UNIVERSITY OF GHANA

SCHOOL OF BIOLOGICAL SCIENCES

DEPARTMENT OF NUTRITION AND FOOD SCIENCE

EXPLORING THE GAPS IN SENSORY AND CONSUMER SCIENCE EDUCATION AND INDUSTRY PRACTICE IN SELECTED FOOD COMPANIES IN GHANA.

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A DISSERTATION PRESENTED TO THE DEPARTMENT OF NUTRITION AND FOOD SCIENCE OF THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF A BACHELOR OF SCIENCE (BSc.) DEGREE IN NUTRITION AND FOOD SCIENCE

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DECLARATION

We hereby declare that this project work entitled “Sensory Standards: Exploring the gaps in sensory and consumer science education and industry practice in selected food companies in Ghana.” submitted to the Department of Nutrition and Food Science of the University of Ghana, Legon by Quarcoo Benedicta Anowa and Abeka Yaa Amoah Sarah is the outcome of our own research supervised by Dr. Maame Yaakwaah Blay Adjei.

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DEDICATION

First and foremost, we dedicate this project to the Almighty God for giving us wisdom, and strength and for guiding us through this research. We also dedicate this work to our wonderful supervisor, Dr. Maame Yaakwaah Blay Adjei for her tremendous support and guidance throughout this research. Lastly, we would like to dedicate our research to our families, friends, and colleagues for their motivation and support in various ways throughout our research.

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ABSTRACT

Sensory evaluation is a scientific discipline to evoke, analyze and interpret reactions to food using the human senses. It has many applications in industry to support the production of quality products. A product is considered to be a quality product when it satisfies various criteria for its functioning. In Ghana, sensory evaluation and analysis is typically taught as part of a university undergraduate and postgraduate degree in food related subjects. It is expected that companies that have graduates from such background will have good knowledge about sensory science and put this knowledge in practice. This is however not often the case as previous studies have revealed. The title of this study is ***Exploring the gaps in sensory and consumer science education and industry practice in selected food companies in Ghana.*** This study aims to explore the knowledge gaps between what students are taught and how they apply this knowledge in industry. The study was done by administering a semi-structured questionnaire using one-on-one interviews and online surveys to students, lecturers, and staff of food companies.

A total of 187 participants (125 students, 6 lecturers, and 56 personnel from companies) participated in the study. 14 out of the 187 did not have any idea on what sensory evaluation was (8 students and 6 company workers) leaving the total number of complete response at 173 which comprises 117 students, 6 lecturers and 50 company workers.

From the results, the only gap found was with the types of sensory tests conducted in industry. It was uncovered that what some of the students knew as the uses of the tests were different from what the workers in food industries used the tests for. This means that what students learn in school about the applications of certain sensory evaluation tests differs from what the tests are

used for in industry. No gaps were discovered for the roles of sensory tests and basic understanding of sensory evaluation; the knowledge students had about both the roles of sensory evaluation and basic understanding of sensory evaluation was same as that of the personnel from companies. This means that both students and food company employees have the same basic understanding of sensory evaluation and its roles.

According to the survey, not all of the knowledge gained in sensory evaluation in school is applied in the workplace. Most companies utilize sensory evaluation, except for small-scale industries; this can be linked to the fact that sensory science is an expensive science.

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LIST OF ABBREVIATIONS

ISO: International Organization for Standardization

QDA: Quantitative Descriptive Analysis

DFC: Difference from Control

TQM: Total Quality Control

NSF: National Sanitation Foundation

HACCP: Hazard Analysis and Critical Control Point

CCP: Critical Control Point

FDA: Food and Drugs Authority

GSA: Ghana Standard Authority

FCOS: Family and Consumer Science

NFS: Nutrition and Food Science

FPEN: Food Processing Engineering

FSTS: Food Science Technology

QC: Quality Control

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Sensory evaluation plays an important role in the development of products in food industries. In a study by Armah (2013), he concluded that sensory evaluation is utilized in selected food industries in Accra. Sensory science is one of the modern sciences; according to (Martens, 1999), Sensory science is a multidisciplinary study that studies how people react to product characteristics as they are perceived by their senses, including sight, smell, taste, touch, and hearing. Sensory evaluation can be used for many purposes which includes the production of quality products, among others. A product is known as a quality product only when it satisfies various criteria for its functioning for the consumer. Reid & Sanders (2015) also stated that, in general, a product can be regarded to be of good quality if it satisfies the user or consumer. A consumer will only purchase a good or service if it meets his or her needs.

A standard is a repeatable, consistent, recognized, and recorded procedure. Standards contain technical specifications or other precise criteria designed to be used consistently as a rule, guideline, or definition. They help to make life simpler and increase the reliability and the effectiveness of many of the goods and services we use (Leinaweaver, 2012).

Manufacturers, organizations, and academics employ standards in sensory analysis to provide standardized, trustworthy, and secure product sensory testing. Global sensory standards are overseen by the International Organization for Standardization (ISO) Committee ISO/TC34/SC12 on Sensory Analysis, whose mandate is "standardization in the field of food sensory analysis that includes vocabulary, general directives, selection and training of sensory

analysis assessors, and the methodology to carry out the different tests, including materials and apparatus specification used in the laboratory." Sensory evaluation is taught in tertiary institution and universities as part of programs such as Nutrition and Food Science, Food Science and Technology, Family and Consumer Sciences, Food Processing Engineering, dietetics among others. Students are equipped with knowledge on what sensory evaluation is, its benefits and principles, methods of sensory evaluation, factors that influence sensory assessment, measurement scales for sensory testing, and statistical analysis of sensory data among others.

Knowledge acquired from what is being taught and learnt can be applied in some departments in industries which include, the quality assurance or control department, production department, research and develop department among others.

1.2 RATIONALE

There has been an increase in the number of food industries nationwide in Ghana. Consumers are found to be purchasing goods that meet their specifications and also render the services or fulfill the purpose for which they purchased the products. Despite the rise in the production of food, no research has established that sensory evaluation is used by all food companies in their production processes; also, no research has shown the gap between what is being taught or learnt on sensory evaluation and what is being applied in industries. This study aims to assist in identifying knowledge gaps in the theory of sensory evaluation between what lecturers teach students and how students eventually apply the knowledge passed on in the industries, as well as to recommend some ways to fill these gaps. From this research, we would be able to establish what the industry's understanding of sensory is and how it differs from researchers and those involved in academia.

1.3 OBJECTIVE

1.3.1 GENERAL OBJECTIVE

- To explore the gaps in the knowledge and usage of sensory evaluation in Ghanaian food industries based on academic curricular.

1.3.2 SPECIFIC OBJECTIVES

- To identify the usage and application of sensory evaluation in product quality improvement in Ghanaian food industries.
- To identify the knowledge gaps in theory and practice of sensory evaluation in Ghanaian food industries.
- To identify knowledge gaps in sensory evaluation theory between what lecturers teach students and how students apply the knowledge passed on in the industries

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Sensory evaluation

According to Stone & Sidel (2004), sensory evaluation refers to the scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the senses of sight, smell, touch, taste, and hearing. Sensory evaluation may also be described as a quantitative discipline that collects numerical data to establish legal and specified links between product attributes and human perception (Lawless & Heymann, 2010). Sensory evaluation attempts to isolate the sensory properties of foods and provides important and useful information to product developers, food scientists, and managers about the sensory characteristics of their products. Sensory evaluation uses the basic senses to analyze food. The five basic senses are sight, smell, taste, feel, and audition. The organs responsible for these senses include the eyes, for appearance properties such as colour, texture, nose for fragrance and aroma, tongue to perceive the basic tastes of sweet, sour, bitter, salty, and umami, skin/fingers to perceive textural properties such as hardness, softness, smoothness, roughness, and ears to perceive sound such as crispiness and crunchiness of products. Sensory evaluation requires human beings to perform their tests. These specially selected people are called panelists, assessors, judges, or respondents. Panelists must be screened to determine their sensory abilities, to check for any impairments or they must be trained depending on the types of tests being performed (Jain & Gupta, 2005). Some characteristics of good panelists include good sensory and descriptive abilities, good health, no intolerances and allergies, good dental health, being prepared to try different ingredients and foods, excellent interpersonal and team working skills, and being objective, among others (Rogers, 2017).

2.1.2. History of sensory evaluation

Sensory evaluation attracted the interest of the food and beverage sector during the 1940s and mid-1950s. During a war, the U.S military did not accept the food they were provided with therefore, there was a need to check the flavor of the food. This received a push through the United States Army Quartermaster Food and Container Institute; they support research in food acceptance for the armed forces. Recently, consumers are being trained to become sensory panelists to help provide profiles of food products and help in product quality. Buyers of food and beverages tested or evaluated a tiny amount or sample of products that, hopefully, represented the whole lot provided. Following that, a process of standardized product quality grading arose, which was the precursor of current sensory analysis (Drake et al., 2008).

2.1.3. Fields in sensory evaluation

Sensory evaluation can be applied in fields such as marketing, cosmetics, personal care, pharmaceutical, fabrics, food and beverage, automobile, environment, and many other industries.

2.1.4. Advantages and Disadvantages of sensory evaluation.

Sensory evaluation has both advantages and disadvantages. Some advantages are that it gives a direct quantification of a human's perception of food attributes, to check for shelf life, and quality control, among others. Some disadvantages also include it can be time-consuming, and expensive, and there can be huge variation both between and among panelists, among others. Some of these disadvantages can be controlled using rapid methods that are being developed.

2.1.5. Types of sensory tests.

The analytical test and the affective test are the two major types of tests used in sensory evaluation (Swiader and Marczewska, 2021). According to Calof (2006), analytical tests are used to assess a product's sensory quality in detail, whereas affective tests are used to determine a product's acceptability or preference among consumers. Under the analytical tests, there are;

- ❖ Discrimination or difference test

It is the most basic sensory test which simply asks if there is any discernible difference between two types of products. We infer differences from the test results based on the proportions of people who can correctly choose a test product from a set of similar or control products. The triangle test, the duo-trio test, difference from control (DFC) and the paired comparison test are all types of discrimination tests (Prescott et al., 2014).

- ❖ Descriptive test

This test helps to know the detailed information about a product. It gives the sensory profile about the product. Descriptive tests help you to understand the characteristics of products to be able to effect changes where necessary. Some examples of descriptive tests include Quantitative Descriptive Analysis (QDA), Texture Profiling, and Flavour Profiling, among others (Yang & Lee, 2019).

There are two types of affective tests; quantitative tests and qualitative tests.

Quantitative tests, measure how much consumers like a product on a quantitative scale. Examples are consumer acceptance test and the consumer preference test, under quantitative tests, hedonic or affective test methods, which attempt to quantify the degree of liking or disliking of a product, using a 9-point hedonic scale. Offering people, a choice between alternative products and seeing if there is a clear preference from most respondents is the most

straightforward approach to this problem. The problem with choice tests is that they don't tell you much about how much people like or dislike something (Rachman, 2018).

For qualitative tests they are used to explore consumers feelings about the product. Examples are focus group discussions or interviews and also observations.

All these tests can help improve product quality.

2.1.6 Importance of sensory evaluation

- Development of new products or improvement of existing products: According to a poll, more than 90% of newly designed items fail due to poor sensory qualities and consumer rejection. As a result, using proper sensory approaches during the creation of new products is unavoidable (Ruiz-Capillas & Herrero, 2021).

- Research purposes: In the development of new products, sensory data is used as a research tool to check whether the product will be accepted by consumers before the product is exposed to the market.

- Marketing: To begin with, while great advertising and tempting pricing may get you to try something, it's the consumption experience that entices you to return for more.

  It is sensible to conduct a "trial run" before introducing a product to the whole market. Before releasing a product, product testing enables you to make any necessary tweaks or revisions. Then there is the small matter of showing that an idea benefits customers in actual reality. Real-world testing that ask whether the product functions provide the proof (Zikmund & Babin, 2010)

- For quality control purposes: Sensory evaluation is included in the modern idea of "Total-Quality-Control" (TQM) at all stages of product flow. This encompasses not just the raw materials’ sensory quality, but also the product's quality during processing and storage.

Sensory approaches must be used to track changes in product quality in terms of color, flavor, and texture during processing and storage.

- For assessing the shelf life of products: Sensory evaluation is used to monitor product changes and also to determine the origin and extent of defects in a product during storage so that corrective actions can be taken. Chemical and sensory techniques must be combined to determine the expiry date (Mihafu et al., 2019).

2.2. Product quality and quality assurance

According to (Gitman et al., 2018), product quality refers to a product's ability to meet the needs and requirements of its customers. It is the product's ability to deliver what the customer wants and values. A good product should be dependable and perform all of its functions smoothly. Within an organization, quality assurance and quality control are formed to pursue and maintain product quality.

Product quality in sensory evaluation has faced lots of challenges. Some of these include; the lack of respect for quality control or sensory measures within the organizations, lack of sensory panelists or lack of trained sensory panelists, and inadequate support for quality control programs from managers which will give more insights about improving product quality, lack of funds and resources that is, lack of personnel’s time needed for product evaluations, reviewing and training sessions. Also, program failures due to poor performance from panelists, which could also be due to lack of motivation, support, or respect for panel assessors from managements (Muñoz, 2002).

2.2.2 Guidelines for sensory quality testing

Objective methods are a way of ensuring product quality. It involves the use of instruments in carrying out evaluation of various attributes in food instead of human sensory organs. They are very useful in identifying contaminants in foods and in discovering faulty processing and adulterations. These tools include chemical tests to determine chemicals and metal contaminants in foods. Microbiological methods for detecting microbial contamination, insect excreta, and other fragments in foods and physical methods for measuring texture, color intensity, and viscosity, among others. These methods usually focus on the determination of a specific characteristic of a food product rather than its overall quality. To ensure the quality and acceptability of new food products, objective tests should go hand in hand with sensory evaluation.

Physical properties of food are important for proper product design and the prediction of the foods' response to processing, distribution, and storage conditions (Nielsen, 2010).

Chemical methods are used for quantitative and qualitative evaluations, determining the nutritive values, food production, and preservation. For example, coloring agents make food more attractive while flavorings make food tastier and stabilizers prolong the shelf life of food (Mihafu et al., 2019).

Sensory analysis can therefore play a fundamental role in the management of product quality in the food industry.

2.3 Sensory Standards

Industry standards are a set of criteria relating to the customary functioning and execution of activities in their respective domains of production within a certain industry to ensure product

quality (Khanna, 2008). The standards address product performance, safety, reliability, and the methods for evaluating product performance.

Standards exist in various fields. There are different standards relating to sensory science that is used for various fields including food and beverages as well as home and personal care products, among others. The International Organization for Standardization (ISO) is one of such organizations mandated to set standards. The standards set takes care of a wide range of products and applications including food. NSF (National Sanitation Foundation) International takes care of food, water, and consumer products. Association for the Advancement of Medical Instrumentation. They take care of medical devices. The Institute of Electrical and Electronics Engineers takes care of electronics and electrical devices. Underwriters Laboratories are in charge of fire and explosion safety of electrical products. All these organizations are associated with the United States (Pfeifer, 2009).

In Ghana, the Food and Drugs Authority (FDA) is in charge of setting standards with regards to food, drugs, food supplements, herbal and homeopathic medicines, veterinary medicines, cosmetics, medical devices, household chemical substances, tobacco and tobacco products, blood and blood products as well as the conduct of clinical trials protocols (Ghana Food And Drugs Authority, 2022).

Also, the Ghana Standard Authority (GSA) is a National Standard body responsible for the management of the nation's quality infrastructure, which includes the three pillars of metrology, standardization, and conformity assessment that is testing, inspection and certification (GSA, 2018).

To make product sensory testing consistent, reliable, and secure, manufacturers, organizations, and academics use standards in sensory analysis. Standards for sensory testing are upheld by

international and national standards, accreditation of labs that do sensory testing, and testing protocol safety and ethics guidelines.

HACCP (Hazard Analysis and Critical Control Point) can also be a way to improve product quality. Hazard Analysis refers to the process of collecting and evaluating information on hazards associated with the food. HACCP is a systematic, preventive, approach to food safety from biological hazards like microbes, chemical hazards like pesticides and insecticides, and physical hazards like metals and stones in production processes that can cause the finished product to be unsafe and designs measures to reduce these risks to a safe level (Pierson,2012).

There are seven basic principles employed in the development of HACCP plans. These principles include conducting hazard analysis, CCP (Critical Control Point) identification, establishing critical limits, monitoring procedures, corrective actions, verification procedures, and record-keeping and documentation ("The Seven Principles of HACCP," 1869).

The HACCP system must be designed by each food establishment and suited to its specific product, processing, and distribution conditions, according to the National Academy of Sciences.

2.3.2. How sensory standards can be used to improve product quality.

According to (Group, 1960), sensory analysis is a crucial tool for consumer-driven food product development, production, and distribution with consistently high sensory quality. Therefore, manufacturers, organizations, and academics employ sensory analysis standards to ensure quality management. The policies used to set excellent sensory standards around the world are the international standards. The International Organization for Standardization (ISO) Committee ISO/TC34/SC12 on Sensory Analysis is in charge of global sensory standards. Its mission is to standardize food sensory analysis techniques. The ISO is an international, non-governmental

organization made up of delegates from numerous national standards organizations (Carpenter et al., 2006). The ISO, which is headquartered in Geneva, Switzerland, is made up of standards bodies and a network of organizations. English, French, and Russian are ISO's three officially recognized languages. There is one ISO representative for each country, and ISO has 163 member standards bodies. The primary purpose of the International Organization for Standardization (ISO) is to bring standardization to a wide range of products and businesses, as well as to make trading easier. It also focuses on process improvement, safety, and quality in a variety of sectors (Leinaweaver, 2012).

2.4. Application of sensory science in industries

Industries apply sensory in the following;

- In the formulation of new products and product enhancement by giving sensory information regarding product differences, attribute intensities, and preferences as a function of ingredient, packaging, and process variables.
- To find the optimal mix of product characteristics and sensory features preferred by consumers.
- Research purposes to utilize the appropriate raw materials, and manufacturing techniques by using various questionnaire designs and sensory tests.
- For ensuring quality assurance by setting intensity limits for critical sensory characteristics in products.

2.5. How sensory science is applied in research

Research departments make use of both sensory and instrumental tests to analyze the quality of products. Sensory evaluation helps in the continual existence of already known products. This is

because researchers can find out the preference of consumers and also some dislikes from the consumers (Kemp, 2008).

2.6. Gap analysis

Gap analysis is either a tool or a process to identify where gaps are and what differences exist between an organization's current situation and "what ought to be" in place. It is also to find gaps between their current performance and their potential/desired performance, that is to make sure all their objectives are met to build plans and strategies to close these gaps (Kim & Ji, 2018).

Gap analysis is important because, it helps you to identify any shortcomings in order to overcome and make improvements.

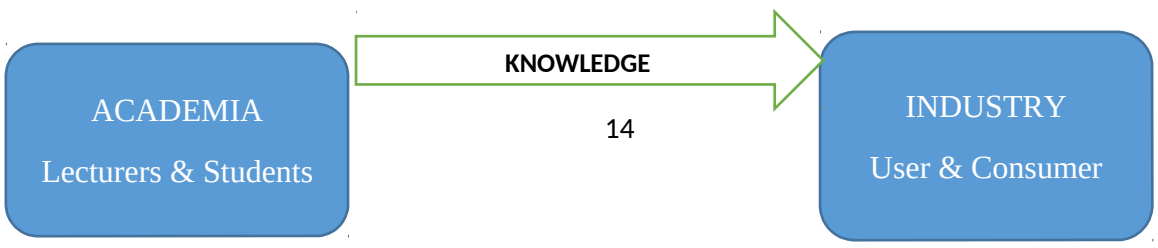
Gap analysis process means that you will have more data on how to improve a situation. For example, when it is used in manufacturing it can help manage resources. What we mean by resources is money, material, or human resources. Also, in research it helps to find shortcomings in situations in order to improve them.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

The overall goal of this study was to investigate the gaps in sensory education and practice. Specifically, to investigate whether industry practice is based on knowledge gained in sensory science from academia. A gap analysis approach was used. The two population groups were academia comprising lecturers and students, and industry made up of users of sensory analysis methods and outputs.



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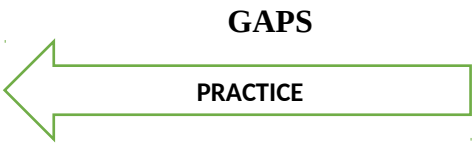


3.2 Study Population

The study population for this research workers in food companies, and research institutions in Ghana, tertiary education students who have any idea of sensory evaluation, and lecturers who teach sensory evaluation in various tertiary institutions in Ghana.

3.3. Study site

A database of registered food companies was obtained from the Food and Drugs Authority (FDA) official website. Food companies contacted were within the areas of North Industrial Area, North Kaneshie, East Legon (Shiashie), Adenta, Spintex, Tema, Nsawam, Sunyani, Akrofum, Madina, Graphic Road, Adeiso and Kasoa. These areas can be found in the Greater Accra, Eastern, Brong Ahafo, Ashanti, and Central Region of Ghana. Data was obtained from students of various tertiary institutions including the University of Ghana across various departments like the Nutrition and Food Science Department, the Food Processing Engineering Department, the Family and Consumer Science Department, and the Dietetics Department. Data was also collected from the University of Health and Allied Sciences, particularly dietetics students; the Kwame Nkrumah University of Science and Technology, specifically food science and technology students; and the University of Development Studies, specifically the Food Science and Technology Department. Also, lecturers who participated in the research were academics from Kwame Nkrumah University of Science and Technology, Kumasi; the University of Ghana, Legon; and the University of Health and Allied Sciences, Ho.

3.4 Sample and Sampling Technique

Convenience and purposive sampling methods were used to select participants. It was important that participants were willing to participate in the study.

3.5 Research Design

Mixed methods approach was used for the study. Both qualitative and quantitative methods were employed. Surveys in the form of a questionnaire as well as interviews were used to obtain data. Specifically, one-on-one interviews with students, lecturers, and workers in industry and research institutions was done in addition to online surveys using Compusensecloud (Compusense 5, Guelph, Ontario).

3.6 Procedure for Data Collection

A total of 314 responses were obtained from all the participants. After removing duplication and incomplete data, a total of 196 responses was obtained, but only 173 data were analyzed as some did not wish to participate. The high incompletion rate was from the students who started the online survey but discontinued midway. In the end, 117 students, 6 lecturers and 50 company workers completed the survey.

Permission was sought from the companies that required formal access to be granted prior to participation. For all participants, the purpose of the study was explained to them and they were informed of the confidentiality clause of the study as prescribed by the ethics requirements of the Sensory Evaluation Laboratory. Some staff of various companies and research institutes were contacted via phone calls and emails to participate in the research, others were interviewed in person.

For students in the Nutrition and Food Science Department at the University of Ghana, the link to the online survey was sent to them through private chats also, the link was shared on various group WhatsApp platforms for the other students to participate in the survey. One-on-one interviews were also conducted. For students in the other departments from other universities, the survey link was sent to course reps and close friends to be shared with other course mates and friends for them to participate in the survey.

Lecturers, were contacted via email and through phone calls for a one-on-one interview. The link was sent to some of the lecturers who were not available for phone calls to participate in the survey.

3.7 Data Collection Instruments

3.7.1 Questionnaire

A semi-structured questionnaire in the form of an online survey was designed based on the objective of the study. The questionnaire was pretested with three respondents from two companies close to campus, two students, and two lecturers. They were asked whether they understood the questions being asked on the questionnaire. Corrections were made based on the comments from the respondents. The final questionnaire was divided into two broad sections; Knowledge and application of sensory evaluation. The goal of the knowledge part was to determine the level of understanding of sensory analysis among all respondents. Thus, questions on objective and subjective types of knowledge, as well as their assessments, were included. Questions about application centered on the aim of sensory testing and the methods utilized in practice.

During the one-on-one interviews, we were fortunate to come across a sensory test being performed by one company. We made observations to support the data collected during the interview.

3.8 Data Analysis

Data for sections whose responses are categorized as quantitative data, specifically nominal data, was analyzed using frequencies, bar charts and percentages.

Scaled data (ordinal data) like knowledge rating on sensory evaluation, where respondents were asked to rate their knowledge on a scale of 1-10, was analyzed using bar chart and finding the average scores for students, lecturers and company workers.

Where participants were asked to provide additional comments, the text obtained were analyzed by identifying words or themes that occur frequently and summarizing their responses.

Data collated from tests that can be used in the industries for sensory analysis was analyzed by providing factual statements from credible source on the roles of sensory evaluation tests as shown in the discussion section for comparison. The participants were asked to tick all the test that can be used or are used in their industries and give their respective roles. The number of yes percentages was presented in a tabular form.

For sections categorized under objective knowledge, data was analyzed by providing factual statements from credible source about sensory evaluation and its application as shown in table 1 and 2. The respondents were asked to answer true or false to each statement. (nominal data). The number of correct answers based on the criteria that was set was collated in percentages.

Table 1: Factual statements on understanding of sensory evaluation

Question	Reference	Answer
1. Sensory evaluation is applied in product development, marketing, and shelf-life studies.	Sensory evaluation methods are used to support marketing and marketing research activities, which begin with new product development and market potential assessment. Sensory evaluation methods can also be used to assess the shelf-life of food products, as well as new technology that can increase product durability and quality (Świąder & Marczewska, 2021).	True
2. Sensory evaluation is a standardized way of using the human senses to explain characteristics of food by inducing stimuli, analyzing and interpreting data from valid scales	The product characteristics are picked up by the sensory organs (eyes, nose, mouth, skin and ears) and analyzed according to various schemes. Sensory testing is used to evaluate food products to ensure that the consumer receives a high quality product that appeals to the senses and has been tested using scientific methods (Tentamus, 2022).	True
3. Sensory evaluation is a scientific method to evoke, measure, analyze, and interpret those responses to products as perceived through the senses	Sensory evaluation refers to the scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the senses of sight, smell, touch, taste, and hearing (Stone & Sidel, 2014).	True
4. Sensory evaluation is a subjective form of quality	Sensory evaluation focuses on both the objective measurement of	False

evaluation using laid down scientific principles	the sensory properties of products also known as "product understanding" and the subjective responses of individuals to physical products also known as "consumer understanding", as well as the interpretation of consumer response through understanding the response to product ("linking product and consumer understanding") (Eirini, 2016).	
5. Sensory evaluation is a scientific discipline to evoke, analyze and interpret reactions to food using the human senses	Sensory evaluation refers to the scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the senses of sight, smell, touch, taste, and hearing (Stone & Sidel, 2014).	False

Table 2: Factual statements on roles of sensory evaluation

Question	Reference	Answer

1. Sensory evaluation helps to know the sensory properties of products.	Sensory analysis examines the properties that is texture, flavor, taste, appearance, smell, among others of a product or food using the panelists' senses that is, sight, smell, taste, touch, and hearing (Ruiz-Capillas & Herrero, 2021).	True
2. Sensory evaluation helps to evaluate the amount of moisture in a product.	Moisture content refers to the amount of water (molecules) that become incorporated into a food product (Mermelstein, 2009).	False
3. Sensory evaluation helps provide information to the research department.	Descriptive sensory evaluation methods provide an extra tool for use in research, product development, and marketing (Drake, 2022).	True
4. Sensory evaluation helps to know the number of microorganisms in a product.	Microorganisms are organisms that are too small to see with the naked eye but can be seen under a microscope (Tortora et al., 2010).	False
5. Sensory evaluation helps provide information to the marketing department.	Descriptive sensory evaluation methods provide an extra tool for use in research, product development, and marketing (Drake, 2022).	True
6. Sensory evaluation helps provide information to the production department	Descriptive sensory evaluation methods provide an extra tool for use in research, product development, and marketing (Drake, 2022).	True

4.0 RESULTS AND DISCUSSION

4.1 Results

4.1.1 Demographics

4.1.1.1. Company size

The companies that participants belonged to were categorized as small-scale, medium-scale, or large-scale based on the categorization suggested by Armah (2013). Table 3 shows how many participants were from the different types of company categories.

Table 3: Company size

Company size	Frequency	Percentage (%)
Small-scale	0	0
Medium-scale	10	20
Large-scale	40	80
Total	50	100

Armah (2013), defined small, medium and large-scale based on the number of employees in the company. Large-scale companies usually have 100+ employees while medium and small-scale companies usually have between 20-99 employees and 5-19 employees respectively. From the responses gathered from the participants, 40 staff of companies worked in large scale companies giving a percentage of 80%, whiles 10 staff of companies worked in medium scale companies giving a percentage of 20%. Unfortunately, the small-scale companies visited do not engage in any form of sensory analysis in their companies.

4.1.1.2. Departments of company workers

Table 4 shows the various departments in the industry the company workers belonged to and the number of participants in the departments.

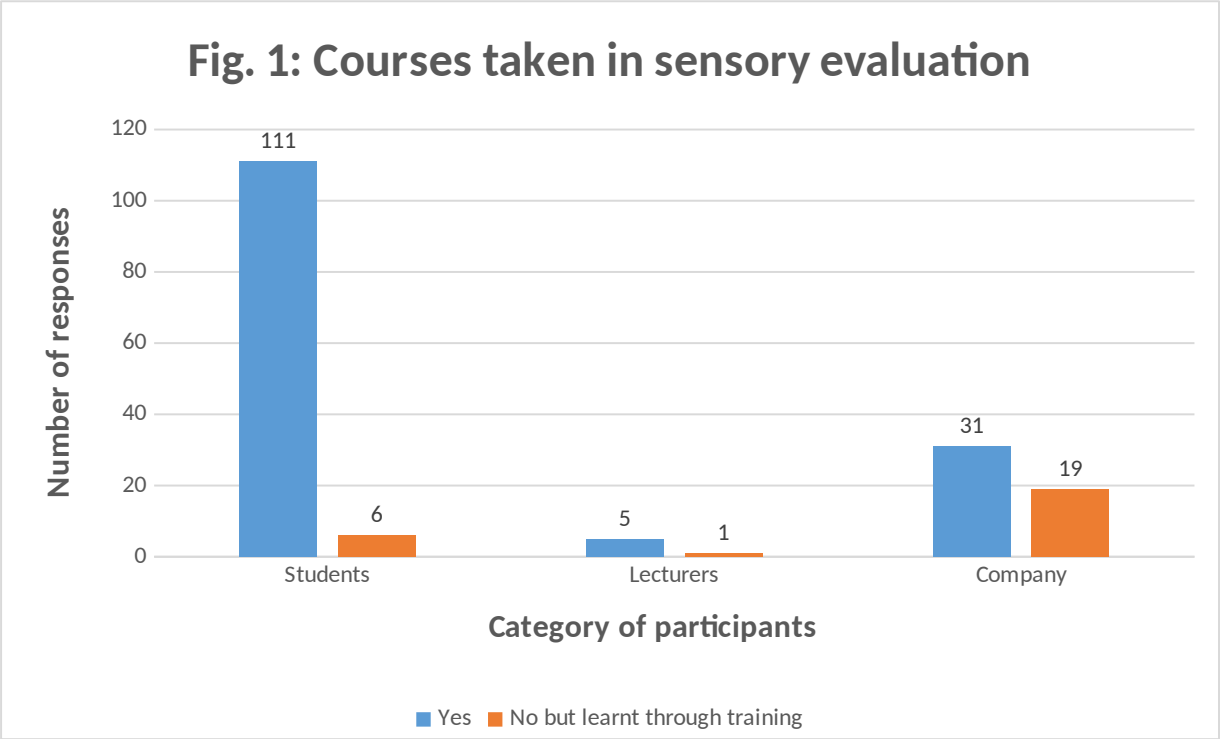
Table 4: Departments of company workers

Departments	Frequency	Percentage (%)
Production	11	22
Quality control and Assurance	24	48
Sensory Analysis	4	8
Research	6	12
Chemistry	1	2
Product Inspection	2	4
Food evaluation and registration	1	2
Import and Export	1	2
Total	50	100

Most of the respondents from the companies were, quality control or assurance department (48%), then production department (22%) Just a few came from sensory analysis department, research department, and product inspection departments. There was one participant each from departments like chemistry, food evaluation and registration, and the import and export departments.

4.1.1.3 Courses taken in sensory evaluation.

Figure 1 shows the number of participants who have taken courses or training sessions on sensory evaluation.

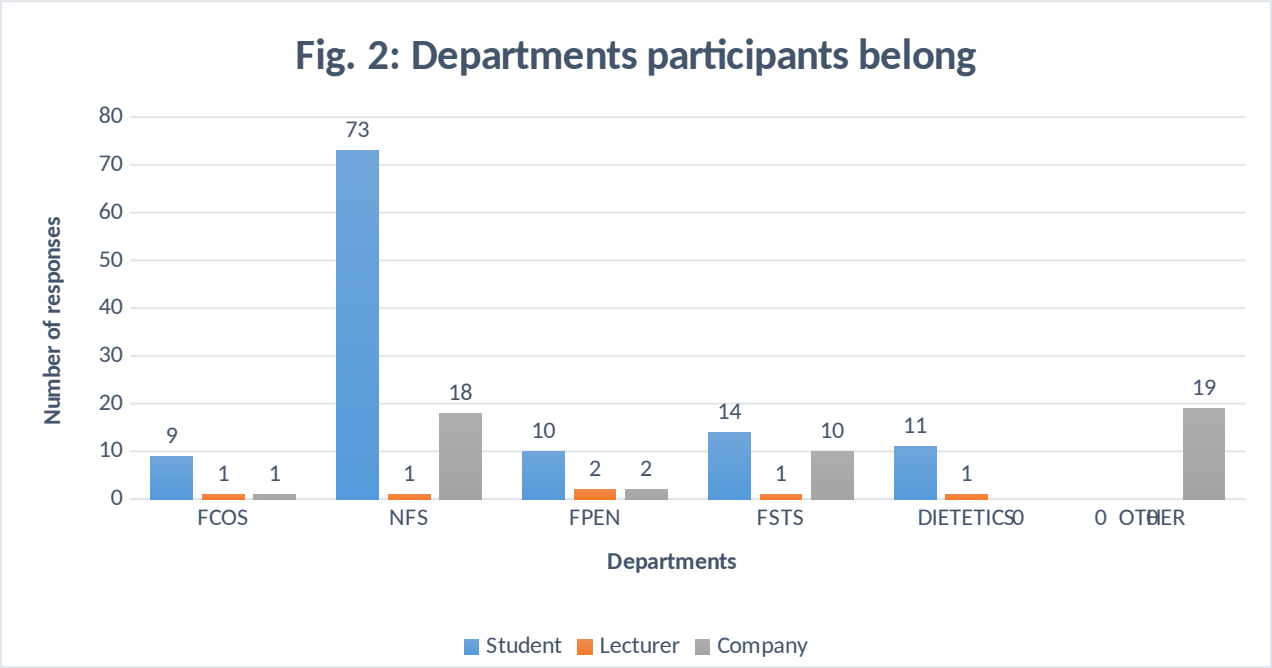


From the 117 students; 111(95%) had taken a course in sensory evaluation, whiles 6(5%) students which were from the dietetics department had training on sensory evaluation. For the 6 lecturers; 5(83%) had taken courses in sensory evaluation whiles 1(17%) had training on it. For the 50 company personnel, 31(62%) had taken courses in sensory evaluation, and 19(38%) had training on sensory evaluation.

The students from the dietetics department at the University of Ghana who did not take a course in sensory evaluation explained that they had a guest lecturer from a renowned food research institute who gave them a lecture on sensory evaluation which was about 3 hours. For the personnel in the companies, most of them had training in sensory evaluation in the companies they work in, two personnel from a large-scale company got their training from a Global Sensory Program.

4.1.1.4. Departments participants belong

Figure 2 shows the various departments the participants belong or belonged to whiles in school.



From the 173 participants who had taken courses in sensory evaluation, 117 were students comprising 9(8%) from FCOS (Family and Consumer Science) department, 73(62%) from NFS (Nutrition and Food Science) department, 10(9%) from FPEN (Food Processing Engineering) department, 14(12%) from FSTS (Food Science and Technology) department, and 11(9%) from Dietetics department.

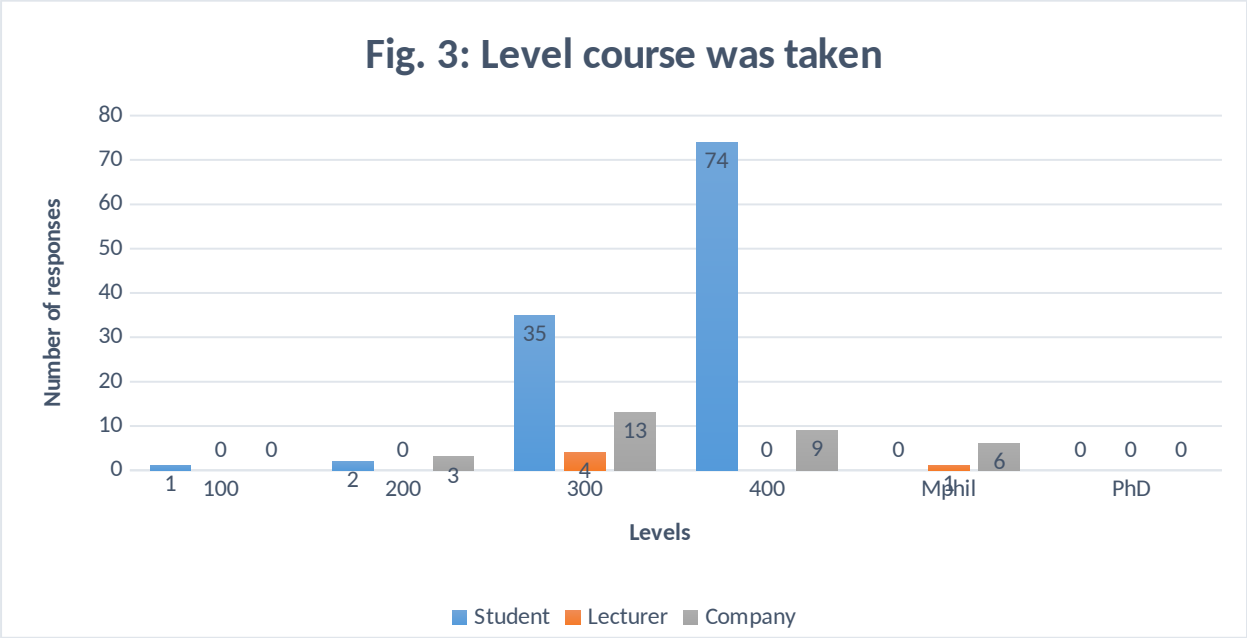
There were 6 lecturers; 1(16.67%) each from FCOS, NFS, FSTS and Dietetics department. 2(33.33%) lecturers came from the FPEN department.

Out of the 50 company workers, 1(2%) participant was from FCOS department, 18(36%) were from NFS department, 2(4%) from FPEN department, 10(20%) from FSTS department, and 19(38%) were from other departments, that is, they were in and graduated from other departments prior to working at the companies. Those departments include biochemistry,

chemistry, and mathematics departments, among others, whiles the majority had sensory evaluation or analysis training in their companies.

4.1.1.5. Level sensory evaluation course was taken

Figure 3 shows the levels participants took sensory evaluation as a course.



19 participants (company workers), 1 lecturer from FPEN department and 5 students (dietetics students at University of Ghana) who had taken training in sensory evaluation were exempted from this section, therefore, the total number of participants for this particular question were 148.

For 112 students; just 1(0.89%) participant took the course in level 100, 2(1.79%) in level 200, 35(31.25%) in level 300, and 74(66.07%) in level 400.

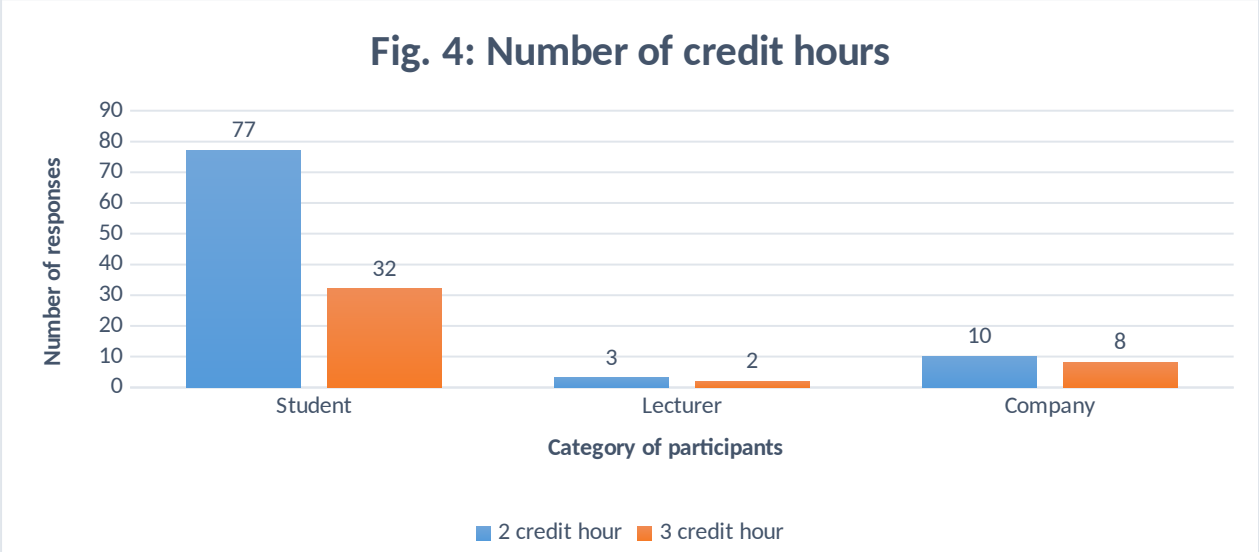
For 5 lecturers; 4(80%) of them took the course in level 300 whereas 1(20%) took the course in a graduate study, particularly masters.

For 31 company workers, 3(9.68%) of them took the course in level 200, 13(41.94%) in level 300, 9(29.03%) in level 400 and 6(19.35%) during their MPhil studies.

Participants who took the course in level 200 were mostly students and staff from the companies and they took the course in the food science and technology department. Those who took the course in level 300, mostly students, a few people in the companies, and all the lecturers except 1 from the NFS department, were from FCOS, FPEN, and FSTS departments. Majority of the participants who took the course in level 400 are from the NFS department. They are mostly students and a few people from the companies. 1 lecturer and a few people also took the course during their master's degree mostly at the NFS department.

4.1.1.6 Credit hours

Figure 4 shows the number of credit hours participants took sensory evaluation as a course.



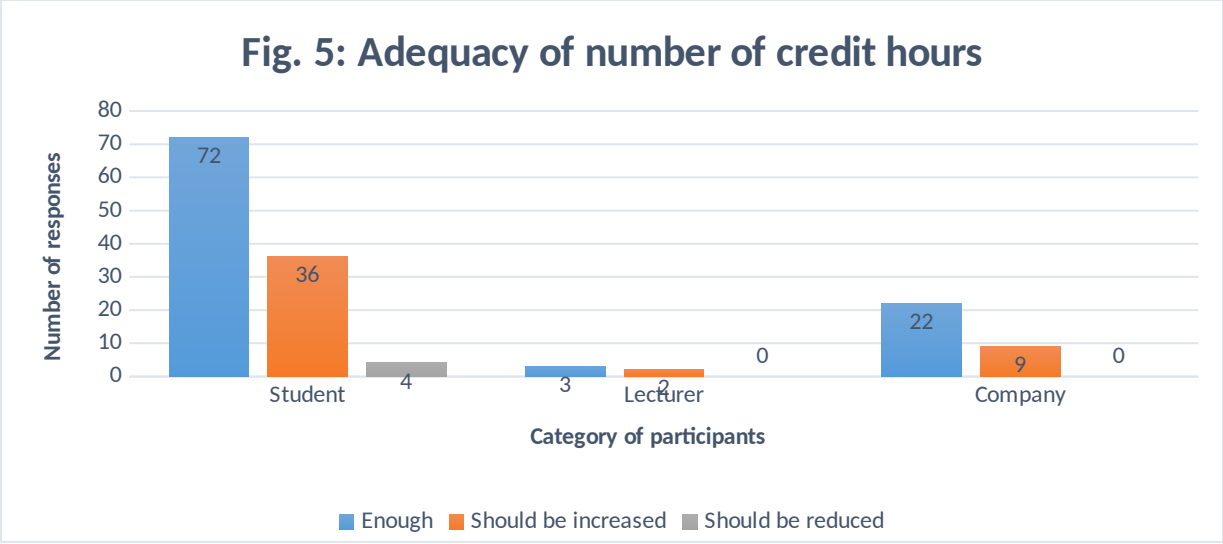
This section was to find out the number of credit hours sensory evaluation was taken in the various schools. 90 participants took the course as a 2 credit hour course mostly from NFS and FSTS departments, 42 took it as a 3 credit hour course mostly from the FPEN, FCOS, and

dietetics departments at the University of Health and Allied Sciences (UHAS), whiles 16 participants did not remember the number of credit hours they took the course.

For students, 77(85.55%) took the course as a 2 credit hour course whiles 32(35.55%) took it as a 3 credit hour course. For lecturers 3(60%) took the course as a 2 credit hour course whiles 2(40%) took it as a 3 credit hour course. For company workers, 10(55.55%) took the course as a 2 credit hour course whiles 8(44.44%) took the course as a 3 credit hour course.

4.1.1.7. Adequacy of the number of credit hours

Figure 5 shows how participants feel about the number of credit hours sensory evaluation course was taken in school.



This section required the participants to state how they feel about the number of credit hours, whether it was enough, whether it should be increased or it should be decreased. From the responses gathered, for the 112 students; 72(64.29%) argued the credit hours was enough, 36(32.14%) argued it should be increased, whiles 4(3.57%) said it should be reduced.

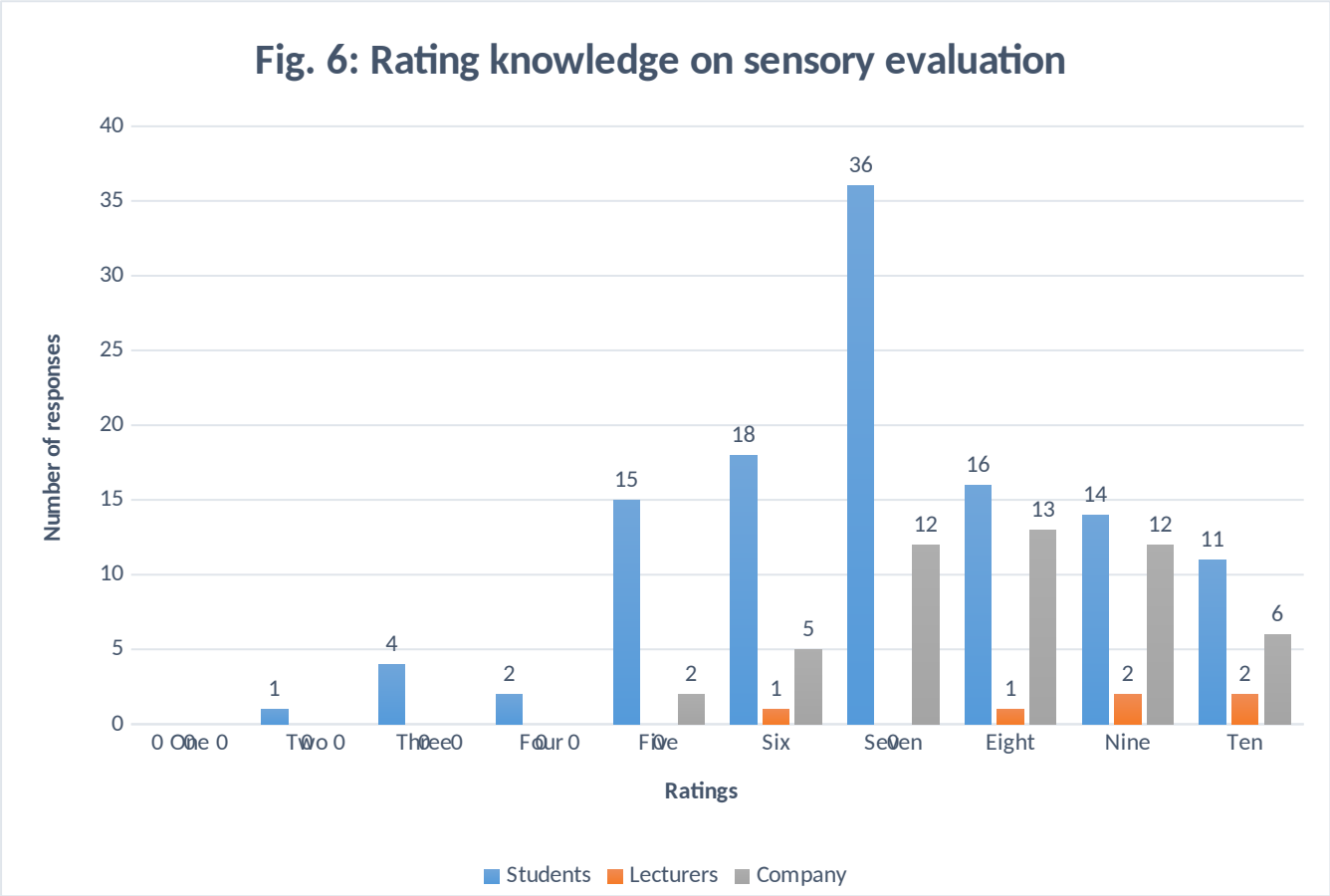
From the 5 lecturers, 3(60%) said it was enough, whiles 2(40%) argued it should be increased.

From the 31 company personnel, 22(70.97%) argued it was enough whiles 9(29.03%) argued it should be increased.

4.1.2 Knowledge

4.1.2.1. Rating knowledge on sensory evaluation

Figure 6 shows how participants rated their level of knowledge on the subjective form of sensory evaluation.



The participants were asked to rate their knowledge of sensory evaluation based on a scale of 1-10. The lecturers ranked their knowledge between 6-10 with an average score of 9 which shows they are knowledgeable in sensory evaluation. The workers from the company ranked their knowledge from 5-10 with an average score of 8 showing they are also very knowledgeable on sensory evaluation. The students ranked their knowledge on sensory evaluation between the ranges of 2-10 with the majority being 7 hence giving an average score of 7. Some students gave very low ratings because they believed that had little knowledge of sensory evaluation with the majority being dietetic students from University of Ghana. From the average score calculated, it indicates that lecturers and company workers rate their subjective knowledge higher than the students.

4.1.2.2. Understanding of sensory evaluation

Table 5 shows participants understanding of basic knowledge on sensory evaluation. The correct percentage score responses for students, lecturers and company workers were recorded.

Table 5: Understanding of sensory evaluation

Percentage of respondents that agreed to the following statements	Students (n = 117) Percentage (%)	Lecturers (n = 6) Percentage (%)	Company (n = 50) Percentage (%)
1. Sensory evaluation is applied in product development, marketing, and shelf-life studies.	98	100	100
2. Sensory evaluation is a standardized way of using the human senses to explain characteristics of food by inducing stimuli, analyzing and interpreting data from valid scales	99	100	98
3. Sensory evaluation is a scientific method to evoke, measure, analyze, and interpret those responses to products as perceived through the senses	99	100	98
4. Sensory evaluation is a subjective form of quality evaluation using laid down scientific principles	16	0	24
5. Sensory evaluation is a scientific discipline to evoke, analyze and interpret reactions to food using the human senses	10	0	16

Participants were asked to state whether the statements provided in the questionnaire were true or false. The aim was to check their knowledge of sensory evaluation. There were 117 students, 6 lecturers and 50 company workers.

All the participants except 2 students, giving a correct percentage score of 98% for students and 100% each for lecturers and company workers, agreed that the statement sensory evaluation is applied in product development, marketing, and shelf-life studies was true.

Also, they all agreed except for 2 participants, a student and a staff in a company, also giving a correct percentage score of 99% for students, 100% for lecturers and 98% for company workers agreed that the statement sensory evaluation is a standardized way of using the human senses to explain characteristics of food by inducing stimuli, analyzing and interpreting data from valid scales was also true. The third statement which is sensory evaluation is a scientific method to evoke, measure, analyze, and interpret those responses to products as perceived through the senses was also agreed by all the participants except for 2 participants, a student and a staff in a company (99% correct percentage score for students, 100% for lecturers, and 98% for company personnel) that it is a true statement.

The statement sensory evaluation is a subjective form of quality evaluation using laid down scientific principles was agreed by 142 participants, 98 students 6 lecturers, and 38 company workers to be a true statement. 31 participants, 19 students, and 12 company workers did not agree with the statement. This gives a correct percentage score of 16% for students, 0% for lecturers and 24% for company workers.

Finally, the statement sensory evaluation is a scientific discipline to evoke, analyze and interpret reactions to food using the human senses was agreed by 153 participants, 105 students, 6 lecturers, and 42 company workers to be a true statement. 20 participants, 12 students, and 8 company workers did not agree with the statement. The correct percentage for student was 10%, 0% for lecturers and 16% for company workers.

4.1.2.3. Roles of sensory evaluation

Table 6 shows participants level of knowledge on the roles of sensory evaluation. The correct percentage score responses for students, lecturers and company workers were recorded.

Table 6: Roles of sensory evaluation

Percentage of respondents that agreed to the following statements	Students (n = 117) Percentage (%)	Lecturers (n = 6) Percentage (%)	Company (n = 50) Percentage (%)
1. Sensory evaluation helps to know the sensory properties of products.	100	83	98
2. Sensory evaluation helps to evaluate the amount of moisture in a product.	67	83	66
3. Sensory evaluation helps provide information to the research department.	97	100	98
4. Sensory evaluation helps to know the number of microorganisms in a product.	90	100	90
5. Sensory evaluation helps provide information to the marketing department.	95	100	94
6. Sensory evaluation helps provide information to the production department	97	100	100

Participants were asked to state whether the roles stated for sensory evaluation were true or false statements. Responses were gathered from 117 students, 6 lecturers, and 50 personnel from the companies.

For the first role, sensory evaluation helps to know the sensory properties of products,171 participants said it is a true statement. The correct percentage score for students was 100%, 83% for lecturers and 98% for company workers. All the students, 5 lecturers, and 49 staff from the companies agreed that the statement is true and is indeed a role of sensory evaluation. In all 2 participants said it was a false statement, 1 lecturer and 1 staff from a company.

With the second statement, sensory evaluation helps to evaluate the amount of moisture in a product, 57 participants that is, 39 students, 1 lecturer, and 17 participants from the company agreed it is a role of sensory evaluation while the rest of the participants said it is not a role of sensory evaluation. 116 participants, that is 78 students, 5 lecturers, and 33 staff in the company said it is not a role of sensory evaluation. The correct percentage score for students was 67%, 83% for lecturers and 66% for company workers.

For statement three, 169 participants, 114 students, 6 lecturers, and 49 personnel from a company agreed that the statement sensory evaluation helps provide information to the research department is a correct role of sensory evaluation. The correct percentage score for students was 97%, 100% for lecturers and 98% for company workers. 4 participants, that is 3 students and a staff in a company said the statement is not a role of sensory evaluation.

For statement four, sensory evaluation helps to know the number of microorganisms in a product, 156 participants,105 students, 6 lecturers 45 personnel in a company said it is a false role of sensory evaluation. The correct percentage score for students was 90%, 100% for

lecturers and 90% for company workers. 17 participants, 12 students, and 5 staff in a company said the statement sensory evaluation helps to know the number of microorganisms in a product is a true statement.

For statement five, 164 participants, that is 111 students, 6 lecturers, and 47 staff in the company agreed that the statement sensory evaluation helps provide information to the marketing department is a true statement while 9 participants, that is 6 students and 3 company workers did not agree that it is a true statement. The correct percentage score for students was 95%, 100% for lecturers and 94% for company workers.

For statement six, 170 participants, 114 students, 6 lecturers and 50 company workers said the statement sensory evaluation helps provide information to the production department is a true statement, whiles 3 students did not agree. The correct percentage score for students was 97%, 100% for lecturers and 100% for company workers.

The participants were also allowed to give other roles of sensory evaluation in the comments section. Some of the roles they gave include; it helps in product description, it gives product developers information on the acceptability of new products by consumers, sensory evaluation also helps with quality control, quality assurance, shelf life studies, the optimization of food products, and the formulation of food products, it also helps in other fields like tribology, sensory evaluation helps more in the quality of a product rather than the safety of a product, among others.

4.1.3 Practice

4.1.3.1 Sensory evaluation tests that can be used in industries

The different types of sensory evaluation tests that can be used in industries are represented in the table below. Also in the table, the number of lecturers, students, and staff of companies that selected the various tests are indicated.

Table 7: Sensory evaluation tests that can be used in industries

Sensory tests	Students (n= 117)	Lecturers (n = 6)	Company(n = 50)
	Percentage (%) of yes responses	Percentage (%) of yes responses	Percentage (%) of yes responses
1. Triangle test	68	83	48
2. Rating test	32	50	18
3. Duo-trio test	46	83	18
4. Hedonic (Liking) test	70	83	82
5. Paired comparison test	39	67	28
6. Quantitative descriptive analysis (QDA)	51	67	56
7. Ranking test	24	67	24
8. Texture profiling	36	50	24
9. Flavour profiling	36	50	24

The participants were asked to select the types of sensory evaluation tests that can be used in industries and how they are applied. If participants do not select any of the tests, for the students and lecturers, it is either they have no idea about the role of that particular test or they don't think it can be used in the industries. But for the staff of companies, it is not used by the company. Responses were obtained from 117 students, 6 lecturers, and 50 staff from companies.

108 participants comprising 9 students (68%),5 lecturers (83%) and 24 staff from the companies(48%) selected the triangle test with the use being that, it is a product-oriented test mostly done by trained panelists used to assess whether a perceivable difference exists between three food products mostly to find the odd one (suggested by students, lecturers, and companies), some also suggested it helps to know the difference between samples and controls, also to know the difference between new and old samples (students). The companies suggested triangle test is for checking the difference between products following a change in formulation or in-processing conditions, and also to see if external factors have influenced the products. 65 participants (38 students, 1 lecturer and 26 staff from companies) did not select the triangle test.

49 participants which includes 37 students (32%), 3 lecturers (50%) and 9 staff from companies (18%) selected rating tests and they gave the use as; it is used to rate the intensities or degree of likeness or dislike for a particular product (suggested by students and staff at the companies). Some students suggested it was a consumer test whiles others suggested it was a product-oriented test. The lecturers, some students as well as some staff in the companies suggested rating test helps to rate the panelists responses on a specific attribute based on given scales. 124 participants (80 students, 3 lecturers and 41 personnel from the companies) did not select the rating test.

70 participants selected the duo-trio test making a total of 54 students (46%), 5 lecturers (83%) and 11 staff from the companies (18%). They gave the following as the use; it is to assess whether a perceivable difference or similarities exists between products or batches of products, some students suggested they are consumer tests whiles others said it was a product-oriented test. Some also suggested it was used to find the difference between samples and their controls. 103 participants (63 students, 1 lecturer, and 39 personnel from the companies) did not select the duo-trio test.

126 participants chose hedonic or liking test 82 students (70%), 5 lecturers (83%) and 39 company staff (82%). Most of them stated that it is a consumer oriented test, to show the degree of likeness (how much they like) for a product. Others affirmed that it is used to determine the degree of likeness or dislike for a product by consumers by it using the 9-point hedonic scale to rate the intensities. However, some also stated that it is used to determine consumers' preference and acceptability while a few students stated that they do not remember its use.

For paired comparison tests, it was picked by 64 participants 46 students (39%), 4 lecturers (67%) and 14 staff from companies (28%). It is used for comparing two samples to choose the more preferred between them, and to know their differences in terms of sensory attributes and similarities. A few said it is used to compare two or three samples, some lecturers also said it is used to determine the difference between two products as well as comparing a new product with an existing one. Some staff of companies stated that it is used for determining the differences between two batches of products. Unfortunately, some students did not remember its use.

91 participants selected Quantitative Descriptive Analysis, 59 being students (51%), 4 lecturers (67%) and 28 staff from companies (56%). Some uses of QDA by the participants are; it is used

for benchmarking, majority said it is used to know the attributes of products (product profiling), it is also used to know the difference of product characteristics. Few said it is used to provide a description of the sensory attributes of a product and to get the properties as well as the actual characteristics of the food product. It can also be used for product optimization, and a lecturer suggested it is a comprehensive determination and description of the sensory attributes within a food product. Few students had no idea of the test.

44 participants chose ranking test 28 students (24%), 4 lecturers (67%) and 12 staff of companies (24%). The following are some of the uses given; to know the most preferred product by their scores or intensities, to show the acceptability of a product, it is also used to rank the intensity of an attribute. Staff from two companies suggested to compare various recipes, and to evaluate and rank set of products. Two lecturers also stated that it is to evaluate multiple products and rank them in order based on predetermined criteria, and to grade products in terms of a given specification regarding attributes so as to select the most suitable for a given purpose. Majority of the students do not remember its use.

Texture profiling was selected by 57 participants, 42 students (36%), 3 lecturers (50%) and 12 staff of companies (24%). The roles of the tests given are; to assess the texture of products, to check the textural properties of products and also the texture attributes desired by consumers. However, a few did not remember and some had no idea

Flavor profiling was selected by 57 participants, 42 students (36%), 3 lecturers (50%) and 12 staff of companies (24%). They gave the following uses; to know the flavor profile of products, to determine the different flavors in a product as well as defining various flavors in a product. Lecturers stated that it is used to determine the flavor profile of products and to determine the

prominent flavors in the food and which is preferred by consumers and also to describe characteristics of wine and other beverages. A few did not write any comment.

4.1.3.2. Ways companies can use sensory to improve product quality

The table below shows ways companies can use sensory evaluation to improve product quality and the percentage obtained for each participant.

Table 8: Ways companies can use sensory to improve product quality

Ways to improve product quality using sensory evaluation	Students (n= 117) Percentage (%) of yes responses	Lecturers (n= 6) Percentage (%) of yes responses	Company (n= 50) Percentage (%) of yes responses
1.Getting feedback from consumers using consumer tests	97	100	100
2.Product profiling to check for consistency	86	100	96
3.Using the right type of packaging	44	67	76
4.Training of employees	59	50	78
5.Product optimization	71	100	90
6.Motivating panelists	48	67	58
7.Performing shelf life studies	62	83	90
8.Others	0	0	4

Participants were asked to select ways by which sensory evaluation can be used to improve product quality in industries; responses gotten were a total of 173 participants, of which 117 were students, 6 were lecturers and 50 staff of companies.

For the first statement, 169 participants 113 students (97%),6 lecturers (100%)and 50 staff of companies (100%) selected getting feedback from consumers using consumer tests as a way of using sensory evaluation to improve product quality, only 4 students suggested it was a false statement.

Also, 155 participants selected product profiling to check for consistency as another way to improve product quality using sensory evaluation but 18 participants (16 students and 2 staff of companies) stated otherwise.

For the third statement which is using the right type of packaging, 91participants comprising 51 students (44%), 2 lecturers (67%) and 38 staff of companies (76%) agreed that it is a way of using sensory evaluation to improve product quality but 82 participants (66 students, 4 lecturers and 12 staff of companies) disagreed with the statement.

Furthermore, 111 participants; 69 students (59%), 3 lecturers (50%) and 39 staff of companies (78%) confirmed that training of employees is another way of using sensory evaluation to improve product quality while 62 participants did not accept the statement.

For product optimization being a way of using sensory evaluation to improve product quality, 135 participants; 83 students (71%), 6 lecturers (100%) and 45 staff of companies (90%) agreed to the statement while 39 participants (34 students and 5 staff of companies) disagreed.

87 participants confirmed that motivating panelists is a way of using sensory evaluation to improve product quality while 85 participants (60 students, 4 lecturers and 2 staff of companies) disagreed

Performing shelf life studies was selected by 123 participants; 73 students (62%), 5 lecturers (83%) and 45 staff of companies (90%) as a way of using sensory evaluation to improve product quality but 50 participants (44 students, 1 lecturer and 5 staff of companies) did not select that.

Only 2 staff of companies decided to suggest other ways of improving product quality using sensory evaluation and they are bench marking of products, and maintain the product's consistency.

4.1.3.3. Who conducts sensory evaluation tests

The table below shows who can or should conduct sensory evaluation tests with the yes percentages for the students, lecturers and company workers.

Table 9: Who conducts sensory evaluation tests

Who conducts sensory tests	Students (n= 117) Percentage (%) of yes responses	Lecturers (n= 6) Percentage (%) of yes responses	Company (n= 50) Percentage (%) of yes responses
1.Members within the company	74	100	88
2.Members from a private external testing company	70	67	52
3.Members from a government testing organization	34	33	30
4.University or members of research institution	60	83	60
5.Others	0	67	28

The participants were asked to choose who can conduct sensory evaluation tests for industries and suggest any other people that can conduct tests who are not listed in the question.

137 participants; 87 students (74%), 6 lecturers (100%) and 44 staff of companies (88%) selected members within the company as people who conduct sensory tests for industries but 36 participants (30 students and 6 staff of companies) did not choose that.

For members from a private external testing company, 112 participants; 82 students (70%), 4 lecturers (67%) and 26 members of staff (52%) selected that option but 61 (35 students, 2 lecturers and 24 staff of companies) participants disagreed.

60 participants; 40 students (34%), 2 lecturers (33%) and 15 staff of companies (30%) selected members from a government testing organization but 86 participants (77 students, 4 lecturers, and 35 staff of companies) did not agree.

105 participants; 70 students (60%), 5 lecturers (83%), and 30 staff of companies (60%) selected university or members of research institution but 68 participants (47 students, 1 lecturer and 20 staff of companies) disagreed.

Staff from companies commented that trained sensory panelist from the company and consumers of that product, trained panelist from anywhere whether in or outside the company, consumers of that particular product and people from France can conduct sensory tests. However, students and lecturers stated that the general public, consumers of that particular products and trained test panel can conduct sensory tests.

4.1.3.4 Departments that use sensory evaluation tests

The various departments that use sensory evaluation are production department, quality control / assurance department, sales and marketing department, consumer service department, innovation and research department, laboratory services department, post market surveillance, sensory department, food evaluation and registration department, nutrition department and research and development.

4.2 Discussion

The principal aim of this research was to find the gaps between what students are taught in school and what is actually being done in the industries in relation to sensory evaluation.

From table 1, it can be seen that the companies we visited were just medium and large-scale companies. The small-scale companies we contacted do not usually employ the use of sensory analysis in their facilities. There are concerns by these small-scale industries about the expenses that accompany sensory tests. This makes them ineligible to take part in the research. This shows that when students who have acquired knowledge in sensory evaluation find themselves in these small-scale industries, they will not be able to apply what they have learned in sensory evaluation in these companies. We suggest small-scale businesses should start utilizing sensory evaluation in their production processes; this will enable production yield because they would get to know what consumers of their products want and prefer.

Table 2 showed the various departments the companies workers belonged. Majority were from quality assurance and control department, and production department. This shows that these departments use sensory evaluation methods and their workers have knowledge in sensory evaluation.

From figure 1, it can be observed that even though tertiary institutions equip lots of students with knowledge on sensory evaluation, not everyone working in the companies gained their knowledge from schools. This statement is as a result of the responses obtained from personnel from the various companies; most of them did not take courses in sensory evaluation but they have been trained on the job in their industries. We also suggest that companies employ persons who are knowledgeable in sensory evaluation.

Figure 2 shows the various departments the participants learnt sensory evaluation. From the statistics obtained from members of the companies, it can be seen that those who took courses in sensory evaluation were mostly from the Nutrition and Food Science department, Food Processing Engineering department, and the Food Science and Technology department, with quite a number from other departments. It can be said that people who took sensory evaluation course in schools actually apply what they were taught. But this also depends on the size of the company and what they produce.

Figure 3, 4, as well as 5 shows the levels of the participants when they took the sensory evaluation course, with their respective number of credit hours. Also, the participants expressed their thoughts on the number of credit hours. Majority of the participants took the course in level 400 (those from the Nutrition and Food Science department) while the other students from the other departments took the course in level 300. Through the interviews we learnt that some of the participants who are lecturers, and company workers took them in two levels, that is in level 400 or 300 as well as in their master's program. Most of the participants took the course as a 2 or 3 credit course. Some of the participants mostly students who took it as 2 credit hours said it was enough. Others said it should be decreased because the theory aspect is too much and difficult to understand, when the grade gained is bad, it can affect their final grade point average (FGPA). Some participants also suggested the course should be increased because it needs to be more practical than theoretical; the students believe the practical aspect will help them in the industries. The teaching of sensory evaluation in schools should be made more practical so that they can familiarize themselves with the various tests used for sensory analysis. From the interviews conducted at the companies, some workers explained that, not all the knowledge acquired in schools is utilized in the industries. It depends on what the company produces.

Figure 6 shows how the various participants rate their knowledge on sensory evaluation. Overall, just a few students rated their knowledge quite low. They explained that the theory aspect of the course was a little difficult to comprehend. Dietetics Students at the University of Ghana rated their knowledge on sensory evaluation very low because they said the questions were too technical for them to answer. They learnt how to use the human senses to analyze food and basic information about sensory evaluation. The lecturers and company workers rated their knowledge on sensory evaluation quite high because they are more experienced than the students and have more practical knowledge on sensory evaluation.

Table 3 to table 6 shows how the participants understand sensory evaluation.

Table 3 gave factual statements to support basic knowledge in sensory evaluation.

From table 4, the first statement, sensory evaluation is applied in product development, marketing, and shelf life studies was stated by (Świąder & Marczewska, 2021). Majority of the participants had this statement correct. The correct percentage score was 98% for students and 100% each for lecturers and company workers. From this result, it can be said that the students, lecturers and company workers have the same understanding when it comes to this statement.

The second statement according to (Tentamus, 2022), sensory evaluation is a standardized way of using the human senses to explain characteristics of food by inducing stimuli, analyzing and interpreting data from valid scales was agreed by all the participants that it was a true statement except two participants, a student and a company worker. This also gave a very high correct percentage score. With this statement too, it can be concluded that all the participants have equal level of understanding when it comes to this statement.

For statement three, according to (Stone & Sidel, 2004), the statement sensory evaluation is a scientific method to evoke, measure, analyze, and interpret those responses to products as perceived through the senses was also agreed by all the participants that it was a true statement with the exception of two participants, a student and a personnel from a company. This gave a very high correct percentage score. From this result, it can also be said that the students, lecturers and company workers have the same understanding when it comes to this statement.

For statement four, sensory evaluation is a subjective form of quality evaluation using laid down scientific principles is a false statement according to (Eirini, 2016). According to her, sensory evaluation emphasizes both the objective measurement of a product's sensory qualities (also known as product understanding) and peoples' subjective reactions to physical products (often referred to as consumer understanding), as well as the interpretation of a consumer response through knowledge of the response to a product (linking product and consumer understanding). Majority of the students and company workers, and all the lecturers said they were true statements. Just a few students and personnel from the companies had this statement right hence giving a very low percentage score. This results also shows that almost all the participants have the same knowledge on this statement even though it is incorrect according to literature.

For the final statement, sensory evaluation is a scientific discipline to evoke, analyze and interpret reactions to food using the human senses is a false statement. According to (Stone & Sidel, 2004), sensory evaluation is a scientific method to evoke, measure, analyze, and interpret those responses to products as perceived through the senses. The statement in our research omitted ***'measure'*** making the statement a false statement. Majority of the participants got this statement wrong, giving a low correct percentage score. They argued that even though that statement had an omitted word, the rest makes the statement a true statement. This reveals two

things; that the participants were not focused on the specificity of the definition. This shows that they did not memorize the definition but rather apply the knowledge. It could also imply that they do not consider sensory evaluation as a measurement science, and hence the absence of the word measure did not send a signal.

From this section, it can be concluded that, there are no gaps between what students are being taught and what is being done in the industries.

Table 5, shows the factual statements on the roles of sensory evaluation.

From table 6, the first statement, sensory evaluation helps to know the sensory properties of products (Ruiz-Capillas & Herrero, 2021) confirms this statement. From the responses gathered, almost all the participants with the exception of two, a lecturer and a worker from a company stated that it was a true statement. This gave a very high correct percentage rate. It can be concluded that, all the participants have the same level of understanding about what this role of sensory evaluation.

From statement two, sensory evaluation helps to evaluate the amount of moisture in a product. This statement is a false statement. According to (Mermelstein, 2009), moisture content refers to the amount of water (molecules) that become incorporated into a food product. A good number of people said it was a false statement. The few that said it was a true statement argued that, the eyes for appearance can help you to see if a product has moisture in it. Also, when it comes to texture at hand, you can know when a product has an amount of moisture in it when it has to be a hard product.

For statement three, five, and six, sensory evaluation helps to provide information to the research, marketing and the production department, is a true statement according to (Drake,

2022) and (Świąder & Marczewska, 2021) . Majority of the participants selected these statements to be true, hence giving a very high correct percentage rate therefore, it can be concluded that all the participants had the same level of understanding with regards to these roles of sensory evaluation.

For statement four, sensory evaluation helps to know the number of microorganisms in a product is a false statement. Majority of participants agreed it was a false statement, giving a very high correct response percentage. According to Tortora et al., (2010), microorganisms are organisms that are too small to be seen with the naked. They can only be seen under a microscope. This shows that all the participants have the same level of knowledge regarding this role.

All the other roles given by the participants in the comment section are also accurate roles of sensory evaluation. This shows that they have a quite a high level of knowledge on the roles of sensory evaluation.

From this section, it can be concluded that what the lecturers teach the students and what the students know is the same as what those in the companies know.

From table 7,

According to (Drake, 2021), assessors are required to select the product that differs the most from the other two out of three in a triangular test; this means it is used to determine the odd product from the two other products given among three products. From table 7 of the results, all categories said that it is used to assess whether a perceivable difference exists between three food products mostly to find the odd one. Some students stated that it helps to know the difference between samples and controls, also to know the difference between new and old samples but the company staff also suggested triangle test is for checking the difference between products

following a change in formulation or in-processing conditions, and also to see if external factors have influenced the products. From what the students stated as the role for triangle tests and that of what the staff of companies stated, it can be clearly seen that what some students know is different from what the workers are using in the industries because some of the students answered the role correctly while others did not.

Rating test is used to determine in which way a particular sensory attribute varies over a number of samples or products (McClement & Grossmann, 2022). Some students and staff of companies stated it is used to rate the intensities or degree of likeness or dislike for a particular product. Some students also suggested it was a consumer test whiles others suggested it was a product-oriented test. The lecturers, some students as well as some staff in the companies suggested rating test helps to rate the panelists responses on a specific attribute based on given scales. From the above roles, it can be said that what some students know as the role of rating test is exactly what those in industries use rating test for.

In duo-trio tests panelists get all three samples concurrently, the formulation of one of the two coded samples and the reference sample are the same. The panelists have to pick the coded sample that is most similar to reference. Duo-trio test is used to determine the similarities between two products among three products where one is the reference product (Prescott et al., 2014). From the results above, duo-trio is said to be used to assess whether a perceivable difference or similarities exists between products or batches of products by companies, some students suggested they are consumer tests while others said it was a product-oriented test. Some students also suggested it was used to find the difference between samples and their controls. It can be understood that some of the students do not know what duo-trio is used for in the industries

According to Pimentel et al. (2016), hedonic test is used to evaluate the acceptance and preference of products. Most of the students stated that it is a consumer oriented test, to show the degree of likeness for a product. Staff from various companies affirmed that it is used to determine the degree of likeness or dislike for a product by consumers by it using the 9-point hedonic scale to rate the intensities. However, some also stated that it is used to determine consumers' preference and acceptability while a few students stated that they do not remember its use. Hedonic test is the most used test in companies. This shows that students are well vexed in what hedonic test is used for in industries.

In paired comparison tests, the aim is to identify the sensory attribute in which the samples differ (Calof, 2006). Therefore, it is used to know how sensory attributes differ in two products. Some students said it is used for comparing two samples to choose the more preferred between them, and to know their differences in terms of sensory attributes and similarities. A few said it is used to compare two or three samples, some lecturers also said it is used to determine the difference between two products as well as comparing a new product with an existing one. Some staff of companies stated that it is used for determining the differences between two batches of products. This means that some of the students have no idea of what paired comparison is being used in industries.

According to (Drake, 2021), Quantitative Descriptive Analysis is used to describe the sensory characteristics of products. Some uses of QDA by the participants are; it is used for benchmarking, majority said it is used to know the attributes of products (product profiling), it is also used to know the difference of product characteristics. Few students and staff of companies said it is used to provide a description of the sensory attributes of a product and to get the properties as well as the actual characteristics of the food product. It can also be used for product

optimization, and a lecturer suggested it is a comprehensive determination and description of the sensory attributes within a food product. From the roles given, what students know about the role of QDA is same as what is being applied in companies.

Ranking test is to compare several samples according to a single attribute, e.g., sweetness, freshness, preference (Świąder & Marczewska, 2021). The following were the roles given; to know the most preferred product by their scores or intensities, to show the acceptability of a product, it is also used to rank the intensity of an attribute. Staff from two companies suggested to compare various recipes, and to evaluate and rank set of products. Two lecturers also stated that it is to evaluate multiple products and rank them in order based on predetermined criteria, and to grade products in terms of a given specification regarding attributes so as to select the most suitable for a given purpose. What the staff of companies stated as the role of ranking test contradicts with what students wrote as well as what is said according to literature.

Prescott et al., (2014) stated that, texture profiling is done to get the textural differences for specific products. The roles of the tests given by students, lecturers and workers from companies were; to assess the texture of products, to check the textural properties of products and also the texture attributes desired by consumers. The roles of texture profiling students gave is same as what industries use texture profiling for.

For flavor profiling, (Prescott et al., 2014) stated that it is for analyzing perceived aroma and flavor characteristics of a product, their intensities, order of appearance and aftertaste. Students and workers gave the following uses; to know the flavor profile of products, to determine the different flavors in a product as well as defining various flavors in a product. Lecturers stated that it is used to determine the flavor profile of products and to determine the prominent flavors

in the food and which is preferred by consumers and also to describe characteristics of wine and other beverages. This shows the students are being taught exactly what is being applied in industries.

Some of tests used in the industries have different names from what the students know. The following are in/out method known by students as DFC, simple difference known as DFC test, simple profiling and blind tasting is known as paired comparison by students, and spiking which is done to know if there is too little or too much ingredients in a product.

From table 8, all the statements listed were confirmed by the participants as ways companies can use sensory evaluation to improve product quality.

The first statement which is getting feedback from consumers using consumer tests implies that consumer test which is a type of sensory evaluation test. Manufacturers must comprehend the reasons behind the specific sensory characteristics that their product possesses and possess the knowledge necessary to guarantee the sensory quality of their products or to alter the sensory characteristics in response to consumer demand. When determining target product quality, two factors must be taken into consideration: the essential sensory qualities that influence liking and the sensory standards that must be adjusted to appeal to various consumer groups within a market sector. A range of permissible variation around this aim must be set when the most popular product(s) have been identified (Everitt, 2009). All these attributes ca be obtained from consumers using consumer tests.

Product profiling can be used to assess the degree of compatibility between a company's present production process and infrastructure investments and the needs of its markets. QDA is done to evaluate the sensory properties of products and it is a type of sensory test. Checking the sensory

attributes can help manufactures maintain product consistency since they will be able to detect any changes in the product batch after batch. This can aid in product quality because of the product's consistency on the market; which is what every consumer wants, quality products.

Using the right type of packaging can be a way of using sensory evaluation to improve product quality because the right type of package may be appealing to consumers the moment they set eyes on the product (it defines the appearance of the product).

Training of employees by equipping them with knowledge on sensory evaluation can help in improving product quality because, they would always watch out for consistency of the products before releasing them onto the markets

In order to improve the targeted qualities and, by extension, the overall consumer approval, a product optimization project often tries to change a few ingredient or process factors. A strong descriptive panel must be used for both sorts of projects in order to confirm the initial consumer needs and record the qualities of the successful prototype (Calof, 2006). Changing formulation of products to meet consumers' demand is a way of using sensory evaluation to/ improve product quality.

Motivating panelists who conduct sensory evaluation tests will inspire them to do good work when evaluating products which will enhance the production of only good and quality products.

Performing shelf life studies is a way of using sensory evaluation to improve product quality because shelf life tests are performed using sensory tests which enables the manufacturer know the changes on many aspects of the product, such as its components, packaging, production, and storage conditions. Consequently, the impact of each of these elements on the product is shown.

Other ways of improving product quality using sensory evaluation as suggested by two participants are bench marking of products, and maintain the product's consistency.

In quality control, quality assurance, and shelf-life/storage projects, product maintenance is a crucial concern. The "effective status" of the standard or control product with consumers must first be established. QC or storage testing can then be used internally to measure the degree and nature of change over time, condition, production location, raw material sources, among others (Calof, 2006).

Using benchmarking to compare your products to similar products may expose a manufacturer to mistakes made during production. This can only be done by using sensory tests like DFC, where the similar products serve as the control, which is also a way of improving product quality as stated by Passos & Haddad, (2013).

From table 9, members within the company, members from a private external testing company, members from a government testing organization and University or members of research institution are eligible to conduct sensory tests from the findings of the survey. Some of the staff from companies commented that trained sensory panelist from the company and consumers of that product, trained panelist from anywhere whether in or outside the company, consumers of that particular product and one staff stated that people from France conduct sensory tests on their products because it is France based company. However, students and lecturers stated that the general public, consumers of that particular products and trained test panel can conduct sensory tests. Also, some students stated that anyone from the company aside anyone from the production department can do the test to avoid biases. One personnel from a large scale industry stated that sensory tests are done by the nutrition department because they lack a quality

assurance unit, another personnel said that the research team in their industries conduct the sensory evaluation tests.

From the results, it can be concluded that the departments that utilize sensory evaluation in industries are the production department, quality control or quality assurance department, sales and marketing department, consumer service department, innovation and research department, laboratory services department, post market surveillance, sensory department, food evaluation and registration department, nutrition department and research and development. This conclusion was made based on our research.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

We can conclude that most companies utilize sensory evaluation except for small scale industries. Personnel from quality control department and production department have more knowledge in sensory evaluation when it comes to the company workers. From the results obtained, students have more idea on what sensory evaluation is as compared to those from the companies. Also, most of the workers graduated from Nutrition and Food Science, and Food Science and Technology department, whiles some are trained on their jobs. They even have regular training for their panelists involved in sensory analysis to constantly check their sensory abilities, hence they seem to have lots of experience in relation to the application of sensory evaluation in industries. Two participants even confirmed to have 10 years of experience in the practice and application of sensory evaluation.

From the survey conducted, personnel from companies said that not all the knowledge acquired in sensory evaluation in school is applied in the companies especially the different types of sensory evaluation tests; they stated that the tests used in the industries is actually dependent on the type of product they produce. Also students should have more of the practical aspect of learning in school to familiarize themselves with the sensory evaluation tests and their respective roles.

Also, the knowledge that students and lecturers have in sensory evaluation based on the understanding, roles of sensory evaluation, who should or conducts sensory tests in the industries, departments that use sensory evaluation, and ways companies can use sensory evaluation to improve product quality is same as personnel from companies. This implies there is no gap between what students are being taught about the roles of sensory evaluation, who should or conducts sensory tests in the industries, departments that use sensory evaluation, and ways companies can use sensory evaluation to improve product quality what is being applied in industries as roles of sensory evaluation.

Finally, it was discovered that for a product to be brought onto the market, a company would need at least three trained panelists to approve it.

5.2 Recommendation

We recommend a more in-depth study using a higher number of companies nationwide. These companies must include all the various sectors, that is small, medium as well as large-scale.

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APPENDIX

APPENDIX A - QUESTIONNAIRE

1.0 DEMOGRAPHICS

1. Kindly tick the category you belong to

a. Student [ ]

b. Lecturer [ ]

c. Company [ ]

2. How is this company classified in terms of size? (For companies only)

a. [ ] Small-scale b. [ ] Medium-scale c. [ ] Large-scale d. [ ] Other (specify)

3. Have you taken sensory evaluation as a course before?

a. Yes [ ]

b. No, I have no idea about what sensory evaluation is [ ]

c. No, but I have had training or a guest lecture on sensory evaluation [ ]

4. Under which department did you take the course, training or guest lecture?

a. Family and Consumer science [ ]

b. Nutrition and Food Science [ ]

c. Food Process Engineering [ ]

d. Food Science and Technology [ ]

e. Dietetics [ ]

f. None [ ] specify……

5. At which level was sensory evaluation taught and how many credit hours was it?

a. Level 100 [ ] Credit hours…….

b. Level 200 [ ] Credit hours ……..

c. Level 300 [ ] Credit hours ……..

d. Level 400 [ ] Credit hours ……..

e. MPhil [ ] Credit hours ……..

f. Ph.D. [ ] Credit hours……...

6. Is the number of credit hours.

a. Enough [ ]

b. Should it be increased [ ]

c. Should it be reduced [ ]

2.0 KNOWLEDGE

7. How will you rate your knowledge of sensory evaluation? 1-10. Where 1 means no knowledge and 10 means very knowledgeable.

…….

8. How do you understand sensory evaluation? Indicate whether the following statements are True or False. Where T means true and F means false.

a. Sensory evaluation is applied in product development, marketing, and shelf-life studies [ ]

b. Sensory evaluation is a standardized way of using the human senses to explain characteristics of food by inducing stimuli, analyzing and interpreting data from valid scales [ ]

c. Sensory evaluation is a scientific method to evoke, measure, analyze, and interpret those responses to products as perceived through the senses [ ]

d. Sensory evaluation is a subjective form of quality evaluation using laid down scientific principles [ ]

e. Sensory evaluation is a scientific discipline to evoke, analyze and interpret reactions to food using the human senses [ ]

9. What are some of the roles of sensory evaluation you know? Indicate whether the following statements are True or False. Where T means true and F means false.

a. Sensory evaluation helps to know the sensory properties of products [ ]

b. Sensory evaluation helps to evaluate the amount of moisture in a product [ ]

c. Sensory evaluation helps provide information to the research department [ ]

d. Sensory evaluation helps to know the number of microorganisms in a product [ ]

e. Sensory evaluation helps provide information to the marketing department [ ]

f. Sensory evaluation helps provide information to the production department [ ]

g. Any other role ……..

3.0 PRACTICE

10. What are some of the test(s) used for sensory analysis and how can they be applied in industries? Tick all that apply.

a. Triangle test [ ]

Role……

b. Rating test [ ]

Role……

c. Duo-trio test [ ]

Role……

d. Hedonic (Liking) test [ ]

Role……

e. Paired comparison test [ ]

Role……...

f. Quantitative descriptive analysis (QDA) [ ]

Role……

g. Ranking test [ ]

Role……

h. Texture profiling [ ]

Role……..

i. Flavour profiling [ ]

Role……

11. What are some of the ways companies can use sensory evaluation to improve product quality? (Tick all that applies)

a. Getting feedback from consumers using consumer tests [ ]

b. Product profiling to check consistency [ ]

c. Using the right type of packaging [ ]

d. Training employees [ ]

e. Product optimization [ ]

f. Motivating panelists [ ]

g. Performing shelf life studies [ ]

12. Under which department in the industry is sensory evaluation used?

a. Research department [ ]

b. Production department [ ]

c. Sales and marketing department [ ]

d. Quality Control department [ ]

13. Who conducts the tests in the industries? (Tick all that apply)

a. Members within the company [ ]

b. Members from a private external testing company [ ]

c. Members from a government testing organization [ ]

d. University or other research institution members [ ]

e. Any other (please specify)……

APPENDIX B - LETTER TO COMPANIES

UNIVERSITY OF GHANA
DEPARTMENT OF NUTRITION AND FOOD SCIENCE
COLLEGE OF BASIC AND APPLIED SCIENCES

SENSORY EVALUATION LABORATORY
UNIVERSITY OF GHANA

The Human Resource Manager

……

……....

……

……....

REQUEST FOR PARTICIPATION IN FINAL YEAR PROJECT

Benedicta Anowa Quarcoo and Sarah Abeka are our names. We are level 400 final year students from the Nutrition and Food Science Department at the University of Ghana, Legon.

We humbly write this letter to request for your participation in our ongoing final year project by filling our online survey, which will take about 20 minutes of your time. The title of our project is *Exploring the gaps in sensory and consumer science education and industry practice in selected food companies in Ghana.*

The aim of our project is to explore and determine where possible, the status of the knowledge and usage of sensory evaluation in food industries in Ghana and also, to know the gap between what students are being taught in school and what is being done in the industries.

Your willingness to participate in this survey will be very helpful since it will help us understand how food companies and food research institutions appreciate sensory evaluation.

We will be very grateful if we are given the opportunity to do our project in your company.

Yours faithfully,

Benedicta Anowa Quarcoo and Sarah Abeka

0571741542/0556790561 and 0267524734/0559555194

baquarcoo002@st.ug.edu.gh and sarahyaa2018@gmail.com

Postal Address: P.O. Box LG 134, Legon
Tel: +233 (0) 545 525 974 / +233 (0) 245 935 322
Email: sensory@ug.edu.gh

APPENDIX C - LIST OF COMPANIES VISITED

Name of Company	Department of persons contacted
1. Promasidor Ghana Limited	Sensory Evaluation Lab
2. Daily Foods Limited	Quality Control Department
3. Fan Milk Limited	Quality Control Department
4. Piccadilly Biscuits Limited	Quality Control Department Production Department
5. Foodtech Limited	Quality Control Department Research Department
6. Blue Skies Limited	Quality Control Department
7. Nestlé Ghana Limited	Quality Control Department
8. Cocoa Processing Company	Quality Control Department Production Department
9. Council for Scientific and Industrial Research (CSIR)/Food Research Institute(FRI)	Sensory Evaluation Lab (Processing Department). Chemistry Department
10. Food and Drugs Authority (FDA)	Import and Export Department Food Evaluation & Registration
11. Ghana Standard Authority	Product Inspection Department
12. Yedent Group of Companies	Quality Assurance
13. Livestock and Poultry Research Center (LIPREC)	Production Department
14. Afrotropic Cocoa Processing Limited	Quality Control Department
15. Coca-Cola Company	Sensory Evaluation Lab (Quality Systems Department)
16. Equator Foods Ghana Limited	Quality Control Department Production Department
17. Kasapreko Company Limited	Quality Assurance
18. Nutrifoods Ghana Limited (Tasty Tom)	Quality Control Department Production Department

19. Eden Tree Limited	Quality Control Department
20. Cycle Farms Ghana Limited	Quality Control Department
21. Emigoh Ghana Limited	Quality Control Department
22. Pioneer Food Cannery Limited	Quality Control Department Production Department
23. Unilever Ghana Company	Quality Control Department
24. Upfield Ghana Limited	Engineering Department
25. Multi Pac Limited	Quality Control Department
26. Wilmar Africa Limited	Quality Control & Assurance Department
27. Nutrifoods Ghana Limited (biscuits company)	Re-bagging (Packaging Department)
28. Milani Limited	Quality Assurance Department
29. Niche Cocoa Industry Limited	Research & Development Department
30. Accra Brewery Limited	Production Department
31. Koa Impact Ghana Limited	Quality Assurance Department Production Department
32. HPW Fresh & Dry Limited	Quality Assurance Department

APPENDIX D- CONSENT FORM

Project Title: Exploring the gaps in sensory and consumer science education and industry practice in selected food companies in Ghana.

Supervisor:

Dr. Maame Yaakwaah Blay Adjei

Investigators:

Abeka Sarah

Quarcoo Benedicta Anowa

Address:

Sensory Evaluation Laboratory, Department of Nutrition and Food Science. School of Biological Sciences, College of Basic and Applied Science, University of Ghana, Legon, Accra.

General Information about Research

This survey to explore the gaps in the knowledge and usage of sensory evaluation in Ghanaian food industries based on academic curricular. Participation in this online survey is voluntary and you can withdraw anytime if you do not feel comfortable.

Possible Risks and Discomforts

Online survey has very little or no risk. The time required to complete this questionnaire is minimal.

Possible Benefits

By participating in this survey, you are contributing immensely to scientific research that will help understand what the gaps are between what students are being taught and what is being done in Ghanaian food industries in relation to sensory evaluation.

Confidentiality

The data you provide to us will be kept confidential by the research team. You will never be personally identified in any work published as a result of your participation in any test without your prior consent. We will protect your personal information and not hand this to any third party. Unless you give us permission to contact you again for any sensory work we carry out at the Department of Nutrition and Food Science, we will not keep your contact information after the end of the research project. If you allow us to contact you again, we will only keep your contact details for the purpose of contacting you for sensory studies only and will not give your

contact information to any third party. Your details will be kept in a secure file with the sensory research team.

Compensation

At the end of the study, you will be shown our appreciation for your time spent on the project. You should understand that there is no economic benefit to you for participating in a sensory study, only the emotional benefit of knowing that you have contributed significantly to the research of how sensory evaluation is used in the industry and the gaps between what students are been taught in school and how it is used in the industry.

Additional Cost

There is no additional cost to you for participating in this online survey.

Voluntary Participation and Right to Leave the Research

Although we would like you to complete the study, you should know that your participation in is purely voluntary and you have the right to withdraw from the study without giving us any explanation and without any penalty to you. Your withdrawal from the study will not negatively affect your personal relationship with the investigators, the department or the university as a whole.

Contacts for Additional Information

For information and questions about this study and general sensory tests and protocols at the Department of Nutrition and Food Science at the University of Ghana, please contact:

Dr Maame Yaakwaah Blay Adjei,

Department of Nutrition and Food Science,

University of Ghana

Email: myblay@ug.edu.gh

Tel: 0545525974

Your rights as a participant

This research has been reviewed and approved by the Ethics Committee for Basic and Applied Science (ECBAS).

If you have any questions about your rights as a research participant, you can contact the ECBAS Office through the address below

Administrator, Ethics Committee for Basic and Applied Sciences

College of Basic and Applied Sciences

University of Ghana

P. O. Box LG 68

Legon – Accra

Tel: +233242759315

Email: janoku@ug.edu.gh

VOLUNTEER AGREEMENT

I have read the above document describing the benefits, risks, and procedures for this survey. By completing this form, I consent to participating in this study as a volunteer.

Yes, I give my consent.

No, I do not give my consent.