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Propensity for Peptides as nutraceuticals: a survey of the Nigerian Market

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Abstract. Over time, scientists have studied the potential of peptides as nutraceuticals by measuring their bio functionalities. The aim of this study was to ascertain the potential of isolated peptides as nutraceuticals in Nigeria using market availability. A market survey was carried out to determine the willingness of citizens who possess buying power, to purchase this product. The survey was conducted using survey monkey. 54.17% of the sample population declared unlikelihood to purchase these bioactive peptides, 20.83% of this group had no idea, of which most were men. Of the 45 and above age group, 55.5% declared high likelihood for purchase of nutraceutical peptides. On the assumption that only the aging group subscribes to nutraceutical peptides, there is little prospect of seeing these peptides being utilized to their maximum potential in Nigeria for health maintenance. Hence enlightenment of the public is necessary to increase acceptability and prospect of bioactive peptides as nutraceuticals.

Keywords: Netraceuticals, Bioactive, Peptides, Market survey, Nigeria

1. Introduction

Nutraceuticals or functional foods have received increased attention and wide acceptance over the years due to their health promoting effects [1]. This reflected in a finance report by the global nutraceutical industries report [2] that the global nutraceutical market should reach $285.0 billion by 2021 from $198.7 billion in 2016 at a compound annual growth rate (CAGR) of 7.5%, from 2016 to 2021. Bioactive peptides however, have not received as much attention as other nutraceuticals because they are often considered to be proteins, whereas they differ in size, structure and function. A lot of studies have confirmed their diverse functionalities which include antidiabetic, cholesterol lowering, antihypertensive, skin repair, anticancer effects among others. These studies have also shown the promising prospects of these peptides as nutraceuticals based on their bioactivity. However, no study has examined the prospects of peptides as nutraceuticals based on market acceptability. Hence the need for this market survey to measure the potential efficacy of peptides if used as nutraceuticals.

Nature provides the most abundant source for bioactive peptides, from living things and their products. Peptides are generally present in various quantities in food of plant or animal origin, and they are released as a result of proteolytic hydrolysis by enzymes participating in the fermentation, aging or ripening process. For example *Oryzasativa*, upon digestion *in vivo* yields anti-inflammatory, antioxidant and immunomodulatory peptides [3].

Isolation and concentration of these peptides in a medium is important to maximise their bioactivities. This is because they may be obtained in minor, insignificant quantities from food sources. They also cannot be stored in the body and so to exert significant effects, they need to be taken in large quantities. Enzyme hydrolysis and fermentation have been the most practiced methods for production of bioactive peptides from protein sources [4]. Hydrolysis by enzymes involves subjecting a target protein to cleavage by a protease at optimum temperature and pH. One or more crude or purified proteolytic enzyme can be used to break down the protein containing material to a solution containing short peptide sequences called a protein hydrolysate [5]. Every proteolytic enzyme yields peptides as the end product of the reaction.

Microbial fermentation on the other hand involves culturing of the selected microbial cells on a protein-containing substrate. The growing cells secrete various proteolytic enzymes into the medium that hydrolyse proteins to yield peptides at different phases of their life cycle. The health benefits of these peptides are numerous. Antihypertensive peptides can be derived from protein-containing foods and used for treatment of high blood pressure or hypertension. These peptides inhibit Angiotensin I converting enzyme (ACE) making them non-functional. ACE cleaves angiotensin I to angiotensin II-bradykinin inhibitor which inhibits bradykinin [6]. Bradykinin is a strong vasodilator that dilates and expands the blood vessels to modulate blood pressure. Therefore inactivation of bradykinin increases blood pressure. However by inhibiting ACE, bradykinin is active. Fermented protein containing foods are a source of peptides that lower blood pressure.

Reactive oxygen species have been linked to many diseases which are usually as a result of tissue damage and cell death. These species can however be cleared from the system by antioxidants, which capture the species within their structure. Tryptophan, histidine, phenylalanine, methionine, tyrosine, valine have been identified as components of antioxidant peptides [7]. The ability of a peptide to scavenge radicals in circulation is conferred by the peculiarity of its side chain structure which stabilizes electron deficient radicals by easily donating protons to them. Antimicrobial peptides have cytotoxic effects on a vast array of microbial cells. The presence of cationic or lipophilic amino acid residues at the exposed region of peptides increases the ability of AMPs to interact with microbes. AMPs attack bacteria by drilling holes through the cell membrane or by interacting with protein or sugar moieties within the cell cytosol [8]. Cationic amino acids disrupt viruses, yeasts or bacteria by mechanisms such as micro pinocytosis.

Peptides also have antidiabetic functions which they exert by inhibiting the activity of α-Amylase. Furthermore, they were observed to act by reducing starch absorption from the gastrointestinal tract through inhibition of cleavage of large starch moieties into simpler permeable ones, thus restricting absorption of starch. Examples of antidiabetic peptides include Cumin seed peptides [9]. Some peptides have cholesterol lowering effects. Cholesterol accumulation in the coronary artery could diminish blood flow and consequently, supply of oxygen to the heart and prompt diseases of the cardiovascular system [10]. Cholesterol lowering peptides act by reducing cholesterol solvency in lipid vectors, and restraining cholesterol uptake in some monolayer cells. Bioactive peptides confer selective cytotoxicity of malignant tissues through various means. A particular peptide HVLSRAPR obtained from *S. platensis* hydrolysates demonstrated solid inhibitory action against HT-29 cancerous cell division yet indicated little restraint against ordinary liver cells [11]. The peptides prompted cell arrest in the S stage by heightening p21 and p27 expression while diminishing cyclinA production. Moreover, the peptides cleaved caspase 3, down regulated Bcl-2, PARP and caspase 9 activities yet up regulated p53 and Bax articulation.

2. Materials and methods

2.1. Survey Design
A mail survey was developed to assess the awareness and market power of peptide nutraceuticals for health benefits. The survey consisted of one section which included one question and was designed

for all individuals who received the questionnaire, whether or not they had used the product previously. This questionnaire covered the willingness of respondents to purchase isolated peptides. The questionnaire consisted of a multiple choice question. One best answer was requested for each question. Percentages were calculated using the number of respondents as the denominator and therefore, summed up to 100%.

2.2. Sampling
The survey was conducted on line in spring 2018 on a sample of two hundred and fifty individuals, representative of the Nigerian population for gender, age (20 and above), and region of residence. The reference population taken into account for the direct survey is represented by the working class residents of the states in Nigeria and different works of life.
The survey was sent out using survey monkey.

2.3. Data analysis
Data were summarized based on gender and also pooled together. It was presented as pictorial results for the sampling frame, Microsoft excel and Survey monkey were used to analyse the results into charts.

3. Results and Discussion

250 respondents made up the survey. About 30% of these respondents were over 45 years of age. Overall, about 8% of all respondents declared high unlikelihood to purchase isolated peptides as nutraceuticals. Equal percentage (25%) of the sample size showed willingness for purchase and unwillingness for purchase. 20.83% of the total respondents declared high likelihood to subscribe to isolated peptides as nutraceuticals while another 20.83% had no idea entirely about nutraceuticals and peptides as shown in figure 1. The outcome of the survey was also grouped into male and female categories. This was done to analyse the interdependence of opinion on the gender of the respondents. It was observed that while 33.33% of the female population declared high likelihood to purchase these nutraceuticals, no male in the total sample population absolutely opted (very likely) to purchase peptides as nutraceuticals. With regards to average likelihood to purchase the peptides, about 27% of females and 22% of males responded. About 44% of males and 6% of females had no idea whatsoever about the nutraceuticals and as such they do not know if they would likely purchase isolated peptides or not. 22% of male and 27% of females declared unlikelihood to purchase the peptides. Finally, 11% of males and 6% of females said they were very unlikely to purchase the peptides as nutraceuticals. When the results were grouped according to age groups, it was observed that 55.5% of the 45 and above age group, declared willingness to buy the nutraceuticals, while 22% opted to not purchase the product. Of the 20-45 age groups, a total of 46.66% declared willingness to purchase while 54.44 declared unlikelihood to buy even with purchasing power.

From the survey conducted on an excerpt of the Nigerian market population, the success of bioactive peptides as nutraceuticals can be predicted. The prospect of peptides as nutraceuticals depends on its bioactivity and largely also on the willingness of the population to purchase it for use. Since 2002, [12] reported that nutraceuticals (including isolated nutrients) represent the fastest growing segment of the food industry. However Nigeria seems to be lagging behind as observed in this survey where a fifth of the total sample population had no idea whether or not they will purchase these peptides as nutraceuticals. This may have been due to ignorance of the subject matter. Of these, 80% were shown to be men. People will normally buy protein-containing foods which will be digested into peptides in the gut, but to maximize the functionality of these peptides, they have to be isolated and concentrated in a medium. Hence the population has to be first aware of nutraceuticals as a whole for the prospects to be actualized. The potential of peptides as nutraceuticals in the Nigerian market depends highly on the desire to buy this product. Again, 20.83% of the population declared high likelihood while 25% declared average likelihood to purchase peptides. This does not correlate with the recent financial

predictions by Global Nutraceuticals Industry Report that the global nutraceuticals market should reach $285.0 billion by 2021 at a compound annual growth rate (CAGR) of 7.5%, from 2016 to 2021. This low percentage however may be as a result of nutraceuticals or peptides not being accepted in Nigeria yet. The financial prediction above ought to cut across every nutraceutical product and every nation, and its actualization is also dependent on Nigerians involvement. A total of 45.83% positive responses were harvested while the negative responses came from 54.17% of the population. Judging from the marginal difference between these two, it can be implied that the future of peptides as nutraceuticals in the Nigerian market is not so promising. The comparison of male and female responses showed significant differences in the responses to the choices-no idea and very likely declared by the different genders, which suggests that propensity for this product may be gender dependent. Males have less interest and are more unlikely to purchase these peptides than women. The live Nigerian population clock as at 20-03-18, 13:20 reported a male population of 50.6%, which is higher (although not significantly), than that of women. Based on the census, the men should have a higher determining power on how successful peptides will be as nutraceuticals in the Nigerian market. Thus the prospect of peptides as nutraceuticals in the Nigerian market is not promising as men have shown less likelihood to purchase them. The outcome was also grouped as 20-45 and 45 and above. Many bioactivities of peptides such as antidiabetic effect, antihypertensive effect, cholesterol lowering effect, anti-cancer effect, skin repair effect, etc. are important for a particular age group. This is due to the fact that age-related diseases are usually suffered by the 45 and above age group. Based on this, it is expected that this age range should show more willingness for purchase of this nutraceutical product. The result was observed to corroborate with the expected outcome, as over half of the 45 and above age group opted to purchase this nutraceutical.
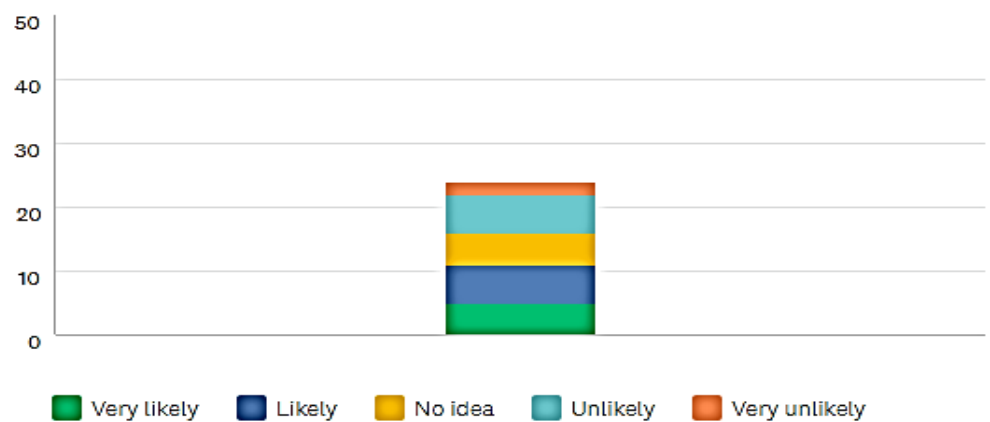
ANSWER CHOICES	RESPONSES
▾ Very likely	20.83%
▾ Likely	25.00%
▾ No idea	20.83%
▾ Unlikely	25.00%
▾ Very unlikely	8.33%

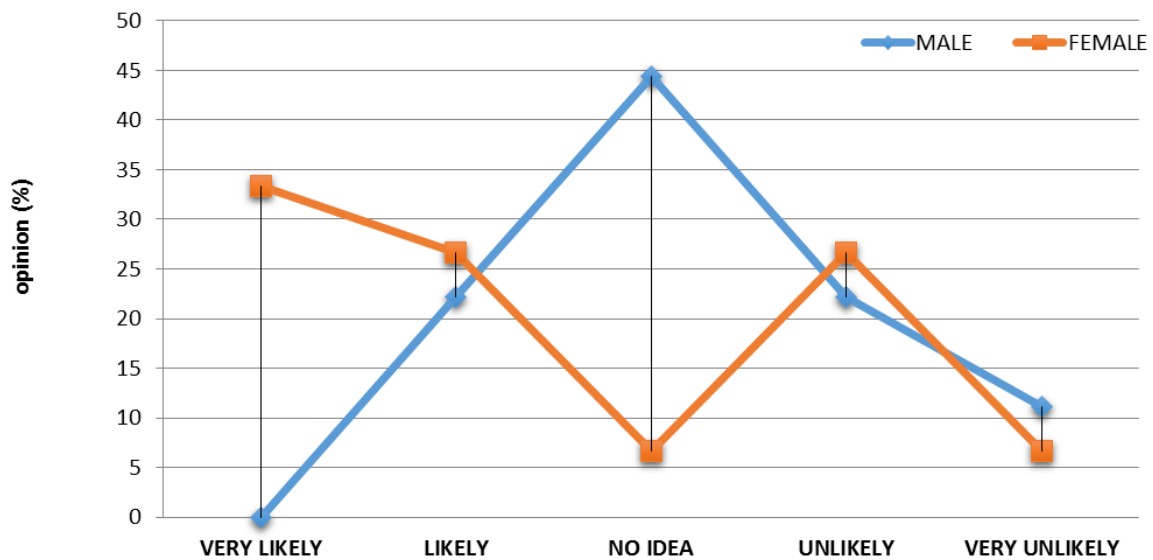Figure 1: Chart representation of the general survey outcome.

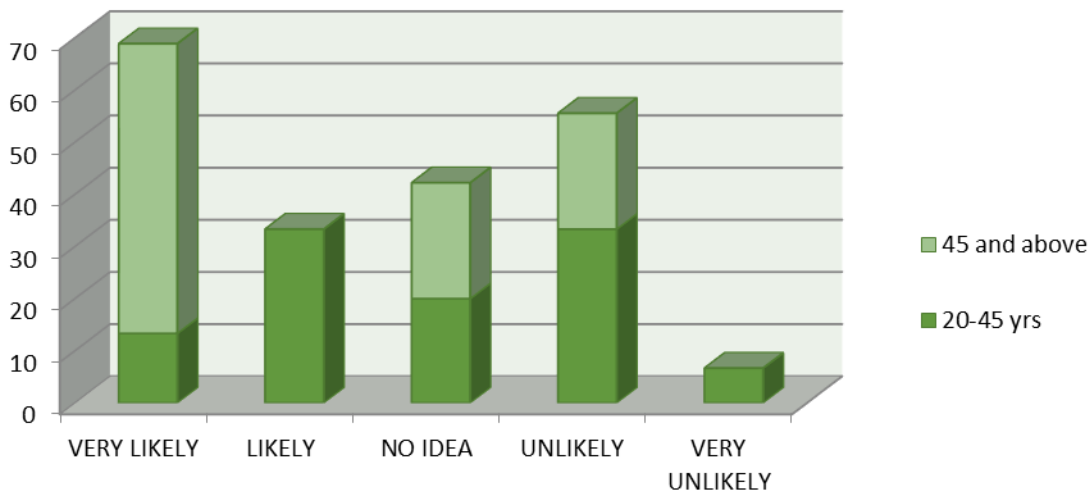Figure 2: Graph representation of difference in male and female responses.

Figure 2: Graphical representation of the outcome of different age groups.

4. Conclusion

Based on the outcome of the major target market in Nigeria alone, the prospect of peptides being used as nutraceuticals in Nigeria looks promising. However, the functions of peptides are not limited to those linked with age-related diseases and in order for bioactive peptides to fulfil and maximize its potential in the Nigerian market, subscription has to increase. Establishing its functionality is not sufficient to determine its prospect. Citizen's awareness of the importance, efficacy and benefits of nutraceuticals as compared to synthetic drugs has to be increased.

Acknowledgements

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