ASSESSMENT and QUALIFICATIONS ALLIANCE

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GCE

Design and Technology Food Technology

Unit FTY6

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FOOD TECHNOLOGY UNIT 6 (FTY6)

SECTION A: MATERIALS AND COMPONENTS

Question 1

- Protein molecules are large. They consist of long chains of amino acids chemically combined by peptide links.
- There are several orders of complexity in the structure of proteins: *primary structure* (the sequence of amino acids in the protein chain) and *secondary structure (*where the amino acids are further linked by various bonds to give it a definite shape, often in the form of a spiral). The most important group involved in cross-linking is the SH group, which forms a disulphide bridge. Other links are formed between the amino acids which contribute to the coiling of the chain.
- Cross links can also be made by the formation of hydrogen bonds.
- Proteins vary in structure but can be classified into two groups according to the shape of the molecules: *Globular* (as in ovalbumin, haemoglobin, myoglobin and caseinogen) and *Fibrous* (as in gluten, collagen and elastin).
- Globular proteins are affected greatly by heat, whereas fibrous proteins are not.
- Heat causes the secondary structure of proteins to *denature*, where the molecule unfolds and changes shape but the sequence of amino acids remains the same. Denaturation breaks the cross-linkages which maintain the shape of the molecule. It is usually irreversible. As a result of denaturation, the properties of proteins alter: they become less soluble and more viscous. The unfolded molecules tend to form clumps, as they bond with each other. This results in the setting or hardening of protein foods, known as *coagulation.*

Give credit for diagrams of protein structure.

Criteria for Marks Awarded	Mark Range
A weak answer which may only outline the structural aspects. There may be little or no reference made to the chemical composition and the effect of heat upon it.	**0 - 3**
A good answer, which may not include all the relevant chemical details and terminology, but demonstrates a sound understanding.	**4 - 6**
A full answer, which takes account of the chemical structure and makes use of all the correct terminology.	**7 - 8**

(b) QUORN: This is produced by fungi growing on suitable substrates usually by a continuous fermentation method. Waste carbohydrate material can be converted by some fungi to proteins. This protein is then extracted and used as a food. The proteins themselves taste like mushrooms. The protein extracted is usually in a powder form. Quorn is derived from *myco-protein* which comes from a tiny plant called *Fusarium graminearum.* The plant has been around for thousands of years and occurs naturally.

Production is as follows:

1. Fusarium graminearum is grown in a fermenter. pH is regulated and nutrients are added.
2. Liquid is added to the myco-protein and this is heat treated by pasteurisation to stop further growth.
3. The myco-protein is harvested by being pumped to a centrifuge where it is chilled and separated from the liquid. A creamy looking dough results.
4. The raw myco-protein is made into Quorn by mixing it with egg albumen and vegetable flavourings.
5. The next stage of the processing depends upon whether it is to be made into pieces, mince, sausages or burgers.

Sensory characteristics: It has a texture similar to lean meat, but a more 'spongy' mouthfeel. It is approx. 12% protein, 3% fat and 5% NSP. It is a useful source of vitamin B12 and zinc. Some people feel that the tastes is 'bland' unless is it prepared with other, more tasty ingredients, though it is marketed as a tasty alternative to meat.

Criteria for Marks Awarded	Mark Range
A weak answer. The candidate may be confused about ingredients used and production methods and may have little or no knowledge about sensory and nutritional characteristics of the protein selected.	**0 - 3**
A good answer in which the candidate describes, reasonably accurately, the ingredients and processes involved and can identify the main organoleptic and nutritional differences between this and other protein foods. Some aspects may be omitted.	**4 - 7**
A full and detailed answer. The candidate makes reference to all aspects of the question and demonstrates a sound understanding of ingredients, production methods and characteristics of the protein.	**8 - 10**

(c) Of the 20 amino acids commonly found in proteins, eight (nine in children) are essential in the diet. These essential amino acids must be supplied by the protein in the diet because they cannot be synthesised by the body. The non-essential amino acids can be synthesised in the body by converting one amino acid into another within the body cells. (Give credit for candidates who list the essential amino acids: Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, tryptophan, Valine, (Histidine).

The *Biological Value* of protein is used as a measure of protein quality. BV is the percentage of absorbed protein which is converted into body protein. Therefore, proteins that contain more of the essential amino acids and which are of higher BV are of more use to the body. Animal sources of protein are very high in BV. Vegetarians, particularly vegans, will need to consume vegetable sources of protein, which tend (with the exception of soya) to be LBV. They need therefore to eat a varied number of LBV proteins to ensure that in one meal the essential amino acids are obtained, e.g. beans on toast.

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Criteria for Marks Awarded	Mark Range
Little or no knowledge of the subject.	**0 - 2**
Some understanding of HBV and LBV protein foods. Answer may be a little confused. (Some amino acids may be named. Give credit for this).	**3 - 4**
A full understanding of the question and a justified answer. Give credit if names of essential amino acids given.	**5 - 6**

Question 2

(a) **NB: Modified starches should not be credited in this section.**

Candidates may select a starch from the ones listed below:

- Cornflour
- Wheat flour
- Arrowroot
- Pectin
- Starchy roots or tubers, e.g potatoes or swede
- Gums, e.g. *tragacanth, arabic and guar.*
- Seeweed, e.g agar agar
- Tapioca
- Rice

No marks awarded for naming the starch type.
Allow credit for amylase and amylopectin, if appropriately discussed.

Answers should provide a wide knowledge of the starches available for thickening and setting and examples must be given, e.g. arrowroot for a fruit flan glaze because it produces a translucent effect once gelatinised, enabling fruit to be seen beneath.
Gelatinisation: If a suspension of starch in liquid is heated, the liquid penetrates the outer layers of the granules and the granules begin to swell (between 60 C and 80 C). The volume can increase up to 5 times the original. The mixture then becomes more viscous and at about 80 C the starch granules break up and the contents disperse throughout the liquid. The water/starch mix becomes more viscous because the long-chain molecules begin to unfold. The thickened mixture is called a *sol*. On cooling, the starch molecules can form a network with the water enclosed in it. This produces a *gel*.

The strength of a starch gel is greater if more starch is present. If there is a high proportion of amylose in the starch, gelling is aided and will lead to a more rigid gel being formed. Sugar will reduce gel strength because it competes with starch for water. Acid, e.g. lemon juice, will hydrolyse starch and reduce gel strength, forming a viscous paste. This is valuable in lemon meringue pie.

N.B. marks to be divided: x 8 for (i) and x 8 for (ii)

Criteria for Marks Awarded	Mark Range
A weak answer that contains few examples. The candidate does not reason very well or describe clearly the process of gelatinisation.	**0 - 5**
A good attempt. The candidate gives several examples of starches and demonstrates a reasonable understanding of gelatinisation. Some of the examples given lack depth and detail.	**6 - 11**
A full and well justified answer. Some of the less familiar starches will have been described. The candidate has a sound understanding of gelatinisation and the factors that affect gel development.	**12 - 16**

(b) In the unmodified form, starches have limited use in the food industry. They tend to produce weak-bodied pastes. Starch is therefore 'modified' to enhance or repress its inherent properties as appropriate for a specific use. Modified starches are used in the food industry to improve binding, provide thickening, increase stability, improve sheen and mouthfeel, to cloud or disperse and to gel. The result for manufacturers is that they can have better control and flexibility in dealing with formulation of recipes, processing and shelf life.

CROSS-LINKING: In this method of modifying starch, the granule is 'welded' randomly, reinforcing hydrogen bonding and inhibiting granule swell. The result is that tender starches are strengthened so that their cooked pastes are heavier bodied and more viscous. They are less likely to break down with extended cooking times.

STABILISATION: This modification prevents gelling and weeping. It maintains textural appearance. High amylopectin starch e.g. waxy corn starch, should be used when preparing foods for a freeze/thaw process because it does not *retrograde* easily (where the amylose molecules in starches unwind and the gel becomes opaque and like a pulpy sponge). Freeze - thaw stabilised starches will produce pastes that will withstand several freeze-thaw cycles before syneresis occurs. They are also useful for cold temperature storage of other processed foods such as canned gravies and sauces, which require stabilised starches to maintain quality.

EFFECTS OF INGREDIENTS: Ingredients present during the cooking process, such as acids, can affect the swelling of the granule because they disrupt the hydrogen bonding. Fats and proteins tend to coat starch which affects the finished viscosity of the paste as it delays granule hydration and lowers the rate of viscosity development. The use of pregelatinised starches helps overcome some of these problems.

EFFECTS OF TIME, TEMPERATURE AND SHEER: Tolerances can be built into starches through cross-linking to prevent rupture of granules through high temperature and 'sheer' in long exposure to these forces.

PREGELATINISED STARCHES: This has been gelatinised and dried by the manufacturer. It develops viscosity when dispersed in cold or warm water without the need for further heating. It can be known as precooked, pregelled, clod water soluble, cold water swelling (CWS) or instant starch.

Questionnaires: The basis of all field work, popular method, widely used, but carry with them a number of problems e.g. difficult to design to extract the information they require without being ambiguous or influencing the person who is answering. If questions are too narrow, important information can be lost. Too free a response means that answers become difficult to analyse.

Interviews: Expensive to carry out. Subject to 'interviewer bias': the interviewer could lead the person being interviewed into giving a 'desirable' answer. An experienced interviewer might adapt a question to suit the person being interviewed. This maximises response levels. Time consuming.

Postal Questionnaires: Rely on precise, unambiguous questions and the willingness of people to return them. Depend upon up to date mailing lists of people who are likely to be interested in the product. Viewed as junk mail. Often thrown away.

Criteria for Marks Awarded	Mark Range
A weak answer. The candidate has little or no sound understanding of the topic. Examples may be given, but explanation may be lacking.	**0 - 3**
A good answer. The candidate has a good understanding of the topic and gives some examples. Some of the answer may be a little confused in places, but a reasonable attempt is made.	**4 - 6**
A full answer. The candidate has an informed knowledge and understanding of modified starches and their uses. Several well described examples given to support the answer.	**7 - 8**

SECTION B: DESIGN AND MARKET INFLUENCES

Question 1

(a)
Market Research types could include any of the following:

- Desk Research where data from such sources as government statistics, specialist journals and business accounts is collected, analysed and evaluated.
- Field Research where data is collected directly from a sample of potential consumers. Field research of one business can provide desk research of another.

Do not allow methods that are related to coursework or NPD if they do not constitute true market research. Some candidates may confuse their own research with market research. Do not allow marketing techniques such as free samples and money-off vouchers. This is not market research.

Candidates are likely to describe field methods, which could include any of the following:

Questionnaires: The basis of all field work, popular method, widely used, but carry with them a number of problems e.g. difficult to design to extract the information they require without being ambiguous or influencing the person who is answering. If questions are too narrow, important information can be lost. Too free a response means that answers become difficult to analyse.

Interviews: Expensive to carry out. Subject to 'interviewer bias': the interviewer could lead the person being interviewed into giving a 'desirable' answer. An experienced interviewer might adapt a question to suit the person being interviewed. This maximises response levels. Time consuming.

Postal Questionnaires: Rely on precise, unambiguous questions and the willingness of people to return them. Depend upon up to date mailing lists of people who are likely to be interested in the product. Viewed as junk mail. Often thrown away.

Telephone Questionnaires: Combine the advantages of the cheapness of the postal questionnaire and the benefits of the interviewer. People often object to their intrusiveness. Best method is to warn people first by means of a letter.

Consumer panels: Groups of people who keep a record of all their actions as a consumer. Data is objective but the selection of the panel could be unrepresentative.
Allow also: Benchmarking / Discussion groups / Focus groups.

N.B. Taste-testing only acceptable if it is a part of market research, i.e. the respondent completes a report on the product.

Survey and questionnaire – candidates must distinguish between them if they use both these methods.

If Internet research is given, the candidate must clarify it. Do not allow vague / generalised answers.

N.B. x 1 mark for the method, explained and x 4 marks for the advantages / disadvantages (4 x 5 marks awarded in this section).

Criteria for Marks Awarded	Mark Range
Little or no understanding of the method(s) of market research. Advantages and disadvantages may be given, but explanation/justification is lacking.	**0 – 1**
A good attempt. The candidate has a good knowledge of the research type and is able to describe some of the advantages and disadvantages. Some confusion may occur.	**2 – 3**
A full answer. The candidate has an informed knowledge and understanding of the market research type and is able to discuss the advantages and disadvantages in depth.	**4 – 5**

(b) Patents are an intellectual property right. A patent is a right, given to an inventor by the state, to exclude any other parties from commercially exploiting the invention, unless they are granted a licence to do so by the inventor. Patents can also protect manufacturing equipment and processes. Give credit to candidates who mention the law or for providing examples of patented products.

In biotechnology, researchers have their academic reputations to protect, but industry relies upon patents for commercial success. Conflicts can arise. Traditionally it has not been possible to patent plants, animals or micro-organisms, but since 1988 and the GM revolution, this has been under consideration.

Criteria for Marks Awarded	Mark Range
Little or no understanding of the term.	**0 - 1**
A reasonable understanding of the term. Some aspects may be omitted.	**2 - 3**
A sound understanding of the term and what it means to designer and manufacturer. Examples may be given.	**4**

Question 2

The term 'functional food' encompasses a broad range of products, ranging from foods generated around a particular functional ingredient e.g. stanol enriched spreads, to staple everyday foods fortified with a nutrient that would not usually be present to any great extent, e.g folic acid fortified bread. Foods with functional ingredients include the cholesterol-lowering spreads and the pre and pro-biotic yoghurts and milk drinks. Functional foods give you something extra - nutrients that do something for you. An investment of intellectual activity – altered to form a particular function – specialised function.

Candidates will be awarded marks for relevant points made. Arguments must be justified. Candidates who provide a good answer will be expected to argue from more than one point of view. Candidates will be expected to draw from many different sources of their personal knowledge and understanding in order to answer this question. Many wider issues may be discussed, such as lifestyles, disposable incomes, media hype, the 'keep-fit' society, health fears, trust in modern-day scientists, the argument that an informed diet is equally as good, people are being pushed into trying out new products as a 'quick-fix' rather than adopting a healthier lifestyle etc.

N.B. Candidates must not confuse the functional foods with other types of novel foods such as Quorn or encapsulated products. Do not accept fortification, unless there is a specialist application.

Criteria for Marks Awarded	Mark Range
A basic answer. There may be some confusion about what functional foods are. T he answer generally lacks depth, detail, argument and justification. Little evidence of scientific understanding.	**0 - 8**
A good answer that poses some good argument, with some justification. Examples will be given. A reasonable level of scientific understanding of the topic.	**9 - 16**
A full, strong answer that has been well constructed. The candidate is able to argue from different viewpoints and can justify answers. A good range of examples and instances are given. Original thought and in-depth scientific understanding is evident.	**17 - 24**

SECTION C: PROCESSES AND MANUFACTURE

Question 1

(a) N.B. Do not allow marks for the consumer and retailer unless this is directly related to the factors affecting the manufacturer.

Advantages: Freezing is well tried and tested and a popular method of storing food for the consumer. Most consumers have a domestic freezer. Frozen food forms an important part of many present-day diets. It is seen as a convenience food. Freezing maintains nutritional value. Sensory qualities are reasonably well preserved. Packaging materials designed to withstand freezing have been tried and tested and are relatively inexpensive for the manufacturer to purchase etc.

Disadvantages: Power failure can cause losses. Machines need to be regularly serviced, cleaned and defrosted. Checks must be made regularly to ensure correct temperatures are reached. Transportation of frozen products is costly. Defrosted and re-frozen foods can be dangerous to consume. Some foods, particularly some fresh fruit and vegetables lose their structure once defrosted, as cells rupture due to ice crystal formation. A lot of research has to be carried out by product development teams, in

conjunction with food technologists and scientists to develop products that can withstand low temperatures and defrosting, with minimal effects upon sensory characteristics etc.

Criteria for Marks Awarded	Mark Range
A basic answer, which covers the most obvious points. Some examples may be given.	**0 - 4**
A good answer that contains a variety of relevant advantages and disadvantages. Examples will be given and most points will be justified.	**5 - 8**
A full answer, which makes reference to many points. The answer is well structured and argued, with justification. Original thought is evident.	**9 - 12**

(b) This answer could be given in table form, or in essay form. Answers may include points such as:

- Product design: During the development phase the product should have undergone sufficient testing to ensure that its sensory characteristics are sustainable throughout the shelf-life period.
- Purchase of high quality, fresh raw ingredients from a reputable supplier.
- Microbial and mycotoxin testing should be built into the manufacturing process to ensure that no pathogens have entered the system.
- Nutritional analysis should be carried out for labelling purposes, but to ensure that consumers are receiving a product that actually contains the nutrients stated.
- If organic or GM free foods are used, their authenticity must be checked.
- Packaging materials should have been tested during the design phase to ensure that they do not react with the food ingredients.
- HACCP needs to be carried out and CCPs monitored regularly.
- Staff training and updates.
- Health and safety issues associated with machine operation and use of cleaning materials.
- Taint testing.
- Visual and sensory testing of products on the production line.
- Metal detection and testing for foreign bodies entering the system.
- Correct storage and transportation conditions need to be maintained prior to dispatch.

Criteria for Marks Awarded	Mark Range
A basic answer that covers some of the points. The answer may deal with points randomly. Very little explanation or justification is given.	**0 - 4**
A good answer in which several relevant points are identified and discussed. The answer may lack structure and some points may not be fully explained.	**5 - 8**
Comprehensive coverage of the points. The candidate is likely to have discussed QA and QC measures in detail. The answer is well structured.	**9 - 12**

Question 2

Candidates will be given credit for highlighting the responsibility all people, especially industrialists, face in tackling the global warming issues. They will also be given credit for describing the effects that global warming can have upon the world.

In discussing the ways in which manufacturers could adapt their manufacturing practices in order to become more energy efficient, the points below may be mentioned:

- Reducing packaging materials to a minimum.
- Looking at more effective methods of recycling packaging materials.
- Utilising renewable forms of energy, such as solar, wind and water power.
- Finding inventive or creative ways of utilising factory waste products, e.g. the manufacture of fruit leathers as a by-product of manufacturing stewed apples.
- Building homes for the workers near to the factory so that they do not have far to travel.
- Providing transport to and from the factory that does not require fossil fuels as fuel.
- Use of biodegradable cleaning materials, which are effective at low temperatures.
- Planning buildings, which maximise the use of natural light.
- Organising production flows to produce frozen and chilled products as they are ordered ('just-in-time'), to reduce the need to store for long periods of time.
- Purchasing locally grown fresh products, to minimise transportation costs.
- Using rail and water networks rather than road haulage.
- Using the media to raise public awareness and to gain their support in supporting the energy-efficient manufacturers.

Criteria for Marks Awarded	Mark Range
A weak answer which looks only at the most obvious issues and adaptations. The answer has little structure and points may not be followed through.	**0 - 8**
A good answer that covers several issues and adaptations, some of which are explained in detail and justified.	**9 - 16**
A full answer that is well constructed and covers a variety of relevant points. The candidate has displayed original thinking and has related the answer to the wider issues realistically.	**17 - 24**