ISSN 0378-5254 Journal of Consumer Sciences, Special Edition
Food and nutrition challenges in Southern Africa, Vol 2, 2017

CONSUMERS' KNOWLEDGE ABOUT AND ATTITUDES TOWARDS LUCERNE (*MEDICAGO SATIVA* L.)

Annchen Mielmann*, Carina Bothma, Faans Steyn and Celia J Hugo

ABSTRACT

Over the past few years, interest has grown about the health benefits of lucerne (alfalfa), however, little is known about consumers' attitudes towards consuming this forage legume. Therefore, the aim of this study was to determine consumer knowledge in different demographic groups and to investigate the role of health benefits, food safety risks, sensory qualities and synonyms on attitudes. Purposive sampling was employed, recruiting male and female respondents (*n* = 384) from Bloemfontein City, Free State Province. For the determination of attitude, hypotheses were represented via the conceptual model, as to depict health benefits, food safety risks, sensory qualities and synonyms as antecedents of consumers' attitudes towards lucerne. Self-administered questionnaires were filled out, and it was examined for validity and reliability. While 63.1% of the respondents were knowledgeable on lucerne as a forage legume and animal feed source, 90.3% never consumed lucerne before. Older respondents with a grade 12 or higher education, were significantly ($p<0.001$) more knowledgeable about lucerne. The predictors, sensory qualities and synonyms, contributed significantly ($p<0.001$) to consumers' attitudes towards lucerne. These predictors should be used for product development, sustainable production and increased consumption of lucerne. Awareness of lucerne's nutritional potential for human consumption should be raised since it could contribute to food security for sustainable development in Africa.

— ***Dr A Mielmann****
Department of Consumer Sciences to School of Physiology, Nutrition and Consumer Sciences
Private Bag X6001
North-West University
Potchefstroom
2520
South Africa
Tel: +27 (0)18 299 2474
Fax: +27 (0)18 299 2470
Email: annchen.mielmann@nwu.ac.za
*Corresponding author

— ***Dr C Bothma***
Department of Microbial, Biochemical and Food Biotechnology
PO Box 339
University of the Free State
Bloemfontein
9301
South Africa
Tel: +27 (0)51 401 2216
Email: bothmac@ufs.ac.za

— ***Prof F Steyn***
Unit for Business Mathematics and Informatics
Private Bag X6001
North-West University
Potchefstroom 2520
South Africa
Tel: +27 (0)18 299 2180
Email: Faans.Steyn@nwu.ac.za

— ***Prof CJ Hugo***
Department of Microbial, Biochemical and Food Biotechnology
PO Box 339
University of the Free State
Bloemfontein
9301
South Africa
Tel: +27 (0)51 401 2692
Email: hugocj@ufs.ac.za

ARTICLE INFO

Article history
Received April 2017
Revision June 2017

Keywords
lucerne, spinach beet, knowledge, attitude, consumer, africa

BACKGROUND

Lucerne (*Medicago sativa* L.) is the most widely grown forage crop in the world and it is one of the plants producing the most protein per hectare (15 – 20% crude protein) (EFSA, 2009; Yari *et al.* 2012). Lucerne has been used for human consumption in Europe in times of shortage. For example, in Spain during the Civil War, lucerne served as the basis of many dishes such as lucerne soup. The young leaves, which are very nutritious and an excellent source of protein and vitamins (Larkcom, 2007) have been consumed as a vegetable in countries like China (Davidson, 2006). Green lucerne has actually been used to a small extent as a human food in the form of vegetables in parts of Russia and America (Levy & Fox, 1935). Stramesi and Falabella (as cited by Bolton, 1962) suggested recipes such as salad, soup, tortilla, stew and pudding. Lucerne products are available in drinks and chocolate bars, but mostly as food supplements (capsules, tablets, powder). A survey by the European Food Safety Authority (EFSA) in 2009 confirmed that lucerne is consumed as food supplements, as well as an ingredient in well-known foods, such as soups and salads.

The use of germinated lucerne seeds originated in Far East countries and has recently spread to the Western world, where they are considered fashionable and healthy ingredients (Peñas *et al.* 2009; Goławska *et al.* 2012). Lucerne is one of the most popular sprouts available on European markets. The sprouts are consumed either raw or slightly cooked in salads and sandwiches or as decorative appetizers. In South Africa, they are sold at convenience stores separately or in combination with other ingredients like chick peas.

Research has been conducted on preparation procedures, application, property and nutritional value of lucerne leaf protein, showing potential biotechnological importance in the production of low fibre, juice-derived co-products such as soluble protein concentrates, carotenoids, vitamins, minerals, growth factors, pharmaceutical agents, cosmetic products and transgenic enzymes (Sreenath *et al.* 2001). The novel food ingredient, alfalfa protein concentrate (APC), has long been recognized as a potential source of high-quality protein (45 – 60%) for human and animal consumption (D'Alvise *et al.* 2000). The use of ACP in human food is limited by their negative sensory properties, which include dark colour due to polyphenols, granular texture, poor solubility and grassy taste (D'Alvise *et al.* 2000; Xie *et al.* 2008) possibly due to their saponin content (Thacker & Haq, 2009). Leaf protein has also been recognized by the Food and Agriculture Organization (FAO) as a potential source of high-quality protein for human consumption (Xie *et al.* 2008).

Recently, with the increase in the demand for healthy, green food, both the agricultural and economic sectors are paying more attention to the utilization of lucerne, because of its high nutritional contents (Lamsal *et al.* 2007; Hao *et al.* 2008). The majority of South African households live in poverty, with a limited variety of foods (mainly staples) available in homes. In essence, most South African children consume a diet low in energy, and poor in protein quality, while children from urban areas are increasingly overweight (Labadarios *et al.* 2001; Mchiza *et al.* 2015). Relieving the environmental pressure of food production for a growing world population – which might approach 9 billion by 2050 – is in different ways, a challenge for all nations (United Nations Population Division [UNPD], 2010; Gregory & George, 2011). To sustain this population growth over the next 30 years, it would be necessary to produce more foodstuffs throughout the world (Kern, 2002). In emerging countries, such as SA, food security is still the main issue and therefore dependant on potential solutions, such as a partial diet shift from animal protein to plant protein (Aiking & De Boer, 2004). Even per capita, the world now produces 40% more food than 40 years ago. However, in the next 40 years, another 70% more is required (Aiking, 2010). By the year 2020, the worlds' protein supplementation will have to double. What is striking is that Africa, as a continent, does not play a role or make a contribution towards protein supplementation in the world. There has been an increase in fat (3.2%), and meat and egg consumption (2.8%). Black and coloured children also have a lower mean protein and fat intake. It was also reported that urban black consumers consumed significantly more sugar and confectionary, and significantly less legumes and maize meal than their rural counterparts (Steyn *et al.* 2001; Steyn *et al.* 2016).

It is therefore becoming a reality that SA consumers need more plant protein legumes such as lucerne that can play a major role in consumers' diets and help to maintain health and prevent disease (e.g. malnutrition).

However, because the nutritional value of lucerne hay in SA has been researched mainly for agricultural or animal grazing purposes (Scholtz *et al.* 2009), consumers in SA may have not enough knowledge to use and consume lucerne as a green leafy vegetable. Consumers may also show a negative attitude consuming lucerne, as it is originally used as animal feed. According to Santosa et al (2013), consumer behaviour, specifically the act of consumption, includes the acquisition, usage and disposal of food products that will provide nutritional value. The relationship between attitude and beliefs has been studied widely, although the relationship has remained somewhat unclear. However, attempts have been made to relate attitude to food consumption. These have led to the development of a framework of knowledge-attitude-practice (behaviour), which means that changes in behaviour can be brought about by increasing knowledge about a particular food product. Studies by Stobbelaar et al (2007) and Aertsens et al (2011) found that a higher awareness and knowledge of food had a positive influence on attitudes towards the consumption of food. When consumers are confronted with more information about food products, their knowledge thereof will increase (Pieniak *et al.* 2010) and they develop certain attitudes towards it. Verbeke (2008) stated that consumers must have a sufficient level of knowledge, based on reliable information, in order for information to have a favourable impact on their food choice. Nevertheless, there is a consensus that knowledge is a key construct in information processing and thus, in the consumer decision-making process.

Interest in how to effectively utilize lucerne as food for humans is growing (Gault *et al.*, 1995; Vázquez-Villegas *et al.* 2015), however little information is available about consuming it as a green leafy vegetable and consumers' behaviour towards it. The promotion of lucerne leafy greens as an underutilised food source for human consumption should be considered, in order to increase the variety of plant sources available to consumers, and at the same time, to expand the utilization of the lucerne plant. As the consumption of lucerne could improve the protein intake of consumers, role-players in food -based programmes can promote the cultivation and use of lucerne in rural and urban communities, in an effort to reduce malnutrition. Therefore, the main objectives of this study were firstly, to investigate knowledge of lucerne in different consumer groups. Secondly, to investigate the role of health benefits, food safety risks, sensory qualities and synonyms on consumers' attitude towards lucerne, developing hypotheses via a conceptual model, and thirdly, to investigate consumer attitudes towards lucerne by means of thematic analysis.

METHODOLOGY

Sampling and data collection

Purposive sampling was employed as particular criteria were used - including the researcher's own judgement on selection of suitable respondents in relation to the research problem (Denscombe, 2003; Babbie, 2007; Maree & Pietersen, 2010). Consumers were recruited from Bloemfontein City, Free State Province (FSP), who complied with two inclusion criteria: (i) the respondent was a regular user of green leafy vegetables and (ii) the respondent was aged 18 – 65 years. Respondents were recruited at a public location such as a university, thereby attempting to incorporate aspects of representativeness into the probability sample. Respondents were provided with a recruitment document, an information document and a consent form to participate in this research study. The information document included the aim, background and possible benefits of the study which aided in familiarising respondents with lucerne. Data were collected from adult consumers (n = 384), 187 male and 197 female (Table I). A self-administered questionnaire was distributed by the researcher. The researcher collected the questionnaires after 20 minutes.

The survey instrument was based on prior literature, with knowledge and attitude measures developed as recommended by Ajzen (1991), Francis *et al.* (2004), and Michaelidou and Hassan (2008). Part I collected demographical information such as gender, age and highest level of education. These demographical variables were used to detect whether these could be linked to consumers' knowledge of lucerne. Part II included information regarding respondents' knowledge and consumption of lucerne, while Part III ('Attitude') included Likert scale statements and three open ended questions: '*What do you believe are the advantages of eating lucerne?*'; '*What do you believe are the disadvantages of eating lucerne?*'; and '*Please indicate if there is anything else you associate with eating*

lucerne?'.

Reliability of the questionnaire was ensured and improved by discussions with field workers and careful construction and pre-testing of the questionnaire. Face validity was determined to indicate whether the instrument truly measures respondents' knowledge and attitude towards lucerne. Content validity ensured that the measuring instrument represented the entire content of the study's constructs and was established by having the adapted questionnaire refereed by a panel (n = 5) of research experts in consumer and food sciences. Statistical Consultation Services also scrutinised the questionnaire.

The following section discusses the research hypotheses to examine the roles of health, benefits, food safety risks, sensory qualities and synonyms in predicting attitude within the context of lucerne.

Development of research hypotheses

In line with the Theory of Planned Behaviour (TPB) (Ajzen & Fishbein, 1980; Ajzen, 1991) and the method described by Michaelidou and Hassan (2008), four hypotheses were developed. These hypotheses included health benefits, food safety risks, sensory qualities and synonyms, as antecedents of consumers' attitudes towards lucerne. These predictors were categorized as independent variables, while an attitude towards lucerne (a direct measurement) was categorized as the dependent variable. The role of each predictor, as forerunners of consumers' attitudes towards lucerne is discussed.

Health benefits

When considering health benefits, unknown or underutilised foods (e.g. lucerne) may be more acceptable to the public if there are tangible benefits to the consumer (Frewer *et al.* 2003). Results suggested that acceptance of food products was largely determined by perceived risk and perceived benefit. Perceived benefits are much more important for the acceptance of food products than perceived risks. Tangible benefits, e.g. products better for the environment or healthier, increased people's willingness to purchase them more often (MacFie, 2007). Consumers who are informed about a food application with a consumer benefit, perceived lower personal risk than those who are informed about an application without a consumer benefit. Recent studies suggest, however, that benefit alone does not guarantee acceptance. It should also be emphasised that consumers are not a homogeneous group. In other words, consumers differ in what they perceive as benefits. Therefore, tangible benefits may not result in higher acceptance for unknown or underutilised food products; instead, it is contingent on consumer acceptability of specific applications. Attitudes towards new technologies are shaped by the perceived benefits associated with them (MacFie, 2007).

Food safety risks

Generally speaking, food risk perception might be regarded as a form of attitude towards a specific object, such as a potential hazard. Risk may be conceptualised in terms of the risk to human health, the environment, animal health and future generations (Miles & Frewer, 2001; MacFie, 2007). In a study by MacFie (2007) it was suggested that perceptions of risks and benefits play an important role in shaping consumer attitudes towards unknown or under-utilised food. Risk perception seems to be linked to social factors and individual differences have been identified in risk perceptions, related to environmental and food-related hazards. Risk communication may have an effect when people do not hold strong convictions related to the unknown food product (Earle & Siegrist, 2006; MacFie, 2007). Slovic et al (2004) suggested that the importance of the 'dreadfulness' of a hazard for perceived risks can be viewed as evidence of 'risk as feelings'. Affect or attitudes seem to determine risk perception (MacFie, 2007).

Information conveyed by risk communication is, therefore, mediated by the attitudes people hold. Scholderer and Frewer (2003) examined the effects of various information strategies on consumer attitude change towards unknown foods and found that the activation of pre-existing attitudes resulted in an increased consistency of the beliefs and choices expressed by the participants. People's attitudes toward unknown foods seem to be so strong that new information is overridden. Informing the public about new food products may often fail to increase acceptance, unless other factors (such as personal or societal benefits and the values placed on these) are also addressed (MacFie, 2007). Attitudes toward unknown or underutilised food are influenced by more

general environmental attitudes. The attitude of favouring the protection of nature, because of its intrinsic value, had a negative impact on the acceptance of these foods. Valuing nature because of its usefulness and benefits to humans, however, had a positive influence on the acceptance of these foods. In a similar study, general attitudes or world views had an important influence on the perception of unknown food (Siegrist, 1999; MacFie, 2007).

The concept of attitudes is a psychological approach toward a better understanding of the acceptance or non-acceptance of novel or unknown food (e.g. lucerne). However, a psychological view may be too narrow. Attitudes toward an unknown food will be influenced, not only by the innovation itself, but also by the surrounding social, economic and political environments. Various dynamic social processes may generate public concern about hazards that are judged as low risks by experts, to the neglect of hazards that they judge as high risks (Kasperson *et al.* 2003).

Sensory qualities

Sensory quality should be considered as a key factor in food acceptance because consumers seek food with certain sensory characteristics. The acceptance of a food will depend on whether it responds to consumer needs and on the degree of satisfaction that it is able to provide (Heldman, 2004). Aikman and Crites (2007) suggested that food attitudes are comprised of five distinct informational bases: positive effect (e.g. calm, comforted); negative effect (e.g. guilty, ashamed); abstract cognitive qualities (e.g. healthy, natural); general sensory qualities (e.g. taste, smell); and specific sensory qualities (e.g. salty, greasy).

Synonyms

When considering synonyms, the name lucerne is commonly used in all European countries east of Spain, and also in SA, Australia and New Zealand (NLO, 2010). Since North and South America now produce a large part of the world's output, the word "alfalfa" has been slowly entering into other languages besides English. Names, derived from the Germanic language (e.g. English), Romance language (e.g. French or Italian), or non-Indo-European language (e.g. Chinese or Swahili), can influence purchasing behaviour and consumers' attitude towards a food product. Exploring other languages when naming, is an obvious approach when the target consumer market includes many non-English speakers. However, non-English names can also be appealing to native English speakers, especially when they are familiar foreign words (Catchword Branding, 2013).

Hypotheses

It is therefore clear that the influence of attitudes on consumer's food choice is especially important in the acceptance or rejection of lucerne, which are presented to the consumer as a possible alternative to conventional food. The researchers believe that the following antecedents are important predictors of consumer attitudes towards lucerne, and hypothesize that:

H1: Health benefits will positively affect attitude towards lucerne;
H2: Food safety risks will positively affect attitude towards lucerne;
H3: Sensory qualities will positively affect attitude towards lucerne;
H4: Synonyms of lucerne will positively affect attitude towards lucerne.

Statistical analysis

All statistical procedures were conducted using the Statistical Package for Social Science version 17 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to determine consumer knowledge and attitudes towards lucerne. The significance of differences of mean knowledge between demographic groups (dichotomous) was measured by the *t*-test for independent groups. The Cronbach alpha coefficient measured the internal consistency, to determine the reliability of the factor analysis, thus detecting the items' (health benefits, food safety risks, sensory qualities and synonyms) relatedness to each other. To guarantee construct validity, confirmatory factor analysis was used to show one-dimensionality of a variable. Using the Pearson correlation coefficient, inter-correlations between variables were performed. In this study, correlation was used as the predicted change in the value of the dependent variable (i.e., attitude towards lucerne), for one-unit change in the independent variable (i.e., health benefits, food safety risks, sensory qualities and synonyms). A multiple linear regression was used to explain the dependent variable, 'attitude direct measurement', by four other predictor variables

(i.e., health benefits, food safety risks, sensory qualities and synonyms). Furthermore, this technique was applied to examine how two or more variables act together, to affect the dependent variable. It was also the equation that represented the best prediction of a dependent variable, from several independent variables (Jaafar *et al.* 2012). Results for reliability and factor analysis, descriptive statistics, the final model and hypothesis summary were tabulated according to the methods of Michaelidou and Hassan (2008).

Ethical considerations

Ethical approval for the study was obtained (ECUFS NR: 183/2012; REC reference nr: 230408-011) and all ethical measures were practically applied.

RESULTS AND DISCUSSION

Demographic characteristics

The demographic profile of the study population (Table 1) showed that the sample size comprised of 187 males and 197 females between the ages of 18 – 32 years (50%) and 33 – 65 years (50%). The sample size comprised of consumers with a higher education level, i.e. consumers with an education level greater or equal than Grade 12 (62.24%), as most of the consumers had to read and complete the provided questionnaires.

Consumers' knowledge of lucerne

As shown in Table 2, 63.1% of the respondents (*n* = 384) were familiar with lucerne as a forage legume used to feed animals. According to Statistics South Africa (SSA) (2012), 638 000 people are formally employed in the agricultural sector in SA. People are both directly and indirectly dependent on the agricultural sector for employment and therefore familiar with forage crops such as lucerne. Although more than half of the respondents were familiar with lucerne, 77% of the respondents were not familiar with the lucerne's synonym, known as 'alfalfa' (Table 2). Respondents' unfamiliarity with this synonym could be explained by the fact that lucerne is known in Europe (except Spain and Portugal), SA, Australia and New Zealand as lucerne, but in the rest of the world as alfalfa (NLO, 2010). Furthermore, seed companies (such as K2 Agri and Pannar) and the National Lucerne Organisation (NLO) in SA market this forage as lucerne.

According to Table 3, of the 246 respondents

TABLE 1: CHARACTERISTICS OF THE STUDY POPULATION: RESPONDENTS (*N* = 384)

Variable	n = 384	% Of Total
Gender		
Male	187	48.70
Female	197	51.30
Age (years)		
18-32	192	50.00
33-65	192	50.00
Education		
< Grade 12	239	62.24
≥ Grade 12	145	37.76

TABLE 2: FREQUENCIES OF RESPONSES TO QUESTIONS REGARDING KNOWLEDGE OF LUCERNE AMONG RESPONDENTS (*N* = 384)

Question	Frequency (n)	Percentage of sample (%)
Do you know what lucerne is?		
Yes	246	63.1
No	138	35.4
Do you know what alfalfa is?		
Yes	81	20.8
No	303	77.7
Have you ever consumed lucerne?		
Yes	32	8.2
No	352	90.3

TABLE 3: FREQUENCIES OF 'YES' RESPONSES REGARDING KNOWLEDGE OF LUCERNE AMONG RESPONDENTS (*N* = 246) AND MEAN DIFFERENCE FOR KNOWLEDGE OF LUCERNE AMONG DIFFERENT DEMOGRAPHIC GROUPS OF RESPONDENTS (*N* = 384)

Variable	n = 246	% Of Total	% Of Variable	Mean	*t*-value
Gender					1.47
Male	124	50.4	66.3	6.8	
Female	122	49.6	61.9	6.3	
Age (years)					2.59**
18-32	109	44.3	56.7	6.9	
33-65	137	55.7	71.3	6.2	
Education					4.1***
< Grade 12	125	50.8	52.3	5.5	
≥ Grade 12	121	49.2	83.5	6.8	

** = p<0.01; *** = p<0.001

TABLE 4: CHARACTERISTICS OF THE STUDY POPULATION: RESPONDENTS (*N* = 384)

Variable	No. of items	Alpha (Corr)	% Variance extracted	Eigenvalue
Health benefits	6	0.79	51.79	3.11
Food safety risks	3	0.61	56.05	1.68
Sensory qualities	12	0.78	51.55	1.73
Attitude towards lucerne	4	0.89	74.84	2.99
Synonyms	2	0.73	52.50	1.77

who were knowledgeable about lucerne, 50.4% were male, 55.7% were between the ages of 33 – 65 years and 50.8% were educated below Grade 12. However, when considering respondents' knowledge per demographic variable, respondents with an education greater or equal than Grade 12 (83.5%) were more knowledgeable. Therefore the significant differences of the mean positive responses regarding the knowledge of lucerne between demographic groups were then measured.

Consumer knowledge of lucerne among different demographic groups

As more than 50% of the total population (*n* = 384) was knowledgeable about lucerne, only the following practically significant demographic variables were found among the population (*n* = 246) who gave a positive response regarding their knowledge of lucerne (Table 3).

Older respondents (33 – 65 years) were significantly (p<0.05) more knowledgeable about lucerne than younger respondents (18 – 32 years). According to Vorster (2007), knowledge differs from individual to individual. The food consumption in a community and household are influenced by their demographic and socio-cultural environments (e.g. age, religion, wealth), leaving individuals with a specific knowledge regarding food consumption. Respondents with a grade 12 or higher education were significantly (p<0.001) more knowledgeable, than those with qualifications below grade 12 (Table 3). Prattala et al (1992) observed that consumers, with a higher level of education, consumed more vegetables than consumers with a lower level of education. Lin (2002) proposed that more education leads to more information search, by increasing consumers' ability to identify, locate and assimilate relevant information. Moreover, consumers with higher education levels have more knowledge in general.

The role of health benefits, food safety risks, sensory qualities and synonyms on consumers' attitudes towards lucerne

Results from the reliability and factor analysis (Table 4) indicated that all five independent variables had eigenvalues greater than 1. Cronbach alpha coefficients were greater than 0.6 for all the factors, meaning that the scale scores for each of the dimensions were reliable. Due to the exploratory nature of this research, alpha values greater than 0.6 for reliability estimates, were considered adequate (Chen & Chai, 2010).

TABLE 5: DESCRIPTIVE STATISTICS OF INDEPENDENT AND DEPENDENT VARIABLES TO DETERMINE FACTORS, CONTRIBUTING TOWARDS CONSUMERS' ATTITUDES IN REGARD TO LUCERNE

Variable	Mean (SD)	1	2	3	4	5
1. Health benefits	1.06 (0.65)	1.00				
2. Food safety risks	0.69 (0.78)	0.38	1.00			
3. Sensory qualities	0.13 (0.60)	0.14	0.12	1.00		
4. Attitude towards lucerne	0.54 (0.83)	0.13	0.15	0.72	1.00	
5. Synonyms	0.03 (1.06)	0.17	0.09	0.62	0.69	1.00

SD = Standard deviation

TABLE 6: RESULTS OF MULTIPLE LINEAR REGRESSION TO DETERMINE THE MOST SIGNIFICANT (P<0.001) FACTOR INFLUENCING CONSUMERS' ATTITUDES TOWARDS LUCERNE

Variables	Dependent	Attitude			
Independent	B	SE B	β	t	Sign. Level
Health benefits	-0.03	0.04	-0.02	-0.57	p = 0.572
Food safety risks	0.07	0.04	0.06	1.79	p = 0.073
Sensory qualities	0.66	0.06	0.48	11.67	p < 0.001
Synonyms	0.30	0.03	0.39	9.60	p < 0.001
P value	0.000				
R^2	0.62				
F-ratio	156.32				

B = unstandardized coefficient; SE = Standard Error; β = Standardised coefficient; t = t-test; R2 = Square root; F-ratio = ratio of the variance between groups to the variance within groups; NS = Not significant

Based on the descriptive data in Table 5, health benefits [mean (M) = 1.06, standard deviation (SD) = 0.65] became the most important criteria in consumers' attitude toward lucerne and food safety risks (M = 0.69, SD = 0.78). Attitude towards lucerne (M = 0.54, SD = 0.83) was average. In order to determine the most influential factor predicting consumers' attitudes towards lucerne, the relationships between all variables were determined through correlation analysis, before proceeding to regression analysis.

Table 6 depicts the r-value for the relationship between independent and dependent variables. The correlation readings indicated a 'no/ negligible to very strong' relationship between variables (Quinnipiac University, 2013). Very strong positive correlations were noted between attitudes towards lucerne and sensory qualities (r = 0.72). Strong positive correlations existed between synonyms and attitudes towards lucerne (r = 0.69) and synonyms and sensory qualities (r = 0.62). Jaafar et al (2012) stated that variables could be grouped into 'important determinants' and 'least important determinants' as influential factors, predicting consumers' attitudes towards lucerne. Therefore, these variables could be grouped as the 'important determinants' and seemed to have a significant influence on consumers' attitudes towards lucerne.

Moderate positive correlations were to be seen between food safety risks and health benefits (r = 0.38), while no/negligible correlations were present between synonyms and health benefits (r = 0.17), attitudes towards lucerne and food safety risks (r = 0.15), sensory qualities and health benefits (r = 0.14), attitudes towards lucerne and health benefits (r = 0.13), sensory qualities and food safety risks (r = 0.12), and synonyms and food safety risks (r = 0.09) (Table 6). These variables could be grouped as the 'least important determinants' and had no significant influence on consumers' attitudes towards lucerne.

Further examination to determine the most significant factor influencing consumers' attitudes towards lucerne was then conducted through multiple linear regression tests. As highlighted in Table 7, the B-values indicated the individual contribution of each predictor

TABLE 7: SUMMARY OF RESULTS TO CONFIRM HYPOTHESES OF THE CONCEPTUAL MODEL

Hypothesis	Predicted effect	Confirmed (Yes/No)
H1	Health benefits will positively affect attitude towards lucerne	No
H2	Food safety risks will positively affect attitude towards lucerne	No
H3	Sensory qualities will positively affect attitude towards lucerne	Yes
H4	Synonyms will positively affect attitude towards lucerne	Yes

(health benefits, food safety risks, sensory qualities and synonyms) to the regression model. The relationship between each predictor and consumers' attitudes towards lucerne was explained, if the effects of all other predictors were held constant. If the coefficient was positive, there was a positive relationship between the predictor and consumers' attitudes towards lucerne, whereas a negative coefficient represented a negative relationship (Field, 2009).

The unstandardized coefficient (B; represents the gradient of the regression; Table 6) of food safety risks (0.07), sensory qualities (0.66) and synonyms (0.30) indicated that, as these predictors increased by one unit, consumers' attitudes towards lucerne will increase by 0.07, 0.66 and 0.30 units, respectively. The unstandardized error (SE B) of each B-value indicated to what extent these values would vary across different samples. These standard errors were used to determine whether or not the B-value differed significantly from zero.

The standardized beta (ß) coefficients were all measured in standard deviation units and were directly comparable; therefore, they provided a better insight into the 'importance' of a predictor in the model. This coefficient for sensory qualities and synonyms were close, 0.48 and 0.39 respectively. These values indicated that both variables had a comparable degree of importance in the model (this concurred with what the magnitude of the *t*-statistics implied) (Field, 2009). The standardized values of food safety risks (ß = 0.06), sensory qualities (ß = 0.48) and synonyms (ß = 0.39) indicated that, as these predictors increased by one standard deviation, consumers' attitudes towards lucerne increased by 0.06, 0.48 and 0.39 standard deviations, respectively.

The *t*-test indicated whether the B-values were significantly different from zero and measured whether the predictor made a significant contribution to the model. Therefore, if the *t*-test, associated with the B-value, was significant ($p<0.05$), the predictor was making a significant contribution to the model. The smaller the value of significance (and the larger the value of *t*), the greater the contribution of that predictor is (Field, 2009). From the *t*-statistics it was concluded that the sensory qualities (t = 11.67) and synonyms (t = 9.60) had a similar impact, whereas health benefits (t = -0.57) and food safety risks (t = 1.79) had less impact (Table 6).

The F-ratio tested the overall fit of the regression model to the set of observed data. It was a measure of how much the model improved the prediction of consumers' attitudes towards lucerne, compared to the level of inaccuracy of the model (Field, 2009). As the F-ratio was larger than one, the model was good and represented a significant effect. The overall result for the regression model in Table 6 was significant ($p<0.001$). This indicated that all the independent factors were simultaneously significant to the dependent variables (Chen & Chai, 2010). It also was proof that consumers' attitudes towards health benefits, food safety risks, sensory qualities and synonyms contributed significantly ($p<0.001$) to the attitudes towards lucerne. The R^2 values (0.62) showed that the independent variables contributed 62% to the dimension of attitudes towards lucerne. From this analysis, sensory qualities and synonyms contributed significantly ($p<0.001$) to the dependent variable (attitude towards lucerne), with the significant value of 0.000.

In regard to hypotheses H1 and H2, the results indicated no significant relationship between consumers' attitudes towards health benefits and food safety risks, and their attitudes towards lucerne (Table 7). As for hypotheses H3 and H4, there was a significant ($p<0.001$) relationship between consumers' attitudes towards sensory qualities and synonyms, and their attitudes towards lucerne. These differences might be explained by the fact that respondents believed that the sensory properties of lucerne were

TABLE 8: RESPONSE FREQUENCIES FOR QUESTIONS REGARDING ADVANTAGES, DISADVANTAGES AND ASSOCIATIONS OF LUCERNE AMONG PARTICIPANTS (N = 212)

Category	Frequency (n)	Percentage of sample (%)
Advantages		
Health General	85	40.10
Nutritious General	60	28.30
Disadvantages		
Sensory Properties	75	35.40
Positive Feedback	24	11.30
Associations		
Vegetables Other/Plants	21	9.90
Vegetables Spinach	52	24.50

neither regarded as advantageous nor disadvantageous, and they could associate with lucerne, as noted in the following section of this article. These beliefs could directly influence consumers' attitudes towards consuming lucerne. Aikman and Crites (2007) suggested that general sensory qualities (e.g. taste, smell) and specific sensory qualities (e.g. salty, greasy) will influence consumers' attitudes towards food products. These sensory qualities can be confirmed by the results obtained from external preference mapping by Mielmann (2014). The lucerne sample preferred by most consumers was lucerne cultivar, 'SA Standard', because of its wet appearance, salty taste and spinach aroma.

Differences between lucerne attitudes and synonyms might be explained by the use of an unfamiliar (for SA consumers) synonym of lucerne on food labels, namely alfalfa, that will influence consumers' attitudes towards consuming lucerne, as names, derived from different languages (e.g. Spanish-Arabic), may develop a more positive attitude towards lucerne products (Catchword Branding, 2013). For example, lucerne sprouts are sold in supermarkets as alfalfa sprouts, in combination with chick pea sprouts in SA (Small, 2011; Pick 'n Pay, 2014).

Consumers' attitudes towards lucerne (qualitative measure)

Open-ended questions (qualitative data) were used in Part III of the questionnaire, in order to obtain the most spontaneous answers from participants (Delport, 2005). Only 212 of the 384 participants were willing to answer the open-ended questions.

Thematic analysis was used, in order to produce intelligible and interpretable data (Kruger *et al.* 2005). This is a method to identify themes or categories in a document, the latter being a type of text (Trochim & Donnelly, 2008). Similar statements from participants (*n* = 212) were filed into categories and sub-categories, according to repeated occurrence (Strauss, 1987). All findings were tabulated and the categories were coded to quantitative data (Trochim & Donnelly, 2008).

Response frequencies for questions regarding advantages, disadvantages and associations of lucerne among participants are categorized in Table 8. Participants regarded 'health general' (40.1%), (e.g. *"I think it may play a vital part in healthy living and create a stable balanced diet for a healthy life*") and 'nutritious general' (28.3%) (e.g. "*I do believe that it has a lot of nutritional value and can help consume vitamins and minerals necessary for healthy growth*") as the most important advantages of eating lucerne. Michaelidiou and Hassan (2008) mentioned that health-conscious consumers are aware and concerned about their health, and are thus motivated to improve and/or maintain their health. Furthermore, they also strive to prevent poor health, by engaging in healthy behaviours and being self-conscious regarding health. Other advantages included the belief that lucerne was also regarded as a healthier option (40.1%) than other foods (e.g. *"It is healthier than red meat"*).

Sensory properties (35.40%) were regarded as a disadvantage of eating lucerne, e.g. "*Some people may not like the bitterness*". According to Cotto (2010), many consumers will initially not like lucerne's taste and recommended that one should persevere, as it is definitely an acquired taste. D'Alvise et al (2000) and Xie et al (2008) stated that the use of lucerne protein

concentrates in human food is limited by their negative sensory properties: dark colour due to polyphenols; granulous texture; poor solubility; and grassy taste. According to Mielmann (2014), lucerne cultivar 'SA Standard Plain' had the highest value for grassy aroma of all the lucerne cultivars, but 'WL711 Plain' showed the highest values for fibrous appearance and mouthfeel, chewy mouthfeel, bitter taste and aftertaste. The numerical values for aroma, taste, texture and overall acceptability for 'SA Standard Stew', were numerically higher than for cultivars 'WL525 Stew' and 'WL711 Stew'. Furthermore, results also indicated that consumers preferred lucerne cultivar, 'SA Standard Stew', having a wet appearance, salty taste and spinach aroma.

Nevertheless, 11.3% of participants (see Table 8) provided positive feedback on the question requesting disadvantages of lucerne, e.g. "*None because it is a nutritious plant. It is healthy to eat green vegetables*". The fact that positive feedback is given for a negative (disadvantages) question, could imply that consumers have a generally positive attitude towards consuming lucerne. This positive attitude was further supported by the association of lucerne with the frequently consumed vegetable, spinach, by 24.5% of the participants (e.g. "*I associate it with eating green vegetables like spinach*". Babin and Haris (2009) stated that consumers in general have positive attitudes toward products that provide value. Lucerne was associated with vegetables by 9.9% of the participants, e.g. "*Wild leafy vegetables*".

The research reported in this paper contributes to our academic and practical knowledge in first studying attitude by modelling health benefits, food safety risks, sensory qualities and synonyms as predictors of attitude towards an under-utilized food source and secondly by means of thematic analysis (a qualitative measure). It is therefore clear that sensory properties have a major influence on consumer attitude towards consuming lucerne. These findings may have implications for advertisers of lucerne produce and should be highlighted when promoting lucerne products to consumers.

CONCLUSIONS

Consumer knowledge and attitudes towards lucerne were investigated by means of qualitative and quantitative methods, to understand consumer behaviour towards lucerne. Differences in lucerne knowledge of respondents from different demographic backgrounds indicated a need to inform SA consumers, on the benefits of consuming lucerne. Descriptive statistics were used to determine the role of health benefits, food safety risks, sensory qualities and synonyms on consumers' attitudes towards lucerne. Very strong positive correlations were found between attitudes towards lucerne and sensory qualities. The findings suggested that sensory qualities and synonyms would positively affect consumers' attitudes towards lucerne and were important predictors in furthering researchers' understanding of their role towards human consumption of lucerne.

Consumers believed that the most important advantages when eating lucerne were health and nutrition, and they associated lucerne with vegetables and, specifically, spinach. This study also found that participants did not perceive eating lucerne as having disadvantages, implying that consumers had a generally positive attitude towards consuming lucerne. These predictors and advantages should be used for product development, sustainable production, economic growth and increased consumption of lucerne. The consumption of lucerne could improve the protein intake of consumers and role-players in food-based programmes in SA can promote the cultivation and use of lucerne in rural and urban communities, in an effort to reduce malnutrition and support economic growth. Lucerne should therefore be proposed as a green leafy vegetable for consumers.

REFERENCES

Aertsens, J., Mondelaers, K., Verbeke, W., Buysse, J. & Van Huylenbroeck, G., 2011, 'The influence of subjective and objective knowledge on attitude, motivations and consumption of organic food', *British Food Journal,* 113, 1353-1378.

Aiking, H., 2010, 'Future protein supply', *Trends in Food Science and Technology*, 2, 1-9.

Aiking, H. & De Boer, J., 2004, 'Food sustainability: Diverging interpretations', *British Food Journal*, 106, 359-365.

Aikman, S.N. & Crites, S.L., 2007, 'Structure of food attitudes: Replication of Aikman, Crites, and Fabrigar (2006)', *Appetite*, 49, 516-520.

Ajzen, I., 1991, 'The theory of planned behaviour', *Organizational Behavior and Human Decision Processes*, 50, 179-211.

Ajzen, I. & Fishbein, M., 1980, *Understanding*

attitudes and predicting social behaviour, Prentice-Hall, Englewood Cliffs:
Babbie, E.R., 2007, *The practice of social research*, 11th edn., Wadsworth, Belmont.
Babin, B.J. & Harris, E.G., 2009, *CB: Consumer behaviour*, Cengage Learning, Mason Ohio.
Bolton, J.L., 1962, *Alfalfa – Botany, cultivation, and utilization*, Leonard Hill (Books), London.
Catchword Branding, 2013, *Just name it. A brand name development guide,* viewed 19 March 2014, from http://catchwordbranding.com/static/uploads/2012/03/Naming-Guide-Final-Version-1.2.pdf.
Chen, T.B. & Chai, L.T., 2010, 'Attitude towards the environment and green products: Consumers' perspective.' *Management Science and Engineering*, 4, 27-39.
Cotto, B., 2010, *The perennial herb alfalfa has many medicinal uses*, viewed 19 March 2014, from http://www.weighttraincentral.com/alfalfa/472-the-perennial-herb-alfalfa-has-many-medicinal-uses.html.
D'Alvise, N., Lesueur-Lambert, C., Fertin, B., Dhulster, P. & Guillochon, D., 2000, 'Hydrolysis and large scale ultrafiltration study of alfalfa protein concentrate enzymatic hydrolysate', *Enzyme and Microbial Technology,* 27, 286-294.
Davidson, A., 2006, *The oxford companion to food,* 2nd edn., Oxford University Press, New York.
Delport, C.S.L., 2005, 'Quantitative data collection methods', in A.S. De Vos, H. Strydom, C.B. Fouché, & C.S.L. Delport, (eds.), *Research at grass roots.* 3rd edn. Van Schaik, Pretoria.
Denscombe, M., 2003, *The good research guide for small scale research projects*, Open University Press, Maidenhead.
Earle, T.C. & Siegrist, M., 2006, 'Morality information, performance information, and the distinction between trust and confidence', *Journal of Applied Social Psychology*, 36, 383-416.
EFSA, 2009, 'European Food Safety Authority. Scientific Opinion. Opinion on the safety of "Alfalfa protein concentrate" as food. Scientific opinion of the panel on dietetic products, nutrition and allergies', *The European Food Safety Authority Journal,* 997, 1-19.
Field, A., 2009, *Discovering statistics using SPSS*, 3rd edn., Sage, London.
Francis, J.J., Eccles, M.P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., Kaner, E.F.S., Smith, L. & Bonetti, D., 2004. *Construction questionnaires based on the theory of planned behaviour – A manual for health services researches. Quality of life and management of living resources*, Centre for Health Services Research, University of Newcastle upon Tyne, New Castle. Viewed 24 April 2014, from http://pages.bangor.ac.uk/~pes004/exercise_psych/downloads/tpb_manual.pdf.
Frewer, L., Scholderer, J. & Lambert, N., 2003, 'Consumer acceptance of functional foods: Issues for the future', *British Food Journal*, 105, 714-731.
Gault, R.R., Peoples, M.B., Turner, G.L., Lilley, D.M., Brockwell, J. & Bergersen, F.J., 1995, 'Nitrogen fixation by irrigated lucerne during the first three years after establishment', *Australian Journal of Agricultural Research*, 46, 1401-1425.
Goławska, S., Łukasik, I., Wjcicka, A., & Sytkiewicz, H., 2012, 'Relationship between saponin content in alfalfa and aphid development', *Acta Biologica Cracoviensia Series Botanica,* 54, 39-46.
Gregory, P.J. & George, T.S., 2011, 'Feeding nine billion: the challenge to sustainable crop production', *Journal of Experimental Botany*, 15, 5233-5239.
Hao, C-C., Wang, L-J., Li, D., Özkan, N., Wang, D-C., Chen, X.D. & Mao, Z-H., 2008, 'Influence of alfalfa powder concentration and granularity on rheological properties of alfalfa-wheat dough', *Journal of Food Engineering*, 89, 137-141.
Heldman, D.R., 2004, 'Identifying food science and technology research needs', *Food Technology*, 58, 32-34.
Jaafar, S.N., Lalp, P.E. & Mohamed, M.M., 2012, 'Consumers' perceptions, attitudes and purchase Intention towards private label food products in Malaysia', *Asian Journal of Business and Management Sciences*, 2, 73-90.
Kasperson, J.X., Kasperson, R.E., Pidgeon, N. & Slovic, P. 2003, 'The social amplification of risk: Assessing fifteen years of research and theory', in N. Pidgeon, R.E. Kasperson, & P. Slovic, (eds.), *The social amplification of risk.* Cambridge University Press, Cambridge.
Kern, M., 2002, 'A key challenge in the 21st century: sustainable food production trends and perspectives for Southeast Asia until 2025', paper presented at International Symposium. Sustaining food security and managing natural resources in Southeast Asia, challenges for the 21st century, Eiselen Foundation Ulm, Germany, Chiang Mai, Thailand, 8–11th January 2001.
Kruger, D.J., De Vos, A.S., Fouché, C.B. & Venter, L., 2005, 'Quantitative data analysis and interpretation, in A.S. De Vos, H. Strydom, C.B. Fouché & C.S.L. Delport (eds.), *Research at grass roots,* 3rd edn., Van Schaik, Pretoria.

Labadarios, D., Steyn, N., Maunder, E., MacIntyre, U., Swart, R. & Gericke, G., 2001, 'The national food consumption survey (NFCS) – children aged 1 – 9 years, South Africa, 1999', *South African Journal of Clinical Nutrition,* 14, 62 -75.

Lamsal, B.P., Koegel, R.G. & Gunasekaran, S., 2007, 'Some physicochemical and functional properties of alfalfa soluble leaf proteins', *LWT-Food Science and Technology*, 40, 1520-1526.

Larkcom, J., 2007, *Oriental vegetables: The complete guide for the gardening cook*, Kodansha International, Otowa.

Levy, L.F. & Fox, F.W., 1935, 'Antiscorbutic value of Lucerne', *Biochemistry Journal*, 29, 884 -888.

Lin, Q., 2002, 'Consumers' information search when making investment decisions', Masters dissertation, University of Georgia, Athens, Georgia.

MacFie, H., 2007, *Consumer-led food product development*, CRC Press, Cambridge.

Maree, K. & Pietersen, J., 2010, 'Sampling', in K. Maree, (ed.), *First steps in research* Van Schaik, Pretoria.

Mchiza, Z.J., Steyn, N.P., Hill, J., Kruger, A., Schönfeldt, H., Wentzel-Viljoen, E. 2015, 'A review of dietary surveys in the adult South African population from 2000 to 2015', *Nutrients*, 7(9), 8227-8250.

Michaelidou, N. & Hassan, L.M., 2008, 'The role of health consciousness, food safety concern and ethical identity on attitudes and intentions towards organic food', *International Journal of Consumer Studies*, 32, 163-170.

Mielmann, A., 2014, 'The chemical, microbial and sensory evaluation of lucerne (*Medicago sativa* L.) for human consumption and acceptability', PhD thesis, University of the Free State, Bloemfontein, South Africa.

Miles, S. & Frewer, L.J., 2001, 'Investigating specific concerns about different food hazards', *Food Quality and Preference*, 12, 47-61.

NLO., 2010, National Lucerne Organization of South Africa, National Lucerne Trust. Viewed on 19 March 2014, from http://www.lusern.org/.

Peñas, E., Gómez, R., Frías, J., & Vidal-Valverde, C., 2009. 'Efficacy of combinations of high pressure treatment, temperature and antimicrobial compounds to improve the microbiological quality of alfalfa seeds for sprout production', *Food Control*, 20, 31-39.

Pick 'n Pay., 2014, "Recipes, hummus and grated carrot on crispbread', viewed 26 May 2014, from http://www.picknpay.co.za/recipe-search-results/hummus-and-grated-carrot-on-crispbread.

Pieniak, Z., Aertsens, J. & Verbeke, W., 2010, 'Subjective and objective knowledge as determinants of organic vegetables consumption', *Food Quality and Preference*, 21, 581-588.

Prattala, R., Berg, M.-A., & Puska, P., 1992, 'Diminishing or increasing contrasts? Social class variation in Finnish food consumption patterns, 1979-1990', *European Journal of Clinical Nutrition*, 46, 279-287.

Quinnipiac University., 2013, 'Pearson's r correlation', viewed 24 April 2014, from http:// faculty.quinnipiac.edu/libarts/polsci/ Statistics.html.

Santosa, M., Clow, E.J., Sturzenberer, N.D. & Guinard, J.X., 2013, 'Knowledge, beliefs, habits and attitudes of California consumers regarding extra virgin olive oil', *Food Research International*, 54*,* 2104-2111*.*

Scholderer, J. & Frewer, L.J., 2003, The biotechnology communication paradox: Experimental evidence and the need for a new strategy', *Journal of Consumer Policy*, 26, 125-157.

Scholtz, G.D.J, Van der Merwe, H.J. & Tylutki, T.P., 2009, 'The nutritive value of South African *Medicago sativa* L. hay', *South African Journal of Animal Science*, 39, 179-182.

Siegrist, M., 1999, 'A causal model explaining the perception and acceptance of gene technology', *Journal of Applied Social Psychology*, 29, 2093-2106.

Slovic, P., Finucane, M.L., Peters, E. & MacGregor, D.G., 2004, Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality', *Risk Analysis*, 24, 311-322.

Small, E., 2011, 'Alfalfa and relatives: evolution and classification of Medicago', NRC Research Press, Ottawa.

Sreenath, H.K., Koegel, R.G., Moldes, A.B., Jeffries, T.W. & Straub, R.J., 2001, 'Ethanol production from alfalfa fiber fractions by saccharification and fermentation', *Process Biochemistry*, 36, 1199-1204.

SSA., 2012, 'Statistics South Africa. Quarterly labour force survey: Quarter 3', viewed 21 March 2014, from http://www.statssa.gov.za/ publications/P0211/P02113rdQuarter2013.pdf.

Steyn, N.P., Abercrombie, R. & Labadarios, D., 2001, 'Food security: an update for health professionals', *South African Journal of Clinical Nutrition*, 14, 98-102.

Steyn, N.P., Jaffer, N., Nel, J., Levitt, N., Steyn, K., Lombard, C. & Peer N., 2016, 'Dietary intake of the urban black population of Cape Town: The cardiovascular risk in black South Africans

(CRIBSA) study', *Nutrients*, 8(5), 285-287.
Stobbelaar, D.J., Casimir, G., Borghuis, J., Marks, I., Meijer, L. & Zebeda, S., 2007, 'Adolescents' attitudes towards organic food: A survey of 15- to 16-year old school children', *International Journal of Consumer Studies,* 31, 349-356.
Strauss, A., 1987, *Qualitative analysis for social scientists*, Cambridge University Press New York.
Thacker, P.A. & Haq, I., 2009, 'Effect of enzymes, flavor and organic acids on nutrient digestibility, performance and carcass traits of growing-finishing pigs fed diets containing dehydrated lucerne meal', *Journal of the Science of Food and Agriculture*, 89, 101-108.
Trochim, W.M.K. & Donnely, J.P., 2008, *The research methods knowledge base*', 3rd edn., Cencage Learning, Mason.
UNPD., 2010, *United Nations Population Division. World population projections to 2150*. United Nations, New York.
Vázques-Villegas, P., Acuna-Gonzalez, E., Mejia-Manzano, L.A. & Aguilar, O., 2015, 'Production and optimization of a chlorophyll-free leaf protein concentrate from Alfalfa (*Medicago sativa*) through aqueous two-phase system', *Revista mexicana de ingeniería química*, 14(2),383-392.
Verbeke, W., 2008, 'Impact of communication on consumers' food choices', *Proceedings of the Nutrition Society*, 67, 281-288.
Xie, Z., Huang, J., Xu, X. & Jin, Z., 2008, 'Antioxidant activity of peptides isolated from alfalfa leaf protein hydrolysate', *Food Chemistry*, 111, 370-376.
Yari, M., Valizadeh, R., Naserian, A.A., Ghorbani, G.R., Rezvani Moghaddam, P., Jonker, A. & Yu, P., 2012., 'Botanical traits, protein and carbohydrate fractions, ruminal degradability and energy contents of alfalfa hay harvested at three stages of maturity and in the afternoon and morning', *Animal Feed Science and Technology*, 172, 162-170.