-GM canola oil (N), or undecided (U)

Fig. 2: Choice preferences of Western Australians for GM canola oil, non-GM canola oil, or neither of the two, in four given hypothetical scenarios

As can be observed from Fig. 2, of the 99 respondents, 57 (56%) always chose the non-GM canola oil (N) in all of the four scenarios (N,N,N,N). This is less than the 65% of all Australians who said that they would not buy food they knew was genetically modified in a national opinion poll carried out by AC Nielsen in June 2000 (Toyne 2001).

It was also noted that 7 respondents (7%) would choose the GM canola oil (GM) if it is 1 dollar cheaper than the non-GM oil (scenario 3), but would otherwise buy the non-GM canola oil (N,N,GM,N). Of the survey sample, 17 respondents (17%) always chose the cheaper option in all four scenarios (GM,N,GM,N). Six respondents (6%) remained undecided (U) in all four scenarios about which canola oil to choose (U,U,U,U). One respondent chose to be undecided about which canola oil to buy if the GM canola oil was 1 dollar cheaper than the

non-GM canola oil (scenario 3), but chose the non-GM canola oil in all other scenarios (N,N,U,N). One respondent preferred the GM canola oil in all four scenarios (GM,GM,GM,GM). One respondent chose the GM canola oil in each of the scenarios 1 to 3, but would buy the non-GM canola oil in scenario 4, where it is 1 dollar cheaper than the GM canola oil (GM,GM,GM,N). The remaining 9 respondents (9%) preferred various other combinations of choices.

3.2 Demographic and socio-economic characteristics of four groups of Western Australians based on their different consumption preferences of canola oil

In order to learn more about the consumption preferences of canola oil of Western Australian consumers, four groups of respondents who had chosen different combinations of options in the four scenarios described above were selected, and some of their demographic and socio-economic characteristics, namely; gender, age group, education, income group, were further investigated, with the aim of further analysis and characterisation of the four groups. Such characterisation enables to gain more understanding about these response groups with respect to their choice. The understanding of different groups' preferences enhances in decision making and market strategy development.

The four groups of respondents are:

- Group 1: Respondents who chose non-GM canola oil in all four scenarios (N,N,N,N). The total number of respondents in Group 1 is 57.
- Group 2: Western Australians who chose the non-GM canola oil in all scenarios, except for scenario 3, where they chose GM canola oil, which was 1 dollar cheaper than the non-GM canola oil (N,N,GM,N). The total number of respondents for Group 2 is 7.
- Group 3: Western Australians who decided for the cheapest option in all four scenarios (GM,N,GM,N). The total number of respondents in Group 3 is 17.
- Group 4: Survey participants who were undecided in all of the four scenarios about which canola product to choose (U,U,U,U). The total number of respondents for Group 4 is 6.

Gender distribution of the four groups

The distribution of genders for Groups 1 to 4 was examined, in order to find out which proportion of males and females are in each group, and whether there is a marked difference in the choice preferences of Western Australian women and men. The gender distribution of respondents in Groups 1 through 4 is shown in Fig. 3.

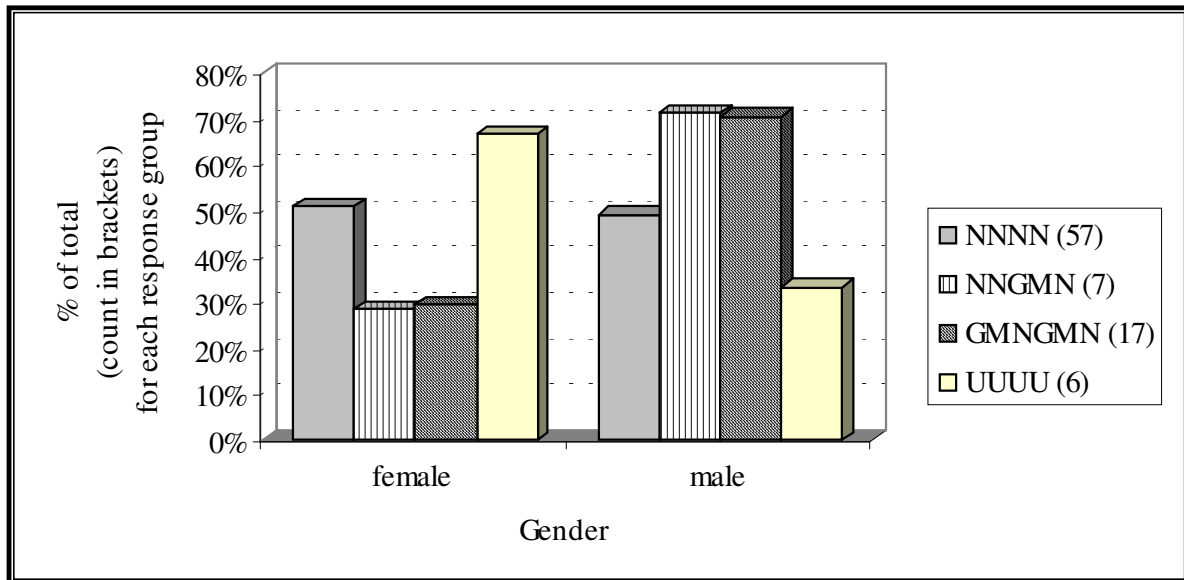


Fig. 3: Gender distribution of four groups of Western Australians based on their different consumption preferences of canola oil

As can be seen from Fig. 3, there are approximately the same numbers of males (N=28) and females (N=29) in Group 1 (N,N,N,N). In contrast, there is a considerably higher percentage of males in Groups 2 and 3 (N,N,GM,N and GM,N,GM,N, respectively), with 71% male and 29% female respondents in each of the two groups. The group of respondents who were undecided in all four hypothetical scenarios (U,U,U,U) has a markedly higher proportion of females (67%) than males (33%).

Age distribution of the four groups

The age distribution of the respondents in the four groups was assessed, in order to find out whether considerable age differences exist between the four respondent groups, and which proportion of respondents of each group falls into which age category. Fig. 4 shows the age distribution of respondents in each of the four groups.

As can be noted from Fig. 4, respondents in Group 1 (N,N,N,N) are fairly evenly distributed among age groups from 25 to 74 years, with 21% of respondents in each of the age groups 35-

44, 45-54, 55-64, and 18% of Group 1 respondents in age group 25-34. About 7% of Group 1 respondents are below 25 years of age, a further 7% are between 65 and 74 years old, and nearly 4% are between 75-84 years old (Fig. 4).

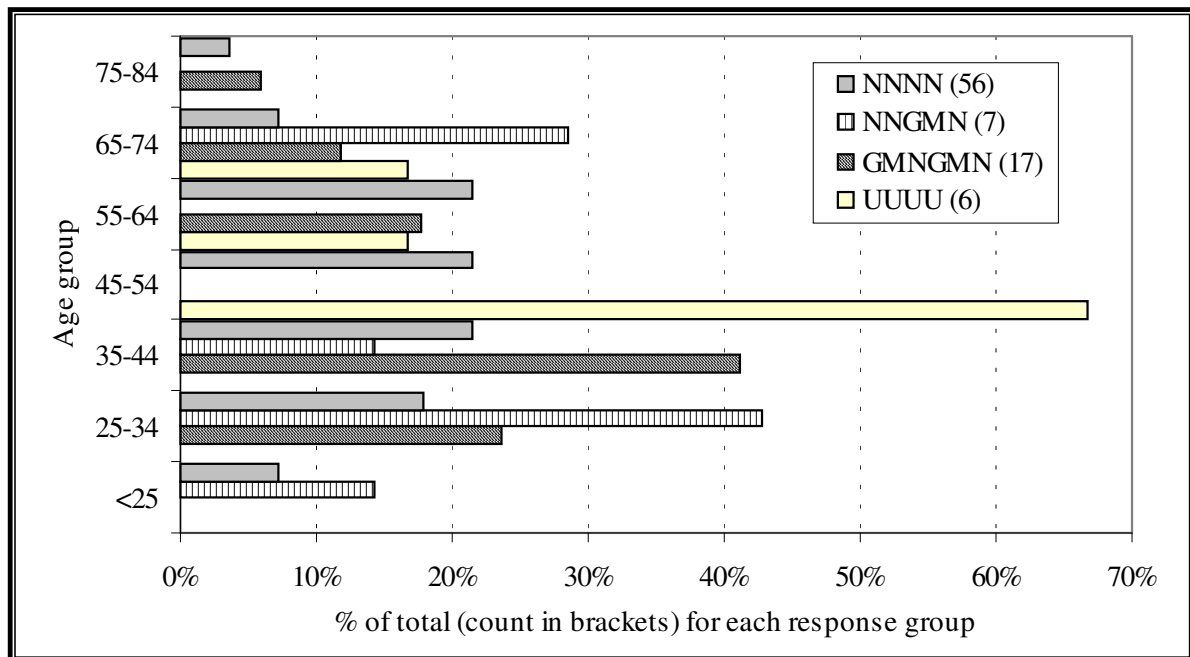


Fig. 4: Distribution of age categories for four groups of Western Australians based on their different consumption preferences of canola oil

A very high proportion (43%) of respondents in Group 2 (N,N,GM,N) belongs to the age group 25-34, while 29% are between 65 and 74 years of age. About 14% of Group 2 respondents are in the age group 35-44, and a further 14% are younger than 25 years. No respondent of Group 2 falls under any of the age categories 45-54, 55-64, and 75-84 years.

The highest percentage (41%) of respondents in Group 3 (GM,N,GM,N) belongs to the age group 35-44 years. The second largest proportion of Group 3 respondents (24%) are in the age category 25-34. The remaining Group 3 respondents are 55 years and older, with 18%, 12% and 6% of respondents in the age groups 55-64, 65-74 and 75-84, respectively. No respondents of Group 3 fall under the age groups 45-54 and <25 years (Fig. 4).

Two thirds (67%) of respondents in Group 4 (U,U,U,U) belong to the age group 45-54. The remaining respondents of Group 4 are between 55 and 74 years old, with 17% of respondents in each of the two age groups 55-64 and 65-74. There are no respondents of Group 4 in any of the age categories <25, 25-34, 35-44, and 75-84 years (Fig. 4).

Education of the four groups

In order to investigate whether the educational level of respondents relates to their choice preferences, it was assessed which percentage of respondents in Groups 1 through 4 have completed primary, secondary, or higher educational level. The result is shown in Fig. 5.

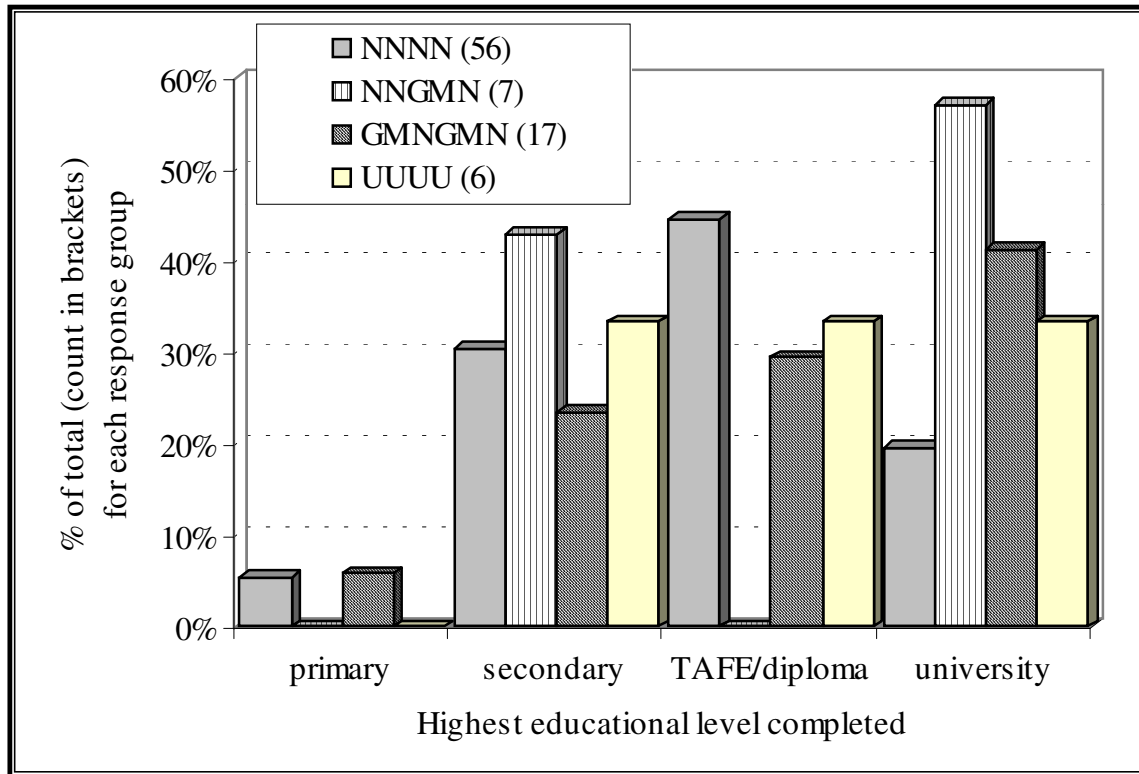


Fig. 5: Highest educational level completed for four groups of Western Australians based on their different consumption preferences of canola oil

As illustrated by Fig. 5, the highest proportion of respondents (45%) from Group 1 (N,N,N,N) has TAFE certificates and/or diplomas. In addition, more than 30% of respondents from Group 1 have secondary education as the highest educational level. About 20% of respondents from Group 1 have completed a university degree, whereas 5% have primary education.

57% of respondents from Group 2 (N,N,GM,N) have a university degree, while 43% have completed secondary education (Fig. 5). No respondent in Group 2 has primary education or TAFE certificates / diploma as the highest educational level completed.

41% of the respondents in Group 3 (GM,N,GM,N) have completed university education. 29% and 24% of Group 3 respondents have TAFE certificates / diploma and secondary education,

respectively. 6% of respondents in Group 3 have primary education as the highest educational level completed.

Respondents in Group 4 (U,U,U,U) are evenly split into respondents with university education (33% of respondents), TAFE certificates / diploma (33%) and secondary education (33%). There are no respondents in Group 4 who have primary education as the highest educational level completed (Fig. 5).

Income distribution of the four groups

In order to find out what percentage of respondents in each of the four groups belongs to which income group, the income categories of the respondent of all four groups were examined in more detail. This might help to explain whether higher income earners tend to have choice preferences that are different from the preferences of lower income earners in the four given hypothetical scenarios. The assessment result is shown by Fig. 6.

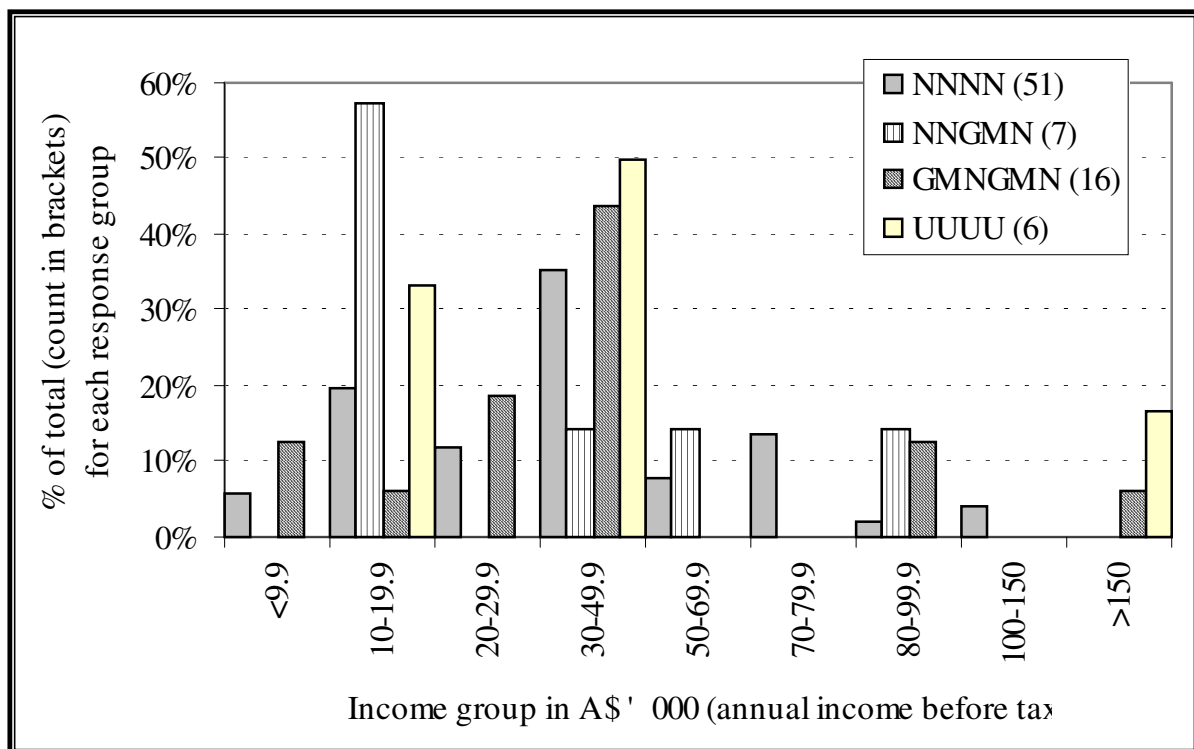


Fig. 6: Income categories for four groups of Western Australians based on their different consumption preferences for canola oil

The highest proportion of respondents in Group 1 (N,N,N,N) belongs to a middle income category, with 35% of respondents earning between A\$ 30,000 and A\$ 49,999 per annum. About 20% of respondents in Group 1 fall into the low income category (A\$ 10,000-19,999).

There are approximately equal proportions of respondents from Group 1 in the income categories A\$ 70,000-79,999 (14% of respondents) and A\$ 20,000-29,999 (12%). A further 8% of Group 1 respondents earn between A\$ 50,000 and 69,999 each year. In addition, 6% of respondents in Group 1 belong to the lowest income category, with an annual income of less than A\$ 9,999. The remaining 6% of respondents of Group 1 are very high income earners, with 4% and 2% falling under income groups A\$ 100,000-150,000 and A\$ 80,000-99,999, respectively (Fig. 6). There are no respondents of Group 1 in the highest income category (A\$ >150,000).

As can be noted from Fig. 6, more than half (57%) of the respondents in Group 2 (N,N,GM,N) belong to a low income class, with annual income of A\$ 10,000-19,999. The remaining Group 2 respondents are evenly distributed among the three income categories A\$ 30,000-49,999 (14% of respondents), A\$ 50,000-69,999 (14%) and A\$ 80,000-99,999 (14%). There are no respondents of Group 2 in the following income classes: A\$ <9,999; A\$ 20,000-29,999; A\$ 70,000-79,999; A\$ 100,000-150,000; and A\$ >150,000 (Fig. 6).

Nearly half of the respondents of Group 3 (GM,N,GM,N) have a middle income of A\$ 30,000 to A\$ 49,999 (Fig. 6). In addition, 19% of Group 3 respondents are in the next lower income class which ranges from A\$ 20,000 to A\$ 29,999. A further 19% of Group 3 respondents are split into two very high income categories: 13% in the category A\$ 80,000-99,999 and 6% in the highest income category (A\$ >150,000 annual income before tax). Interestingly, there are also 19% of respondents from Group 3 in the two lowest income groups: 13% of respondents in the income category lower than A\$ 9,999 and 6% in the A\$ 10,000-19,999 income class (Fig. 6).

It was found that 50% of Group 4 respondents have a middle income of A\$ 30,000-49,999. One third of Group 4 respondents earn A\$ 10,000 to 19,999 annually. In addition, there is also a high proportion (>16%) of Group 4 respondents in the highest income category (A\$ >150,000 annual income before tax).

Other choice combinations

One of the respondents, who does not belong to any of the Groups 1 through 4 described above chose the GM canola oil in all four hypothetical scenarios (GM,GM,GM,GM). The

respondent belongs to the age category 45-54 years and is male. The income group and educational level of the respondent are not known.

Another respondent chose the GM canola oil in scenarios 1 through 3, but decided for the non-GM canola oil in the last scenario where the non-GM canola oil was 1 dollar cheaper than the GM canola oil (GM,GM,GM,N). This respondent is male, falls under the age group 25-34 years and has TAFE certificates / diploma as the highest educational level completed. The income category (annual income before tax) for the respondent is A\$ 50,000-69,999.

There are nine respondents who made ‘irrational’ choices between the GM and the non -GM canola oil in the four scenarios. For example, 2 respondents always chose the more expensive option in all four scenarios. One respondent always chose non-GM canola oil, except for scenario 4 (GM 1 dollar more expensive) where the respondent chose the GM canola oil. Another respondent chose GM canola oil in scenario 1, where it was 50 cents cheaper than the non-GM canola oil, but chose non-GM canola oil in all other scenarios.

One respondent would buy the GM canola oil in scenarios 1 and 2, was undecided in scenario 3 (where the GM canola oil was 1 dollar cheaper than the non-GM canola oil), and decided to choose the non-GM canola oil in scenario 4. The remaining 4 respondents had various other irrational choice combinations of GM, non-GM and undecided.

3.3 Answers to the question: Under the current Australian regulation, canola oil produced from genetically modified (GM) canola does not need a label (sign) which says that the oil is made from GM canola. Do you think that canola oil made from GM canola should have a label (sign) on the oil bottle or container on which it says that the oil was made from GM canola?

Labelling laws became effective in Australia on 7 December 2001. Any product produced with gene technology after this date has to be clearly labelled, for example: ‘Soyflour, made from genetically modified soybeans.’ The labelling laws in Australia are among the most stringent regulations world-wide, allowing only for a threshold of up to 1% GM material in food that is not declared as GM food on the label (ANZFA 2002).

In Australia, any food that contains more than 1% genetically modified organisms (GMO) in the final product must be labelled “genetically modified”. Some other countries that have less strict regulations allow for bigger thresholds, for example, Japan and Korea have a 5% threshold for “unintended presence” of GM material. Similar labelling legislation with varying degrees of thresholds for unintended GMO presence has been or will soon be in force in several other countries, for example, New Zealand, the European Union (15), Saudi Arabia and Thailand.

The Commission of the European Union (15) recently agreed upon a new Directive which proposes the labelling of genetically modified processed food, even if the modified protein and/or DNA is not present in the final food (Danish EU Presidency 2002).

Unlike the proposed European Directive, the Australian GM food labelling rules exempt highly refined foods, where the genetically modified DNA and/or protein is not present in the final product (ANZFA 2002). Those products do not have to be labelled “genetically modified.” This includes foods such as oils and margarines.

Since the current Australian regulation does not require labels for genetically modified processed food items, it does not allow Western Australians to make a choice between, for example, GM canola oil and non-GM canola oil, like they could in the four hypothetical scenarios. In order to find out whether it is important for Western Australians to be able to choose between non-GM canola oil and GM canola oil, all survey respondents were asked whether they think that the GM canola oil should have a label (sign) which says that it has been produced from genetically modified canola. Respondents were given the following three options in answering the question:

- a) Yes, GM canola oil should have a label (sign) which says that it is GM
- b) No, GM canola oil should not have a label (sign) which says that it is GM
- c) Don't know / undecided

Nearly 90% of the survey sample answered “yes, GM canola oil should have a label.” Only 5% thought that such a label was not necessary. Six of the 99 respondents (6%) were undecided about whether or not GM canola oil should have a label which says that the oil was made from genetically modified canola.

Respondents from all four response groups supported the labelling of the genetically modified canola. In Group 1 (N,N,N,N), 55 out of the 57 respondents (97%) were in favour of labelling GM canola oil, and all of the Group 2 respondents (N,N,GM,N) answered that GM canola oil should be labelled as being GM (100%). Interestingly, there were also 11 out of the 17 respondents from Group 3 (GM,N,GM,N) who supported labelling (65%), even though response Group 3 comprises those respondents who had based their choices in the four hypothetical scenarios mainly on product price, rather than production method. In Group 4 (U,U,U,U), 5 of the 6 respondents (83%) said they would like GM canola oil to be labelled as being GM.

3.4 Answers to the question: In your view, who or what should regulate the growing of genetically modified crops in Western Australia?

In order to investigate Western Australians' preferences regarding the regulation of GM crops and food safety issues, the survey questionnaire included several questions in which respondents could express their preferences for various regulatory regimes by choosing one or more options among several given options.

In the section: "Regulation of Genetically Modified Food Crops" of the questionnaire, respondents were invited to express their opinions about which Commonwealth and State bodies and organisations they find most appropriate for the regulation of the growing of genetically modified crops in Western Australia. Respondents could choose one or more options from a set of six given options.

The options given were:

- a) The Commonwealth Government of Australia
- b) The Western Australian State Government
- c) The biotechnology industry which produces and sells the seeds for the GM crops
- d) The Australian Competition and Consumer Commission
- e) No regulation through institutional body, the Australian market should regulate GM crops
- f) Other parties (please specify) _____

In total, 169 choices were submitted by the 99 respondents, which means that each respondent submitted 1.7 choices on average. The total number of choices given by the respondents to each regulatory option are depicted in Fig. 7.

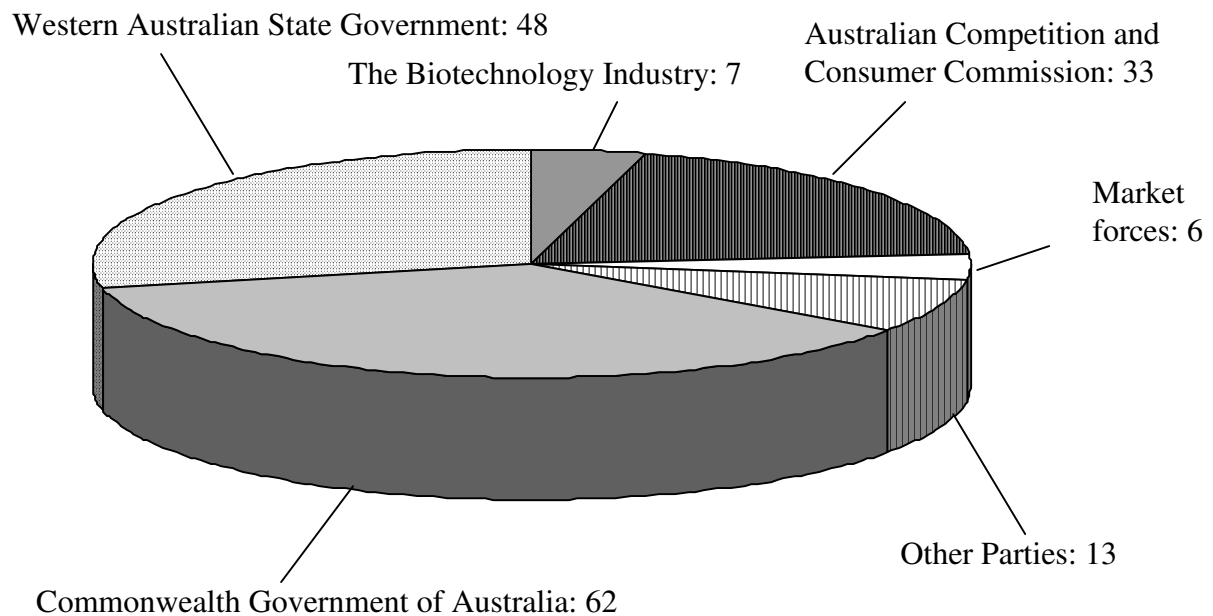


Fig. 7: Choices of Western Australians about who should regulate the growing of GM crops. Total number of choices: N=169

As is illustrated by Fig. 7, the institution that is most preferred by Western Australians for the regulation of GM crops in Western Australia is the Commonwealth Government of Australia, which was chosen 62 times. The Western Australian Government (48 choices) is the second most preferred GM crop regulator. The Australian Competition and Consumer Commission (ACCC) was chosen 33 times. The option “other parties” was chosen 13 times, and respondents mentioned different organisations and institutions, such as environmental groups, all Australian people / referendum, educated and informed consumers, Western Australian Department of Agriculture, Environmental Protection Authority (EPA), Department of Health, Commonwealth Scientific and Industrial Research Organisation (CSIRO), and an independent and judicially chaired body funded by the Commonwealth Government, in this option. The biotechnology industry which produces and sells the seeds for GM crops and the Australian market are the least preferred options of the respondents for the regulation of genetically modified crops in Western Australia, with 7 and 6 choices, respectively.

3.5 Answers to the question: Before a new food item is released onto the Australian market, it has to be tested for its safety. In your view, who should carry out such tests?

Respondents were invited to express their opinion about which Australian bodies and organisations they find most appropriate for the testing of new food items before these are released onto the Australian market. Respondents could choose one or more options from a set of six given options. The options were:

- a) The Commonwealth Government of Australia
- b) The Australia New Zealand Food Authority
- c) The firm that produces and markets the new food item
- d) The Australian Competition and Consumer Commission
- e) An independent researcher or research team
- f) Other agencies or government organisations (please specify) _____

In total, 210 choices were submitted by the 99 respondents. Hence, each respondent submitted 2.1 choices on average. Fig. 8 illustrates how many choices were given to each option by the survey respondents.

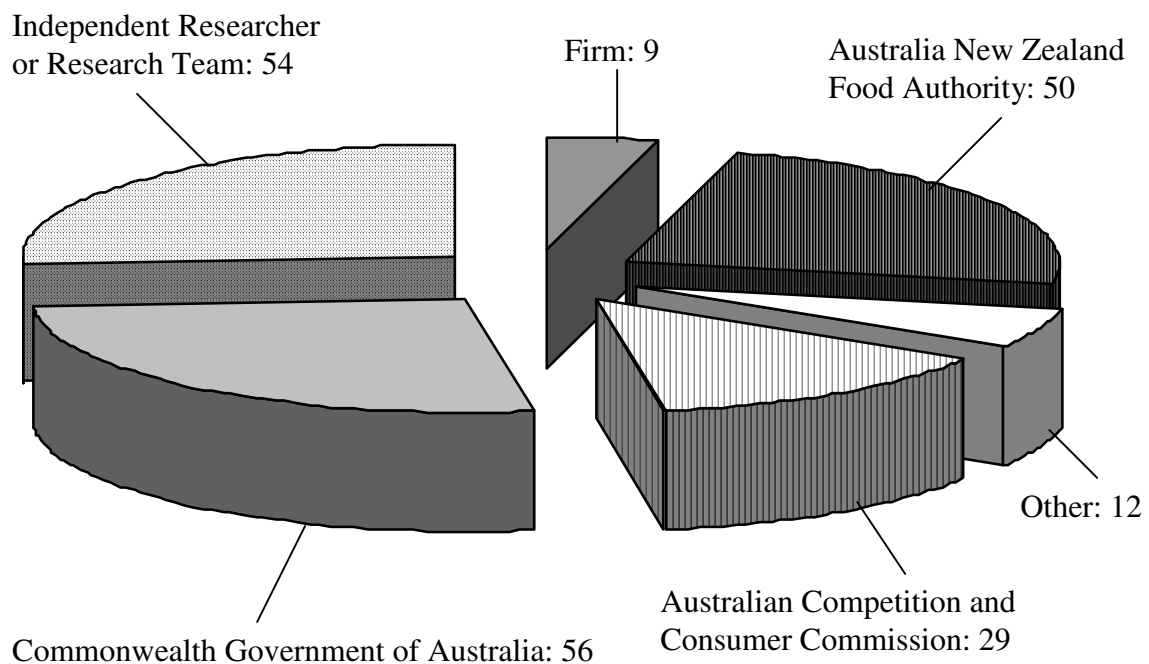


Fig. 8: Choices of Western Australians about who should carry out food safety tests in Australia. Total number of choices: N=210

The organisations or government agencies favoured most by Western Australians for having the responsibility of carrying out food safety tests prior to the release of a new food item are the Commonwealth Government of Australia (56 choices) and independent researchers or research teams (54 choices), followed by the Australia New Zealand Food Authority, which received 50 choices (Fig. 8). The Australian Competition and Consumer Commission was chosen by 29 respondents, making it the fourth most favoured body to carry out food safety tests. The category “other” was chosen 12 times, and respondents mentioned various government organisations and agencies in this category, for example, CSIRO, EPA, Department of Health, environmental research groups, multiple agencies with varied interests, and anybody/company that stands to profit. Only 9 respondents preferred the firm that produces and markets the new food item to undertake food safety tests in Australia (Fig. 8).

4. Discussion

The results presented in the previous chapter suggest that, at present, there is a large proportion of Western Australians who would be willing to pay considerably more for non-GM produce in order to avoid consuming GM produce. In the four given hypothetical scenarios, 56% of the survey respondents expressed their willingness to pay 1 dollar (Australian) more for non-GM canola oil, an additional 7% of respondents would be willing to pay 50 cents more. The percentage of respondents who would always choose the cheaper produce, regardless of the method with which it has been produced, is 17%. The results also suggest that there is a fairly high proportion of Western Australians (6% of the survey sample) who are currently undecided about whether or not to consume food that has been made with gene technology. Only 2% of the survey sample are willing to pay more for GM products at present.

It was noted that 9% of the survey respondents chose GM and non-GM products quite irrationally in the four scenarios, which might in part be due to difficulties in understanding the survey questions, or because of inadequate reading of the questions and given options for answers.

If the above percentage distributions of respondents who gave “rational” answers are interpreted for the total Western Australian population (in Dec 2000: 1,897,199 people: ABS

2001), it can be inferred that there are currently about 1.2 million Western Australians who do not want to consume GM food and would be willing to pay between 50 cents and 1 dollar more for GM free produce. About 320,000 would buy and consume GM products, if they are cheaper than non-GM products. Nearly 115,000 Western Australians are undecided. Approximately 38,000 would be willing to pay more for food that has been produced with gene technology, because they perceive benefits from the consumption of GM food.

After the initial analysis of the willingness to pay for GM and non-GM food, four groups of respondents were formed, based on the choice of the respondents in the four hypothetical scenarios (see Chapter 3). Such categorisation of some of the survey respondents into different groups is useful, because it allows to analyse the demographic and socio-economic characteristics of the respondents in the four groups. Despite the marked differences in size of the four groups (largest group: 57 respondents, smallest group: 6), it is possible to identify and describe tendencies in the distribution of gender, age categories, education and income classes for the four groups.

The analysis of gender distribution of the four groups shows that there are approximately equal proportions of men and women in Group 1 (N,N,N,N). There is a noticeable similarity between the distribution of females and males in Group 2 (N,N,GM,N) and Group 3 (GM,N,GM,N), with more than two times more men than women in each of the two groups. In contrast, there is a much higher proportion of female respondents in Group 4 (U,U,U,U), compared to male respondents.

The distribution of age categories for the four groups also shows some interesting tendencies: While respondents of Group 1 (N,N,N,N) are fairly evenly distributed over all age categories, the age distribution of Group 2 (N,N,GM,N) and Group 3 (GM,N,GM,N) respondents shows a marked tendency towards the younger and middle ages. Nearly 60% of Group 2 respondents are 34 years or younger, more than 70% are 44 years and younger. In addition, there is also a fairly high proportion of Group 2 respondents in the age group 65-74.

The distribution of age groups for respondents in Group 3 is similar to Group 2, albeit they tend to be slightly older than Group 2 respondents: 65% of the respondents are between 34 and 44 years old, while no respondent in Group 3 is younger than 25 years. To compare, 14% of Group 2 respondents are younger than 25 years.

The respondents in Group 4 (U,U,U,U) tend to be mostly from middle or older age groups, with two thirds of respondents belonging to the age group 45-54, and the remaining one third being 55 years and older. No respondents in Group 4 are younger than 45 years of age.

The evaluation of educational categories for the four groups reveals that Group 1 respondents (N,N,N,N) are present in all educational levels, but tend to be most strongly represented in the TAFE certificates / diploma and the secondary education class. More than half (57%) of the respondents in Group 2 (N,N,GM,N) have university education, which might be in line with the fact that this is the “youngest” group. There is also a very high proportion of Group 2 respondents with secondary education (43%), while no respondents from Group 2 have TAFE certificates / diploma or primary education as the highest educational level completed. Similar to Group 2 respondents, most respondents in Group 3 (GM,N,GM,N) have university education, but they are also represented in the other three educational categories. Respondents from Group 4 (U,U,U,U) are equally strongly represented in the secondary, TAFE certificates / diploma and university educational levels. There are no respondents from Group 4 who have primary school as the highest educational level completed.

Respondents from Group 1 (N,N,N,N) are represented in all income categories, except for the highest income category (A\$ >150,000 annual income before tax). The highest proportion of Group 1 respondents have a middle income of A\$ 30,000-49,999. The income structure of Group 2 (N,N,GM,N) respondents is different. In this Group, more than half of the people have a very low income (A\$ <20,000). This could be explained in part by the high proportion of very young people in this group who might be just at the beginning of their professional career and might not be receiving high salaries as yet. The other respondents in Group 2 are predominantly distributed over the middle income classes (A\$ 20,000-69,999). In addition, 14% of Group 2 respondents fall under the high income category, with annual income of A\$ 80,000 to 99,999 (before tax).

Respondents from Group 3 (GM,N,GM,N) have an income structure that is similar to that of Group 2 respondents, but is shifted towards the middle income categories. In this Group, about half of the respondents have an annual income of A\$ 30,000 to 49,999. This might be due to the slightly older age structure of Group 3, compared to Group 2. Respondents from Group 3 might be further advanced in their professional career than Group 2 respondents and therefore be earning more. There is also a fairly high proportion of Group 3 respondents in the

lower income categories, with more than one third of the respondents earning between A\$ 0,00 and 30,000 per annum.

Similar to Group 1 and Group 3 respondents, the respondents in Group 4 also represent both low income, middle income and very high income earners. However, at the same time, the income distribution for respondents from Group 4 (U,U,U,U) is much more polarised than the distribution from all other respondent groups, as the respondents from Group 4 are represented in only 3 of the 9 income categories.

Respondents were nearly uniform in their view that genetically modified canola oil should be labelled as being GM, which will enable them to decide whether to buy the GM product or not, with nearly 90% of respondents supporting such a label and only 5% clearly opposing a label for the GM canola oil.

Interestingly, there was also a large majority of respondents from Group 3 (65%) who supported labelling of GM canola oil, even though, in the four hypothetical scenarios, these respondents had based their consumption preferences of canola oil on the product price, not on the production method. This suggests that Western Australian consumers who are willing to consume genetically modified produce if it is cheaper than non-GM produce would nevertheless prefer the GM produce to be labelled, so that they are informed about what they are buying.

A recent experiment carried out in France with 112 participants found that consumers are often unaware of the labelling indicating that a product is GM (Noussair *et al.* 2002). The authors recommend for France the use of a standardised logo rather than a long text, to ensure that the information of the GM content is transmitted to the consumer.

Western Australian consumers also have strong views about the regulation of the growing of genetically modified crops in Western Australia, and many Western Australians firmly believe that the regulation should be a shared responsibility between two or more government agencies or institutions. An average of 1.7 choices was selected by each survey respondent. The Commonwealth Government of Australia received the largest number of choices, making it the most preferred GM crop regulator by Western Australians for GM crops that are grown in Western Australia.

This is an interesting result, and it leaves the question open why Western Australians think that GM crops that grow in Western Australia can be better regulated and controlled by a government that is several thousands of kilometres away, rather than by the State Government which is at their “doorstep”. Even though the Western Australian State Government received the second highest number of choices (48 choices) by the survey respondents, this number is considerably lower than the number of choices given to the Commonwealth Government (62 choices). This suggests a need of increased collaborative works among the Western Australian Government and the people on issues of GM crop regulation, to enhance reliance and trust in the regulations. Many survey respondents also saw a role for the Australian Competition and Consumer Commission in the regulation of genetically modified crops in Western Australia. However, at present, no such role is defined.

Very few choices were given to the options “The biotechnology industry” and “market forces”. This substantiates that Western Australians would prefer GM crops to be regulated by a more independent institution, not the biotechnology industry that is a driving engine in the production of GM seeds and profits from their commercialisation, sale and consumption. Further, survey respondents do not want to leave the regulation of GM crops to market forces alone, they prefer GM crops to be subject to a regulatory framework that is developed, enforced and monitored by an Australian institution.

In his study of Australian consumers’ perceptions of GM food, Kelley (1995) found that Australians are concerned about food safety issues. The results of this current study are in harmony with the author’s findings. The results from this survey confirm that Australians would like food safety to be very strictly regulated.

Western Australians would like at least two institutions or organisations to be involved in the food safety assessment (average: 2.1 choices per respondent), and they found the Commonwealth Government of Australia, an independent researcher or research team, and the Australia New Zealand Food Authority (ANZFA) to be nearly equally adequate bodies to carry out food safety tests prior to the release of a new food item. The Australian Competition and Consumer Commission (ACCC) was also seen as suitable by many Western Australians.

Interestingly, the firm that produces and markets the new food item was perceived suitable to carry out food safety tests by only very few survey respondents, even though, in reality, it is

often the biotechnology firm that carries out or authorises food safety tests and submits the results to ANZFA when applying for the release of a new food item (see, for example, ANZFA 2001).

According to the view of most Western Australians, food safety assessments by the biotechnology industry alone are not sufficient and should be accompanied by further food safety assessments that are carried out by a more independent institution, such as the Commonwealth Government of Australia, an independent researcher, ANZFA, or the ACCC.

5. Summary and conclusions

To sum up, more than half of the survey respondents would not buy GM canola oil at present, even if the GM oil is 1 dollar (Australian) cheaper than the non-GM canola oil. Other respondents would be willing to pay up to 50 cents more for non-GM canola oil, in order to avoid consuming GM produce.

Most of the survey participants (87%) can be categorised under four groups with distinct choice preferences regarding GM and non-GM canola oil. Marked differences were found between the four respondent groups, with regard to their demographic and socio-economic characteristics. Respondents from Group 1 (N,N,N,N) might be the most challenging to classify, since they tend to be represented equally in both genders; they are also represented in all age categories, all educational levels, and all income categories, except for extremely high incomes of A\$ >150,000 (annual income before tax).

Group 2 respondents (N,N,GM,N) tend to be young males with university education, but with a low income, possibly because they are at the beginning of their professional career. Respondents from Group 3 (GM,N,GM,N) also tend to be highly educated males, but slightly older and with higher annual incomes than Group 2 respondents. They might be further advanced in their professional career. The respondents in Group 4 (U,U,U,U) tend to be middle aged females with different educational levels and varying annual incomes from very low to extremely high.

The similarities among Group 2 and Group 3 respondents in terms of gender distribution and education could suggest that respondents from Group 2 - who are currently willing to pay 50 cents more for non-GM products - might change their choice preferences and might, in several years' time, be willing to consume GM products if they are cheaper than non-GM products (like the Group 3 respondents), because they get older and might have increasing financial commitments and family responsibilities. This means that the market for GM produce might increase in the near future and become bigger than initially assumed (see above). In addition, Western Australians who are undecided at the moment about whether or not to consume GM food (Group 4 in this study) might be willing to consume GM food when they can perceive a benefit from doing so, that is, when second generation GM crops enter the Australian market.

6. Recommendations and research perspectives

More intensive collaboration among the biotechnology industry, the respective government departments, grain growers and Western Australian consumers should be encouraged. Such co-operation will enable to generate better information about GM crops and food and thereby boost knowledge of the pros and cons of the use of plant gene technology for food production, in the long as well as in the short term.

Given that a large number of Western Australians would prefer GM canola oil to the clearly labelled, the Commonwealth Government of Australia and the Western Australian Government might reconsider their current regulatory framework and facilitate the mandatory labelling or encourage the voluntary labelling of highly refined genetically modified foods in which the modified DNA and/or protein has been removed by the refining process. This would, first, considerably increase public awareness of GM food in Western Australia; it would, second, enable Western Australians to make choices between GM and non-GM processed food items such as canola oil.

In addition, such regulation could further harmonise the Australian regulatory framework with that of the European Union (15) which has become an increasingly important export market for Western Australian canola in recent years. In light of the current trends of many of Australia's overseas markets to strictly regulate, if not completely avoid, GM produce, a

consistent labelling regime in Australia could foster consumer trust in Australian GM and non-GM products, both in Australia and overseas, and might intensify the links and co-operation among Australia and its trading partners.

The Australian Commonwealth and Western Australian State Governments could consider and test various options for GM labels, in order to ensure that the labels are easily read by consumers in Australia, as well as overseas.

In addition, the Western Australian State Government could stimulate the collaboration and co-operation with interested Western Australian consumers in the area of GM crop regulation. This would considerably increase trust in the regulatory system and would enhance support for the regulations by Western Australians. Current practices regarding the assessment of food safety prior to the release of a new food item could be enlarged and independent institutions could be involved more strongly.

Furthermore, the Western Australian Government should ensure that the growing of GM crops in Western Australia is strictly regulated and the regulations enforced, so that possible contamination of non-GM crops is kept to a minimum. This is in line with Western Australians' view about the introduction and commercialisation of GM canola.

More research needs to be done on consumer attitudes towards GM crops such as canola. For example, this study could be extended at a larger scale, to enhance understanding of Western Australian consumers' preferences for GM and non-GM food. The extended study could also include another hypothetical scenario with a second generation GM food that delivers direct benefits to the consumers. Such a survey might enable comparison between consumers' attitudes towards first generation and second generation GM crops and, thus, increase knowledge about future market options for non-GM and different generations of GM produce in Australia. More scientific knowledge about consumer preferences of GM and non-GM food will enhance sustainable GM crop commercialisation in Australia and will thereby benefit the whole Australian bio-socio-economy.

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8. References

ABS (2001): *3311.5 Demography, Western Australia*.

<http://www.abs.gov.au/Ausstats/abs@.nsf/lookupMF/37D1C5F9651D97C3CA2568A9001393CA> (17 January 2003).

ANZFA (2002): *Food Standards Code 1.5.2: Food Produced Using Gene Technology*.

http://www.foodstandards.gov.au/_srcfiles/Standard152_GM_v62.pdf
(19 January 2003).

ANZFA (2001): *Draft Risk Analysis Report Application A363: Food Produced from Glyphosate-Tolerant Canola Line GT 73*. Australia New Zealand Food Authority, Canberra.

http://www.anzfa.gov.au/documents/gen13_00.htm (3 April 2001).

da Costa, M.C., Deliza, R., Rosenthal, A., Hedderley, D. and L. Frewer (2000): Non conventional technologies and impact on consumer behaviour. *Trends in Food Science and Technology* **11**, 188-193.

- Danish EU Presidency (2002): GMO food and feed: agreement on new rules for labelling and authorisation. Press Release, 28 November 2002.
http://www.eu2002.dk/news/news_read.asp?iInformationID=25422
(27 January 2003).
- Frewer, L.J., Howard, C. and R. Shepherd (1996): The influence of realistic product exposure on attitudes towards genetic engineering of food. *Food Quality and Preferences* **7**, 61-65.
- James, C. (1999): Transgenic Crops Worldwide: Current Situation and Future Outlook. Paper presented at the conference "Agricultural Biotechnology in Developing Countries: Towards Optimizing the Benefits for the Poor", organized by ZEF and ISAAA in collaboration with AgrEvo and DSE, Bonn, 15-16 November 1999.
- James, C. (2001): Global Review of Commercialized Transgenic Crops: 2001. ISAAA Briefs No.24: Preview.
- Kelley, J. (1995): *Public Perceptions of Genetic Engineering: Australia, 1994*. Final Report to the Department of Industry, Science and Technology. International Social Sciences Survey/Australia, Canberra.
- Lähteenmäki, L., Grunert, K., Ueland, Ø., Åström, A., Arvola, A. and T. Bech-Larsen (2002): Acceptability of genetically modified cheese presented as real product alternative. *Food Quality and Preference* **13**, 523-533.
- Noussair, C., Robin, S. and B. Ruffieux (2002): Do consumers not care about biotech foods or do they just not read the labels? *Economics letters* **75**, 47-53.
- Oda, L.M. and B.E.C. Soares (2000): Genetically modified foods: economic aspects and public acceptance in Brazil. *Trends in Biotechnology* **18**, 188-190.
- Roy Morgan Research (2002): *Survey of Attitudes toward genetically modified crops in rural WA communities*. Report prepared for Dee Margetts, MLC, Perth. Roy Morgan Research, Melbourne.
- Sittenfeld, A. and A.M. Espinoza (2002): Costa Rica: Revealing data on public perception of GM crops. *Trends in Plant Science* **7**, 468-470.
- Telstra (2002/2003): *White Pages*, telephone directories, various
- Toyne, P. (2001): Label GM food for goodness. *The Australian*, 2 May 2001.
http://www.theaustralian.news.com.au/common/story_page/0,5744,2640101%255E15025,00.html (27 January 2003).

APPENDIX

List of abbreviations

ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ANZFA	Australia New Zealand Food Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DNA	deoxyribonucleic acid
EPA	Environmental Protection Authority
EU (15)	European Union of 15: The term European Union of 15 refers to the fifteen founding member states. The European Union was founded on 1 November 1993 by the following 15 states from the former European Community: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom of Great Britain and Northern Ireland
GM	genetically modified
GMO	genetically modified organism
TAFE	tertiary and further education