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# Global Journal

## of Medical Research: L

# Nutrition and Food Science



Healthy and Graceful Aging

Celiacs, Challenges in Accession

Highlights

Phenolic-Protein Interaction

Comparison of Nutritional Quality

**Discovering Thoughts, Inventing Future**

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# Phenolic-Protein Interaction: Effects on Functional Properties of Phenolics and Advantages on Phenolic Delivery Platform Development

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*Abstract-* The interaction between phenolics and proteins is one of the most research areas in food, pharmaceutical, and cosmetic fields since these interactions affect the functional properties of proteins and phenolics. By using this phenomena, organoleptic properties of phenolic compounds can be engineered, foaming and gelling properties of proteins can be increased, and also novel delivery platforms for phenolics can be designed. During the construction of phenolic-protein interaction, both covalent and non-covalent bonds occur. Formation of these bonds depends on the type of phenolic compounds and protein and also environmental conditions such as pH, temperature and ionic strengths. Understanding the exact mechanism behind these interactions are leading to generate tunable food, drug, and cosmetic products.

*Keywords: interaction, antioxidant capacity, bio accessibility, sensory quality, delivery of phenolics.*

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# Phenolic-Protein Interaction: Effects on Functional Properties of Phenolics and Advantages on Phenolic Delivery Platform Development

Gokce Altin [α], Eda Nur Ayar [σ] & Beraat Özçelik [ρ]

*Abstract-* **The interaction between phenolics and proteins is one of the most research areas in food, pharmaceutical, and cosmetic fields since these interactions affect the functional properties of proteins and phenolics. By using this phenomena, organoleptic properties of phenolic compounds can be engineered, foaming and gelling properties of proteins can be increased, and also novel delivery platforms for phenolics can be designed. During the construction of phenolic-protein interaction, both covalent and non-covalent bonds occur. Formation of these bonds depends on the type of phenolic compounds and protein and also environmental conditions such as pH, temperature and ionic strengths. Understanding the exact mechanism behind these interactions are leading to generate tunable food, drug, and cosmetic products.**

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## I. Introduction

Phenolic compounds, abundantly present in plants, account for one-third of the dietary phenols and are a large family of phytochemicals (Herrmann & Nagel, 1989). The phenolic compounds have numerous physiological functions, such as anti-inflammatory, anti-mutagenic, and antioxidant properties through phenolic compounds` potential to protect from oxidative stress (Lee et al., 2005; Altin, Gültekin-Özgüven & Ozcelik, 2018). The studies on animals and also human submits that phenolic compounds in daily diet have significant roles in protection from several diseases including certain types of cancers, cardiovascular diseases, and prevention of osteoporosis (Ali, H., 2012). Even insignificant structural differences in the location, number, or form of substituted groups can directly affect the bio-distribution, free concentration, and metabolism of phenolic compounds, and resulting affect to their bioactivity (Jaldappagari et al., 2013).

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Interactions between the different food compounds have been commonly identified and it is known to have influence on the biological, functional and, nutritional properties of food products. The interaction of phenolic compounds-proteins seems to be the most important one using different aspects. Phenolic acids could be interacted by non-covalently and covalently with proteins, and the interactions of protein-phenolic may affect the biological and functional properties of phenolics as well as proteins (Charlton et al., 2002). The bioactivity of a compound after the consumption is related to its bioaccessibility and bioavailability. Based on the type of interaction between phenolics-proteins can be increased or decreased their bioaccessibility and bioavailability. In the sensory aspect, organoleptic quality of food product such as color, bitterness, and astringency, is directly affected form phenolic-protein interaction. (De Freitas & Mateus, 2012; Chung, C., Rojanasasithara, T., Mutilangi, W., & McClements, D. J., 2017).

In last decade, numerous studies are focusing on delivery of phenolics, since to contribute the functionality of phenolics is crucialsince they have several positive effects on health such as antioxidant, antimicrobial, anti-inflammatory, anti-carcinogenic, and hepatoprotective effect. Protein-phenolic conjugates and protein-based nanoparticles are the most common studied techniques about a delivery of phenolics, which can be used in food, pharmaceutical, and cosmetic sector.

Therefore, understand the exact mechanism between phenolic-protein interaction not only leads to the observation of nutritional and sensory changes on foods but also enhance to develop novel strategies for functional foods and dietary supplement area. While the interactions can be analyzed considering several aspects, it still is a challenge for food analysis and researchers (Czubinski, J., & Dwiecki, K., 2017). To comprehend the roles of proteins and phenols in interaction, it is essential to designate the nature of the physicochemical and chemical interactions of the proteins-phenolic acids (Ali, H., 2012). The bonding types can be characterized by spectroscopic methods,



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microscopic methods, thermodynamic methods, bioinformatics methods, electrophoretic and chromatographic methods.

The goal of this review is to give researchers an overview of the currently used methods for identification of bonding type, negative and positive effects of interaction on food quality, bioaccessibility, bioavailability as well as to introduce the novel delivery strategies that base on phenolic-protein interaction.

## II. Type of Bindings that Contributes to the Interaction

The phenolic-protein interaction is mainly contributed via non-covalent bonds, which are weaker than covalent bonds and they are always reversible. Among the covalent bonds, hydrogen bonds provide more stable complex than Van-der -Waals interactions, dipole-dipole interactions and hydrophobic interactions (Yuksel et al., 2010; Nagy et al., 2012; Jakobek 2015). While non-covalent bonds commonly occur in protein-phenolic interaction, in some case covalent interaction can also be formed (Gallo et al., 2013; El-Maksoud et al., 2018; Sui et al., 2018). To determine the phenolic-protein interaction is necessary for the biological activity of phenolics as well as proteins. There are several approaches to investigate this interaction such as, spectroscopic methods, microscopic methods, thermodynamic methods, bioinformatics methods, electrophoretic and chromatographic methods. Several studies focus on to investigate phenolic-protein interaction. Previous studies and their findings are summarized in Table 1. To obtain the excat result during determination of the binding type, different techniques are used together (Table 1).

The proteomic approach is one of the novel bioinformatic technique to identify the binding type. Gallo et al. (2013), investigated the type of interactions between cocoa polyphenols and milk proteins by proteomic technique. They characterized the interaction of β-lactoglobulin (β-Lg) with catechin and epicatechin, moreover identified the amino acid residue at the binding site. For this aim, they used the matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF-MS) and the electrospray ionization tandem quadrupole/orthogonal-acceleration time-of-flight mass spectrometer (ESI-Q-TOF MS/MS). In these analyses, tryptic peptides of β-Lg have allowed the identification of the binding site as the free thiol group of cysteine and found that while polyphenols covalently bound with β-Lg, they interact with casein via non-covalent bonds. In another study, fluorescence, circular dichroism spectroscopy, and docking studies were used for characterization of the interaction between β-Lg and cyanidin-3-*O*-glucoside According to this study, the interaction was mainly contributed by both hydrogen bonding and the hydrophobic interaction (Cheng et al., 2017). Furthermore, after the binding of cyanidin-3-*O*-glucoside to β-Lg, the secondary structure of the β-Lg was changed in which the major structure of β-sheetincreased and the minor structure of α-helix decreased. The changes in secondary structure of proteins after the phenolic interaction also identified in different studies (Zhang et al., 2014; Al-Hanish et al., 2016; Jia et al., 2017). The significant reduction of α-helix and an increase of β-sheet and turn structures were determined in α-lactalbumin and β-Lg in the phenolic-protein complex (Zhang et al., 2014). Also, Jia et al. (2017) observed the conformational changes on the secondary structure of β-Lg, after phenolic compound attachment, via circular dichroism and Fourier transform infrared. According to their findings, after the binding of the phenolic compound, the surface hydrophobicity of β-Lg was changed. Thus α-helix to β-structures transition occurred. The non-covalent interactions between α-lactalbumin and epigallocatechin-3-gallate were determined by circular dichroism and Fourier transform infrared spectroscopy (Al-Hanish et al., 2016). Based on their findings, epigallocatechin-3-gallate caused the conformational changes in α-lactalbumin, which were inducing α-helix to β-structures transition.

Not only the non-covalent bonds but also the covalent bonds also occur in a phenolic-protein complex. Sui et al. (2018) demonstrated the conformational changes on soy proteins in the presence of anthocyanins. They used three-dimensional fluorescence and Fourier transform infrared spectroscopy to determine the interaction character. They reported that the covalent bonds occurred more abundant than non-covalent bonds in soy protein isolate-anthocyanin complex. The conformational changes on the secondary structure of soy protein isolate also detected as a decrease in β-sheets and an increase in β-turns and random coils.

## III. Interaction Effect on Nutritional and Antioxidant Quality of Foods

The interaction of phenolics-proteins and starch may be one of the mostfundamental factors affecting the nutraceutical quality of the food products. There are several studies that is confirmed by earlier studies including phenolic–protein (Arts et al 2002; Świeca, Gawlik-Dziki, Dziki, et al., 2013), phenolic–phenolic (Gawlik-Dziki, 2012), and phenolic–starch interactions (Chai, Wang, & Zhang, 2013; Zhang, Yang, Li, & Gao, 2011, Swieca, M., et al., 2014).

The chemical structure of phenolic compounds is the enhancive reason for interaction with major food components. In other words, a hydroxyl group and carboxylic acids give rise to increasing of phenolic interaction with proteins, carbohydrates, lipids, and



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minerals (Bravo, 1998; Alu'datt, Rababah, Ereifej, Brewer, & Alli, 2013; Escarpa & Gonzalez, 2001). As mentioned before, phenolic acids and proteins bring about two main types of interactions (covalent or non-covalent) that result in two kinds of precipitation of proteins. First one is multisite interactions, that is, several phenolics bind to one protein molecule and the second one is multidentate interactions, that is, one phenolic binds to several protein sites or protein molecules. A study by Rawel, Meidtner, and Kroll (2005) stated that the non-covalent binding of phenolic compounds does not affecton the secondary structure of the proteins while may induce to distinct alteration in the tertiary structure of proteins. However, it has been indicated that the covalent binding of phenolics compounds may affect both tertiary and secondary structures of proteins (Kroll et al., 2003). Moreover, these interactions may also end in changes in the thermal stability, solubility, and digestibility of food proteins (Kroll et al., 2003; Ozdal et al., 2013). S. Wu et al. (2018) have studied on 71 phenolic acids, and the derivatives of these phenolics were chosen to estimate the binding affinity with β-lactoglobulin. According to their study, the potential mechanisms for increased binding affinity is the inclusion of the hydrogen bond in the interaction between the β-lactoglobulin and phenolic acids. The interaction between β-lactoglobulin–phenolic acid has enhanced antioxidant activity when compared tothat of the phenolic acids alone (S. Wu et al., 2018). This study gives perspective for understanding the relationship between the chemical structure of phenolic acids and the affinity for β-lactoglobulin.

Most of the nutritional concern of phenolics focus on their side effects caused by the capability of phenolics to conjugate and precipitate protein, lipids, minerals and carbohydrates resulting in reducing food digestibility (Bravo, 1998). On the other hand, several studies indicated that regarding the bio-functional impact of the naturally occurring interactions between phenolics with food constituents such as antioxidant effects become inadequate (Bravo, Saura-Calixto, and Goni, 1992; Alu'datt, Rababah, Ereifej, Brewer, et al., 2013).

## IV. Interaction Effect on Organoleptic Quality of Foods

Polyphenol compounds are currently present in multiform beverages and food products. Several properties of phenolic compounds are using in the food industry. Antioxidant properties of phenolic compounds have been utilized in the food industry to stabilize cysteine proteases and to prolong shelf-life of processed products (Howell, 2005). Also, phenolic compounds including anthocyanins, β-carotene, riboflavin, and curcumin are using as natural food colorants in beverage products (Mortensen, 2006). These compounds have poor solubility and limited chemical stability which is challenging as a natural colorant in food products and beverages (Chung, C., Rojanasasithara, T., Mutilangi, W., & McClements, D. J., 2017). On the other hand, phenolic-protein interaction is using to maintain the stability of phenolic-colorants. The interaction between protein and phenolic compounds is initially starting with a hydrophobic effect and is stabilized by hydrogen bonding (Oh, Hoff, Armstrong, & Haff, 1980; Siebert, 1999). Thus, different research groups are studying on improvement of the stability of phenolic-colorants by using phenolic-protein interaction phenomena. Chung et al. (2015) proved that when heated whey protein isolates are added to model beverage systems containing ascorbic acid, it is improved the color stability of anthocyanins in the beverage. Ascorbic acid has a strong effect to tint ofthe anthocyanins in these systems. (Mercadante & Bobbio, 2007; Poei-Langston & Wrolstad, 1981). Recently, Chung and co-workers studied beverage products containing ascorbic acid. They examined the effect of polypeptides and amino acids on the color stability of anthocyanins. Also, the product containing ascorbic acid and an amino acid is two times more convenient regarding to the average half-life of the anthocyanin than alone ascorbic acid added the product (Chung C. et al., 2017).

Astringency sensation and bitterness are another important sensory attribute for wine. Interaction and precipitation of proline-rich proteins, especially, salivary proteins by tannins is estimated to be the general explanation of astringency onset (Charlton et al., 2002; De Freitas & Mateus, 2012; Haslam & Lilley, 1988). Soares et al. (2018) found evidence that the interaction of proline-rich proteins by tannins is disparate when the proteins are present simultaneously or alone. However, protein-phenolic interaction and co-protein interaction via tannins may be responsible and need to be more investigated.

In respect of food processing, there are only limited studies to confirm the effects of phenolic-protein interactions. Indeed, for the food industry, the interaction is exploited as refining and clarification treatments to improve haze stability (Cosme, Ricardo-da-Silva, & Laureano, 2008). There are few studies on improving textural properties via the phenolic-protein interaction. Wu, Clifford, and Howell (2007) reported that the forming and the gelling potential of egg albumin protein could be significantly increased by addition of the instant green tea. In another study, green tea powder added to weat dough to enhance viscous/elastic modulus and the stability of wheat dough. (Wang et al., 2015). Having obtaining protein-phenolic interaction between fruit extract and soy protein isolate in a gluten-free rice noodle, improved noodle quality, and the dough is achieved (Lee et al., 2016). Lately, Song & Too (2017) the quality of rice-substituted fried noodles is



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enhanced via interaction of pea protein isolate with green tea extract to the supported both antioxidant activity and network.

Beyond that, presence of phenolic compounds at a nutritional daily intake had no adverse impact on protein digestibility. However, the high dose consumption of a phenolic extract may appear destructive to humans who consume low protein amount. Hence, consuming polyphenol supplements needs to be given to the benefit/risk balance with dedicated care (Dufour, C. et al., 2018).

## V. Interaction Effect on Bioaccessibility/Bioavailability of Phenolics

To demonstrate the bioactivity of a compound on human health, it should have a sufficient bioaccessibility and bioavailability. While bioaccessibility refers to the (%) undecomposed (bioactive) fraction of a compound after gastro-intestinal digestion, bioavailability represents the (%) metabolized fraction of a bioactive compound. Both bioaccessibility and bioavailability of phenolic compounds can be improved, impeded or unaltered when co-delivered with other foods like rich in protein, carbohydrate, fat or fiber (Yang, Koo, Song, & Chun, 2011). The bioaccessibility has been currently demonstrated to be affected by the co-digestion of phenolics with various food components (McDougall, Dobson, Smith, Blake, & Stewart, 2005; Dupas, Marsset-Baglieri, Ordonaud, Ducept, & Maillard, 2006; Ribnicky et al., 2014; Sengul, Surek, & Nilufer-Erdil, 2014).

There is currently a natural affinity between polyphenols and proteins (Bandyopadhyay, Ghosh, & Ghosh, 2012). Thereby, protein-rich food matrices can be stabilized and concentrate anthocyanins and also other phenolics (Roopchand, Kuhn et al., 2012; Roopchand, Grace et al., 2012; Roopchand et al., 2013). Grape and blueberry polyphenol-enriched protein matrix have been studied for oral administration, and the hypoglycemic effect obtained in mice indicates that the phenolic-protein complex is bioactive. (Roopchand et al., 2013). In another study, it is reported that anthocyanins are conserved by the sorption to defatted soy flour while transiting through the upper gastrointestinal tract by permitting huge amounts to be gained to the colon (Ribnicky D. M. et al., 2014). Pineda-Vadilloet al. (2016) studied on protein-rich products enriched with grape extracts. As a result, they showed that the food matrix has no affect on the antioxidant activity; while the antioxidant capacity was steady during the oral and gastric phases, it considerably increased during the intestinal phase of digestion. There is also another study, that supports the approach of the non-covalently polyphenols-proteins interaction which are hydrolyzing during digestion, and there was no effect on the absorption of polyphenols and proteins (Budryn, G., & Nebesny, E., 2013). These studies indicated that becoming complex with the protein matrix does not affect the bioaccessibility of anthocyanins/polyphenols negatively (Budryn, G. & Nebesny, E. 2013; Ribnicky D. M. et al., 2014; Pineda-Vadillo et al., 2016). In the previous*in vivo* models, it was demonstrated that the bioavailability of milk and coffee can reduce when they are consumed together (Duarte & Farah, 2011). The different inferences among various studies may be the potential of some phenolics to be complex with digestive enzymes and food matrix. The previous study of Rohn et al. (2002) confirmed that the activity of selected digestive enzymes such as trypsin and α-amylase was a decline in the case of protein-phenolic interaction. Thereby, the interaction has caused to the antioxidant activity of phenolic compounds reduce as it cannot leave the protein-phenolic complex. However, the interaction of phenolic-protein occur only some functional groups and the un-interacted part still can be show activity (Rohn, Rawel, & Kroll, 2002; Alminger, M. et al., 2014). Indeed, being complex with polyphenols is known to reduce protein digestibility via protecting proteins from enzyme degradation or through interaction with digestive enzymes.

## VI. Delivery Techniques based on Phenolic-Protein Interaction

Phenolic compounds are highly unstable bioactive compounds due to exposure to degradation by light, soluble oxygen or enzymes. The basic goal of delivery techniques is to protect the phenolic compounds from adverse environmental conditions. Protein-based delivery techniques are one of the novel strategies from this area, and there are numerous studies about this subject. The delivered phenolic compounds, as well as the delivery system, is summarized in Table 2. These strategies can mainly divide into two groups; (i) protein-phenolic conjugates and (ii) protein-based nanoparticles.

*a) Protein-phenolic conjugates*

Protein-phenolic conjugates can be used to enhance antioxidant activity of a protein as well as its stability (Frazier et al., 2010; Wu et al., 2011; El-Maksoud et al., 2018) or to reduce the degradation level of delivered phenolic compounds. Since the non-covalent interactions are reversible, the stable structure cannot be obtained by non-covalent bonds. Besides, these types of interactions lead to alterations on protein and phenolic compound structure, hence their functionality and nutritional value are changed (Mehanna et al., 2014; Ozdal et al., 2013). Conversely, conjugates are constructed with covalent bonds. Hence stable structure can be obtained. El-Maksoud et al. (2018) were produced covalently bond protein-phenolic conjugates via carbodiimide cross linker chemistry. The



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phenolic compound that they used in conjugate was caffeic acid, and β-lactoglobulin was selected for protein part of conjugates. They reported that the conjugates showed better water solubility than native β-lactoglobulin and non-covalently bond β-lactoglobulin-caffeic acid complex. Moreover, the thermal stability of β-lactoglobulin significantly was increased with this conjugate.

In the view of nutraceutical delivery aspect, protein-phenolic conjugates offer several advantages. Liu et al. (2016) investigated the physicochemical properties of β-carotene emulsions stabilized via chlorogenic acid–lactoferrin–glucose/polydextrose conjugates. They indicated that the produced conjugate offered better emulsifying properties such as the physicochemical stability of β-carotene emulsions can be conserved during the freeze–thaw treatment. Besides, chemical stability of β-carotene in the emulsions against ultraviolet light exposure can enhanced by the conjugate. Therefore, they suggested that the conjugates containing protein, polyphenol and carbohydrates could be a smart building block for delivery systems (Liu et al., 2016). In another study, the chemical stability of curcumin to degradation at physiological pH and of resveratrol to degradation under ultraviolet irradiation conditions was obtained by zein-epigallocatechin gallate conjugates (Liu et al., 2018).

*b) Protein-based nanoparticles*

Zein and gliadin are the prolamine-type proteins which generally occur in in cereals such as corn and wheat, respectively. The four major components of zein are α, β, γ and δ-zein (Hu & McClements, 2015). Since both zein and gliadin contain the high amount of non-polar amino acids in their primary structure, they are soluble in aqueous ethanol solution (60–90%), but insoluble in water (Rombouts et al., 2009; Shukla & Cheryan, 2001). Because of their highly hydrophobic nature, these proteins can be easily converted into spherical colloidal nanoparticles, which are effective delivery agents for phenolic compounds (Chen, Zheng, McClements, & Xiao, 2014). Previous studies reported that protein-based nanoparticles are suitable and effective delivery agents for different phenolic compounds (Table 2). During the formation of protein-based nanoparticles with phenolics, non-covalent interactions such as electrostatic interaction, hydrogen bonding, and hydrophobic interactions were involved in the structure (Dai et al., 2018). On the other hand, these interactions mainly depend on the type of protein and phenolic compounds. Joye et al. (2015) studied on binding ability of resveratrol to the zein and gliadin. They assumed that hydrogen bonds are the main force that contributed to the interaction between resveratrol and zein. However, the hydrophobic interactions constructed the resveratrol-gliadin interaction. In another study about curcumin delivery by zein-nanoparticles, are indicated that hydrogen bonds between the phenolic hydroxyl groups in curcumin and the carbonyl group in amide bonds in zein were attributed to the formation of protein-based nanoparticle with polyphenol (Dai et al., 2017; Sun et al., 2017). These nanoparticles are not only protecting the related phenolic compounds form adverse environmental conditions, beyond that they support the controlled released of the phenolics. Liang et al. (2017) reported that the controlled release property of epigallocatechin gallate was improved by zein/chitosan nanoparticles and according to Sun et al. (2017), controlled release of curcumin during in vitro digestion, can be obtained by zein-shellac composite colloidal particles. In another study, in vitro release of curcumin as well as its stability are improved by zein nanoparticles (Dai et al., 2018). The authors suggested that curcumin might bind to zein in tyrosine residue. Since, the aromatic side groups and double bonds in zein molecules could absorb UV light (Luo et al., 2013), zein nanoparticles enhance the stability of curcumin against UV light. The zein-lecithin composite nanoparticles also improved the stability of curcumin against UV irradiation, high ionic strength and thermal treatment (Dai et al., 2017).

## VII. Conclusion

The interaction between phenolic compounds and proteins is an important phenomena since it affects the functionality, biological activity and nutritional quality of protein and phenolics. The interaction is contributed with both non-covalent and covalent bonds that depend on the type of protein and phenolics as well as the environmental conditions. Depending on the bonding type, there occur conformational changes in protein structure. There are several techniques for determining the bounding type such as spectroscopic methods, microscopic methods, thermodynamic methods, bioinformatics methods, electrophoretic and chromatographic methods. The delivery of phenolics in the desired system can be done by novel agents which are constructed with proteins. Indeed, the bonding type is important to select the novel delivery strategies. If the protein functionality is important in delivery system, then the covalent bonds are crucial to eliminating the structural changes. But if the controlled released of phenolic is desired, the non-covalent bonds are wanted.

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*Table 1:* Bounding type of protein-polyphenol interaction, the interaction factors and determination methods.

| Polyphenol | Protein | Determination Method | Type of Interaction | Effect of Interaction | Reference |
|---|---|---|---|---|---|
| Green tea flavanoids | Milk proteins | Fluorescent probe binding method<br>Isothermal titration calorimetry | Hydrophobic interactions between catechin and β-casein. | Protein surface hydrophobicity was decreased by the hydrophobic binding between milk proteins and GT flavanoids | Yuksel et al., 2010 |
| Pelargonidin | Dairy proteins:<br>β-lactoglobulin<br>Caseinate | Fluorescence spectroscopy | Hydrophobic interactions between pelargonidin-β-lactoglobulin<br>Hydrogen bonding between pelargonidin-caseinate | the structural conformation of the milk proteins effect the binding process | Arroyo-Maya et al., 2016 |
| Chlorogenic acid<br>Ferulic acid | β-lactoglobulin | Fluorescence spectroscopy | Hydrogen bonding and Van der Waals interactions between β- | The secondary structure of β-lactoglobulin | Jia et al., 2017 |



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| | | | | | |
|---|---|---|---|---|---|
| Epigallocatechin-3-gallate | | Molecular modeling study | lactoglobulin and chlorogenic acid, β-lactoglobulin and ferulic Acid<br>Hydrophobic interaction between β-lactoglobulin and epigallocatechin-3-gallate | changed from α-helix to β-structures transition | |
| Black rice anthocyanins | Soybean protein isolate | Three-dimensional fluorescence<br>Fourier transform infrared spectroscopy | Covalent interactions between soybean protein isolate and black rice anthocyanins | Changes in the secondary structure of soybean protein isolate with a decrease in β-sheets and an increase in β-turns and random coils. | Sui et al., 2018 |
| Proanthocyanidins | Wheat gluten proteins | Attenuated total reflectance – Fourier transform infrared spectroscopy | Hydrophobic interactions between gluten and proanthocyanidins | reduced gluten solubility in urea decreased surface hydrophobicity of glutenins | Girard et al., 2018 |
| Chlorogenic acid<br>Caffeic acid<br>Ferulic acid<br>Coumalic acid | α-lactalbumin<br>β-lactoglobulin | Fourier transform infrared spectroscopy<br>Fluorescence spectroscopy<br>Circular dichroism | Interact with the C=O and C-N groups of the whey protein structural subunits | Conformational changes of whey protein: reduction in the amount of α-helix increase the β-sheet and turn structures | Zhang et al., 2014 |
| Caffeic acid<br>Gallic acid | Trypsin | Fluorescence spectroscopy<br>Molecular modeling studies | Hydrogen bonding between trypsin and phenolic acids | inhibit trypsin by altering the enzyme conformation | Liu et al., 2017 |
| Gallic acid<br>Epigallocatechin gallate | Whey proteins | Isothermal titration calorimetry | Hydrophobic interaction between whey proteins and phenolics | structural changes, modify the surface activity, and enhance the foaming properties of whey proteins. | Cao et al., 2018 |
| Resveratrol | Whey proteins: Lactoferrin holo-lactoferrin apo-lactoferrin<br>Whey protein isolate: β-lactoglobulin α-lactalbumin-rich fractions | Fluorescence spectroscopy | Dipole–dipole and Van der Waal interactions between whey proteins and resveratrol | Interaction did not affect the secondary structure of the proteins | Hemar et al., 2011 |
| Epigalocatechin-3-gallate | bovine α-lactalbumin | Fluorescence quenching analysis<br>Circular dichroism Fourier transform infrared spectroscopy spectra | Hydrophobic interactions between a-lactalbumin and epigalocatechin-3-gallate | Conformational changes in α-lactalbumin inducing-helix to β-structures transition | Al-Hanish et al., 2016 |
| Chlorogenic acid | Sunflower protein isolate | Isothermal Titration<br>Calorimetry analyses | Hydrogen bonding between Sunflower protein isolate and chlorogenic acid | Enhanced the interfacial and emulsifying properties of sunflower proteins | Karefyllakis et al., 2017 |
| Cyanidin-3-O-glucoside | β-lactoglobulin | Fluorescence spectroscopy<br>Circular dichroism spectroscopy | Hydrophobic interaction between β-lactoglobulin and cyanidin-3-O-glucoside | alterations of the secondary structures of β- lactoglobulin, with a decrease in α-helix, and an increase in β-sheet | Cheng et al., 2017 |



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|---|---|---|---|---|---|
| | | Molecular docking studies | Hydrogen bonding between β-lactoglobulin and cyanidin-3-O-glucoside | | |
| Rosmarinic acid | bovine milk whey protein: α-Lactalbumin, β-Lactoglobulin and Lactoferrin | Fourier transform infrared spectroscopy<br>Differential scanning calorimetry | Hydrophobic interactions<br>hydrogen bonding<br>dipole–dipole interactions<br>between bovine milk whey protein and rosmarinic acid | physical and reversible interactions | Ferraro et al., 2015 |
| Cocoa phenolics: Catechin Epicatechin | β-lactoglobulin | Proteomic techniques | Covalent and non-covalent bonding between β-lactoglobulin and cocoa phenolics | decreasing the in vitro antioxidant activity of polyphenols | Gallo et al., 2013 |

*Table 2:* Delivery techniques based on polyphenol-protein interaction

| Technique | | | Delivered bioactive compound | Function | Reference |
|---|---|---|---|---|---|
| Protein-polyphenol conjugate | Type of Polyphenol compound | Type of Protein | | | |
| | Caffeic acid | β-Lactoglobulin | β-Lactoglobulin | surface-active agents with exceptional antioxidant properties | El-Maksoud et al., 2018 |
| | Chlorogenic acid | Lactoferrin | β-carotene | effective emulsifiers to stabilize β-carotene emulsions | Liu et al., 2016 |
| | Epigallocatechin gallate | Zein | Curcumin and Resveratrol | improve the stability and bioaccessibility of curcumin and resveratrol | Liu et al., 2018 |
| Encapsulation | Type of delivery particle | | | | |
| | Zein/chitosan nanoparticles | | Epigallocatechin gallate | Increase the antioxidant activity of epigallocatechin gallate | Liang et al., 2017 |
| | Zein/rhamnolipid complex nanoparticles | | Curcumin | Increase the stability and in vitro bioaccessibility of curcumin | Dai et al., 2018 |
| | Zein nanoparticles and gliadin nanoparticles | | Resveratrol | rationalize ingredient selection and production of protein nanoparticles and microparticles for encapsulation, | Joye et al., 2015 |
| | Pectin coated caseinate/zein nanoparticles | | Curcumin | Increase the antioxidant activity of curcumin | Chang et al., 2017 |
| | Zein/lecithin composite nanoparticles | | Curcumin | improved the physicochemical stability of Curcumin | Dai et al., 2017 |
| | Zein-shellac composite colloidal particles | | Curcumin | controlled release of curcumin in simulated gastrointestinal fluids. | Sun, et al., 2017 |
| | Emulsion system | | | | |
| | O/W emulsion Stabilizer: Dairy proteins: whey and sodium caseinate plant-derived proteins: soy and pea | | Lycopene | improve the physicochemical stability and bioavailability of lycopene | Ho et al., 2017 |



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# Celiacs, Challenges in Accession to Food Plan Gluten: A Systematic Review

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*Abstract-* *Objective:* To identify in the literature factors that influence dietary adherence in celiac patients.

*Methods:* Systematic review of the literature, carried out from February to May 2019, through secondary sources in the Virtual Health Library (VHL), PubMed and in the Scientific Electronic Library Online, through the descriptors: Disease Celiac, Patient Cooperation, Diet Therapy combined. The eligibility criteria used were: scientific articles published in the English, Portuguese and Spanish languages, from 2013 to 2018. After the searches, 18 articles were included in the final analysis.

*Results:* In all, 710, but after analysis and submission to the inclusion and exclusion criteria, there were 17 articles, 16 in English, 1 in Spanish. Of the 17 articles analyzed, 8 studies reported social discomfort as eating out, going to parties among other reasons related to sociability led to non-adherence followed by high cost of food specific for coeliac.

*Keywords:* *celiac disease, patient cooperatio, diet therapy.*

*GJMR-L Classification:* *NLMC Code: WD 100*




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# Celiacs, Challenges in Accession to Food Plan Gluten: A Systematic Review

## Desafios na Adesão ao Plano Alimentar de Pacientes Celíacos: Uma Revisão Sistemática

Marilia Porto Oliveira Nunes [α], Jakeline Serafim Vieira [σ], Robson Salviano de Matos [ρ] & Júlio César Chaves Nunes Filho [ω]

*Resumo- Objetivo:* Identificar na literatura fatores que influenciam para não adesão do plano alimentar em pacientescelíacos.

*Métodos:* Revisão sistemática da literatura, realizada nos meses de fevereiro a maio de 2019, por meio de fontes secundárias na biblioteca virtual de saúde (BVS), PubMed e na biblioteca de artigos SciELO (ScientificElectronic Library Online), através dos descritores: Doença Celíaca, Cooperação do Paciente, Dietoterapia combinados entre si. Os critérios de elegibilidade utilizados foram: artigos científicos publicados nos idiomas inglês, português e espanhol, nos anos de 2013 a 2018. Após as buscas, incluíram-se 18 artigos na análise final.

*Resultados:* Ao todo foram 710, mas, após análise e submissão aos critérios de inclusão e exclusão, restaram 17 artigos, sendo 16 em inglês, 1 em espanhol. Dos 17 artigos analisados, 8 estudos relataram desconforto social como comer fora, ir a festas dentre outros motivos relacionados a sociabilidade levaram a não adesão seguido por alto custo do alimento especifico para celíacos.

*Conclusão:* vulnerabilidade social causada pela restrição alimentar e o alto custo dos alimentos foram barreiras relevantes.

*Descritores: doença celíaca, cooperação do paciente, dietoterapia.*

*Abstract- Objective:* To identify in the literature factors that influence dietary adherence in celiac patients.

*Methods:* Systematic review of the literature, carried out from February to May 2019, through secondary sources in the Virtual Health Library (VHL), PubMed and in the Scientific Electronic Library Online, through the descriptors: Disease Celiac, Patient Cooperation, Diet Therapy combined. The eligibility criteria used were: scientific articles published in the English, Portuguese and Spanish languages, from 2013 to 2018. After the searches, 18 articles were included in the final analysis.

*Results:* In all, 710, but after analysis and submission to the inclusion and exclusion criteria, there were 17 articles, 16 in English, 1 in Spanish. Of the 17 articles analyzed, 8 studies reported social discomfort as eating out, going to parties among other reasons related to sociability led to non-adherence followed by high cost of food specific for coeliac.

*Conclusion:* social vulnerability caused by food restriction and the high cost of food were relevant barriers.

*Keywords: celiac disease, patient cooperatio, diet therapy.*

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## I. Introdução

O plano alimentar é uma ferramenta elaborada para ajustar a quantidade e qualidade dos alimentos ingeridos levando em consideração hábitos alimentares, cultura, preferências e aversões [(1)].

Sendo assim,obter um plano alimentar é possível através de uma boa avaliação nutricional por parte do profissional, iniciando com uma anamnese, que é um procedimento que tem por objetivo compreender os motivos que levaram o paciente a consulta, sendo importante para identificar e interpretar as três dimensões do diagnóstico que são: paciente, patologia e circunstâncias relacionadas e assim conduzindo a uma elaboração de uma dieta adequada[(1)].

Nesse sentido o atendimento nutricional também tem como potencial promover o aconselhamento, sendo importante para essa etapa do atendimento o protagonismo do paciente, a percepção dele sobre o problema e a sua busca por estratégias que possam solucioná-las através do plano alimentar e de orientações específicas para cada paciente [(2)].

Consequentemente é de responsabilidade do nutricionista a educação nutricional que decorre de uma comunicação clara e efetiva, visando aperfeiçoar o conhecimento do público alvo sobre nutrição, que tem por finalidade melhorar os hábitos alimentares e promover a mudança voluntária[(3)], pois essas mudanças ocorrem através das intervenções direcionadas a cada patologia [(4)].

Dessa forma, a adesão ao plano alimentar é estabelecida quando o comportamento do paciente é similar com as recomendações e prescrições dietoterápicas provocando mudanças de hábitos alimentares, pois considerando que o ato de comer é algo profundo e não somente a ingestão de nutrientes, pois abrange sensações, sentimentos, valores e cultura. Sendo necessário esclarecer ao paciente a importância da adesão ao tratamento[(5)].



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Contudo é relatado na literatura vários obstáculos para a adesão como restrições ao estilo de vida, comprometimento financeiro, não gostar dos alimentos propostos no plano alimentar, restrições alimentares devido a patologia, ausência de sintomas, comida não saborosa, desconhecimento sobre as complicações, restrição social, ausência de apoio familiar, baixa autoestima dentre outras questões [(6)].

Esses fatores são muito prejudiciais a pacientes com doenças crônicas que necessitem cuidado nutricional contínuo como por exemplo os portadores de Doença Celíaca (DC) que é uma enfermidade inflamatória crônica ocasionada pela intolerância permanente a ingestão do glúten, substância encontrada em cereais como trigo, centeio e cevada[(7)].

Sendo o tratamento mais efetivo da DC é uma dieta isenta de glúten, mas apesar da sua eficiência ela consiste em um grande desafio para os celíacos, pois afeta a qualidade de vida no contexto familiar e social [(7).]

Porém é possível elaborar um plano alimentar para o paciente celíaco totalmente isento de glúten com o objetivo de controlar os efeitos adversos da doença e manter a qualidade de vida e a saúde do paciente evitando assim que outras patologias se desenvolvam[(7)].

Desse modo a ingestão do glúten pode provocar sintomas como distensão abdominal, diarreia, perda ou ganho de peso, lesões na pele dentre outros, mas quando não tratada têm dois a quatro vezes maior risco de linfoma, mais de 30 vezes maior risco de adenocarcinoma do intestino delgado e 1,4 vezes maior risco de morte. Por isso se faz observável a prevalência da DC que é de 1 a 2% da população da América do Norte e do Sul, Norte da África, Oriente Médio e Índia[(8)].

Portanto é considerável o percentual da população com diagnostico de Doença Celíaca na atualidade. A não adoção de uma dieta isenta de glúten pode gerar danos graves ao paciente, porém diversos fatores podem interferir para a não adesão doPlano. Diante de poucas revisões atualizadas acerca da adesão de um Plano alimentar isento de glúten relacionado aos hábitos alimentares contemporâneos, o presente estudo se propôs a identificar na literatura fatores que influenciariam para não adesão do Plano alimentar de pacientescelíacos.

## II. Método

A busca por estudos científicos foi realizada de fevereiro a maio de 2019, por meio de pesquisa na Biblioteca Virtual em Saúde (BVS), biblioteca de artigos SciELO (ScientificElectronic Library Online) e PubMed. Foram utilizados como descritores: Doença Celíaca, Cooperação do Paciente, Dietoterapiacombinados entre si, previamente consultados em Descritores em Ciências da Saúde - DeCS, sendo eles pesquisados nos idiomas inglês e português.

Considerou-se a seguinte pergunta condutora: Quais os fatores associados para não adesão da Dietoterapia por portadores de doença celíaca? Utilizaram-se como critérios de elegibilidade: artigos científicos experimentais, sob qualquer faixa etária, publicados nos idiomas inglês, português e espanhol, publicados nos últimos 6 anos e que respondesse à pergunta condutora.Todos os artigos que não apresentaram resumo, artigos de revisão, estudos de validação de questionário e que não estavam disponibilizados com texto completo foram excluídos.

Na busca, foram obtidos 327 artigos na BVS, 1 no Scielo e 382 PubMed totalizando 710, após a aplicação dos filtros os artigos da BVS foram para 113 e Pubmed 120 dos quais 110 eram repetidos entre as bases. Após a leitura dos títulos e resumos, 22 artigos foram pré-selecionados eleitos e lidos na íntegra. Destes, 17 compuseram a amostra final da revisão. Esquema detalhado na figura 1.



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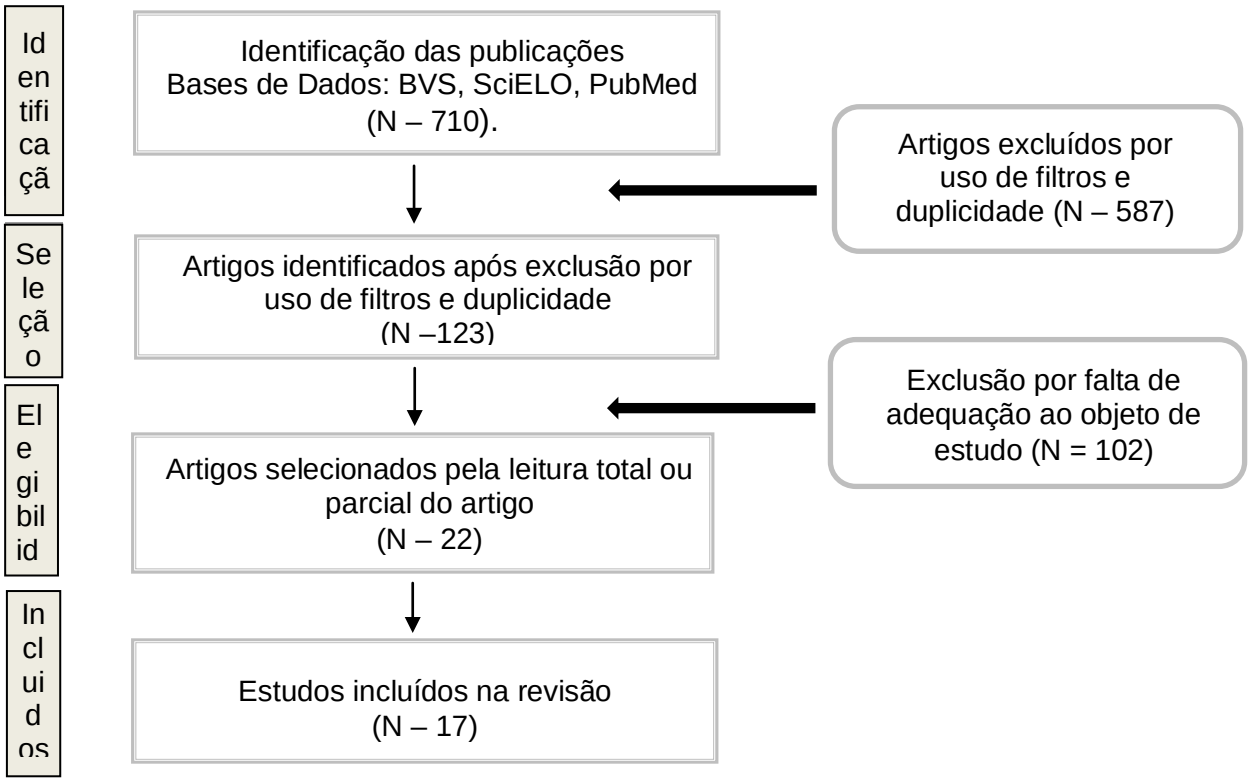



*Figura 1:* Fluxograma das principais etapas da revisão sistemática.

## III. Resultados

Dos 17 artigos selecionados, 16 foram publicados em língua inglesa e 1 em Espanhol, sendo três no ano de 2013, um em 2014, quatro em 2015, um em 2016, cinco em 2017 e três em 2018.

Entre os artigos selecionados 17 adotaram a metodologia de estudo transversal e um estudo de coorte, com uma variação amostral entre 35 a 13.279 indivíduos.

Os diferentes instrumentos foram classificados como diretos e indiretos, considerando-se questionários e/ou formulários indiretos, testes laboratoriais e de campo, fatores antropométricos e exames clínicos diretos.

Através do quadro 1 pode ser observada as características dos artigos incluídos no estudo, sendo possível observar as informações dos autores, ano de publicação, país onde foi realizada o estudo, aspectos metodológicos, amostra e principais resultados sobre os fatores da não adesão à dieta isenta de glúten.

Os resultados mostraram que a baixa adesão se deu por vários motivos, podendo destacar como mais apontados foram: restrição social causada por uma dieta livre de glúten, pois (comer fora, maior transgressão em festas, isolamento social, comer pequenas porções para se sentir incluído) foram bastante abordados, bem comoo custo elevado do alimento isento de glúten.

*Quadro 1:* Características dos artigos analisados descritas por autor, país, amostra, aspectos metodológicos e principais resultados.

| Autores/Ano/País | Amostras | Aspectos Metodológicos | Principais Resultados |
|---|---|---|---|
| Machado, J.; et al [9] 2013/Brasil. | 46 pacientes, com idades compreendidas entre os 3 e os 49 anos, ambos os sexos. | Estudo transversal | Ingestão acidental de glúten. |
| D Charalampopoulos et al [10]/ 2013/Grécia. | 90 crianças, faixa etária 2 e 18 anos ambos os sexos. | Estudo transversal | O conhecimento percebido pelos pais significativamente associado com conformidade. |
| M. Zarkadas et al [11] 2013/ Canadá. | 10, 693 participantes, adultos de ambos os sexos. | Estudo transversal | Isolamento por causa da dieta foi o fator mais relevante, seguido de rotulagem de alimentos e a alimentação fora de casa. |



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| | | | |
|---|---|---|---|
| A. J. Dowd et al [12]/ 2014/ Canadá | 203 adultos, ambos os sexos com idade a partir de 18 anos. | Estudo Transversal | Ao comer fora foram menos cuidadosos e amar o gosto dos alimentos com glúten foram os motivos mais apontados. |
| J. Vilafuerte-Galvez et al [13]/ 2015/Estados Unidos. | 709 adultos maiores de 18 anos, de ambos os sexos. | Estudo Transversal, retrospectivo | O custo percebido continua sendo uma barreira para a adesão. |
| Emily J Kothe et al [14]/ 2015/ Austrália. | 228 indivíduos maiores de 18 anos, ambos os sexos. | Estudo Transversal | Dificuldades de manter a prática de exclusão do glúten, por não conseguir um hábito constante por um período prolongado. |
| Francisco Casellas et al[15]/ 2015/ Espanha. | 366 pacientes, eles precisavam estar entre 16 e 75 anos de idade, ambos os sexos. | Estudo prospectivo, transversal, multicêntrico, observacional | A baixa adesão estar associada a uma maior gravidade dos sintomas e a uma pior percepção da importância do tratamento. |
| Charlotta Webb et al[16]/ 2015/ Suécia. | 13.279 adolescentes de doze anos de idade, ambos os sexos. | Estudo transversal | O período da adolescência dificulta a adesão, pois são socialmente afetados pela restrição, sendo essa fase da vida extremamente sensível há mudanças ou restrições. |
| Karen lizzette Ramírez-Cervantes et al[17]/2016/ México. | 56 pacientes com doença celíaca e 24 com sensibilidade ao glúten não celíaca foram incluídos. Maiores de 18 anos ambos os sexos. | Estudo transversal | Por ser considerado extremamente raro no país, a não adesão se deu por desinformação sobre os alimentos sem glúten sendo importante uma boa orientação por parte dos profissionais. |
| Karin W. Schilling; Karla Yohannessen; Magdalena Araya[18] / 2017/ Chile. | 65 crianças e adolescentes, ambos os sexos, menores de 18 anos. | Estudo Transversal, analítico. | Maior chance de transgressão de crianças impedidas de participar de aniversários por conta da doença. Não participam de cerimônias religiosas consumindo (hóstias, pão ou vinho). |
| Humayun Muhammad et al[19]/2017/ Inglaterra. | 375 candidatos adultos maiores de 18 anos, ambos os sexos | Estudo transversal | 80% relataram que os produtos destinados para celíacos eram caros e isso dificulta a adesão e não entender os rótulos dos alimentos foi significantemente associado à pior adesão dietética (75%) dos participantes. |
| Laura Kivelã et al [20]/ 2017/ Finlândia | 504 crianças, menores de 18 anos, ambos os sexos. | Estudo de Coorte | Disponibilidade e custo dos produtos isentos de glúten foram os fatores apontados para não adesão, porém a população estudada teve uma boa aderência dieta. |
| A. Justine Dowd; Mary E. Jung[21]/ 2017/ Canadá | 220 Adultos de ambos os sexos. | Estudo Transversal, prospectivo | Consumo de glúten por acidente. |
| Francisco Cabrera-Chávez et al [22]/2017/ Argentina. | 1209 adultos, maiores de 18 anos de ambos os sexos. | Estudo Transversal | A falta de adesão a dieta livre de glúten está correlacionada à gravidade dos sintomas desencadeados após a ingestão de trigo/glúten e a disponibilidade e custos elevados dos produtos sem glúten. |
| Benjamin Lebwohl et al [23]/ 2018/ Estados Unidos da América. | 50 candidatos adultos maiores de 18 anos e 30 adolescentes sendo considerada a faixa de 13 a 17 anos, ambos sexos. | Estudo Transversal, prospectivos | Comer fora foi a barreira mais apontada para a ocorrência de transgressões a dieta, seguido de opções limitadas em restaurantes e funcionários desinteressados ou desinformados. |
| Maraci Rodrigues; Glauce Hiromi; Carla Aline Fernandes Satiro[24]/ 2018/ Brasil | 35 candidatos com faixa etária de 1 a 20 anos de idade, ambos os sexos. | Estudo Transversal e retrospectivo | A maioria das transgressões ocorreram em festas. 20% relataram não adesão à dieta. |



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|---|---|---|---|
| Grazina Czaja-Bulsa; Michal Bulsa[25]/2018/ Polônia | 102 Crianças e adolescentes 0 a 18 anos, ambos os sexos. | Estudo Transversal | Os fracassos na dieta de adolescentes são causados pela a ausência de sintomas após o consumo de uma pequena quantidade de glúten. |

## IV. Discussão

A prevalência da doençacelíaca tem aumentado de forma expressiva nos últimos 50 anos, assim como a importância da adesão a uma dieta isenta de glúten para essa população, pois ela é essencial paraprevenir sintomas imediatos, bem como, reduzir os riscos a saúde. Por se tratar de um tratamento permanente e vitalício a adesão ao Plano Alimentar adequado torna-se desafiador tanto para o profissional quanto para o paciente[12].

Neste sentido em todos os artigos destacados foi possível evidenciar os desafios enfrentados pelos celíacos ao longo dos anos e em varias faixas etárias. Um dos obstáculos observados em pacientes adultos principalmente aqueles cujo o diagnóstico se deu quando adulto, foi gostar do sabor dos alimentos que continham glúten em seu preparo[12]. Também relataram o consumo por relacionar a gravidade dos sintomas desencadeados após a ingestão do glúten e os motivos que levaram a se submeter aos riscos vão de sociabilidade a altos custos para adquirir os alimentos, pois a restrição alimentar causa isolamento social sendo assim perceptível como um fator relevante, pois a sociabilidade comprometida é bastante relatada sendo o isolamento uma barreira apresentada por uma estudo como um dos maiores problemas para não adesão, bem como a percepção do custo alto do alimento isento de glúten [11,13,15,22].

Segundo um estudo transversal analítico envolvendo 65 crianças demostrou que crianças diagnosticadas antes dos 2 anos de idade tem maiores chances de permanecerem aderentes a uma dieta isenta de glúten cerca de 60,7 % contra 28% daquelas cujo o diagnóstico entre 2 a 10 anos de idade. Destacando assim a importância do diagnóstico prévio da doença [18].

Demostrando que por conta do fato de lidar com a doença desde de criança possivelmente seria mais fácil o manejo profissional nestes pacientes, pois diminuiria a problemática de gostar do gosto do alimento com glúten. Entretanto, a pesquisa revelou que um dos maiores dilemas da doença na infância é manter a restrição em momentos sociais como aniversários o que possivelmente afetaria a qualidade de vida destes jovens [12,18].

Em virtude de manter o hábito em uma dieta restrita ser sempre algo complicado, conseguir manter-se regrado do durante um período prolongado foi apontado como um fator de não adesão relevante[14].

Considerando o que foi exposto o comprimento da dieta isenta de glúten é desafiador em todas as faixas etárias, mas o seu engajamento fica bastante comprometido na adolescência um estudo transversal em adolescentes com 13,279 participantes de 12 anos de idade relata que por se tratar de uma fase extremamente sensível há mudanças e uma restrição alimentar afetaria socialmente o que prejudicaria a adesão dessa população [16].

Consequentementeum estudo apontou que o fracasso na dieta em adolescentes é causado pela ausência de sintomas após o consumo de pequena quantidade de glúten, ao associarmos a ser um período sensível a restrições e onde socializar-se é de grande importância, sendo assim compreensível que os esses jovens tenham dificuldades em resistir a ingestão do glúten em momentos festivos[15,25].

Em outro estudo é perceptível o fortalecimento desse resultado onde a maioria das transgressões em adolescentes ocorreu intencionalmente em casa ou em festas indicando que a sociabilidade é levada em consideração na hora de aderir ou não ao plano alimentar [24].

Um dos fator relevante em todas as faixas etárias é o custo dos alimentos sendo frequentemente percebido como uma barreira a aderência ao plano, a pesar de hoje em dia haver uma maior visibilidade da doença celíaca e já existir produtos destinados para esse publico e até mesmo legislações que obrigam que os rótulos venham com advertência que o produto contémglúten, os alimentos permanecem caros e muitas vezes inacessíveis por esses consumidores [13,19,20].

Apesar das legislações vigentes regularem as rotulagens dos alimentos que contém glúten há obstáculos para compreensão do que está escrito nos rótulos trazendo grandes dificuldades para adesão sendo apontado como um dos fatores para não adesão, pois pode provocar a ingestão acidental do glúten por conta de rótulos inadequados [9,11,21].

Outro impedimento mencionado pelos participantes das pesquisas de suma importância é o fato de ser problemático comer fora, pois requer um maior cuidado com possíveis contaminações, consiste em constrangimento por ter muitas vezes que explicar o motivo da exclusão do glúten, sendo muitos se obrigam a consumir glúten só para evitar este incômodo, pois é possível ressaltar que é bem comum a desinformação ou desinteresse pelos funcionários dos estabelecimentos [12,23].

Como apontado anteriormenteo desconhecimento sobre o que é o glúten e onde encontra-lo não um fato raro,um estudo mexicano demostrou que a desinformação sobre quais alimentos



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continham glúten era um dos responsáveis pela transgressãopor esse motivo é de suma importância orientação nutricional por parte dos profissionais [17].

## V. Conclusão

Visto que, a relação da comida está intimamente ligada com a sociabilidade vemos como uma das maiores dificuldades para a adesão do plano alimentar por esses enfermos se dá pela vulnerabilidade social sofrida e pelo alto custo dos alimentos que mesmo em país desenvolvido como Estados Unidos, Inglaterra e Finlândia o custo percebido foi relevante um fator agravante para o descumprimento da dieta.

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# Comparison of Nutritional Quality and Organoleptic of Dadih (Minangkabau Traditional Yogurt) of Cow Milk and Soy Milk as Functional Food Probiotics

By Oktariyani Dasril, Gusliani Eka Putri & Syamsul Amar B

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*Abstract-* Functional food was defined as foods that are nutritious and also have a positive influence on health. One of the functional foods which was a typical traditional food of Minangkabau was Dadih. Dadih was a nutritious food for the health of the human body. One of the properties of Dadih was to reduce blood cholesterol because it contains Lactic Acid Bacteria (LAB) which are potential as probiotics. Dadih can be made from cow's milk or soy milk but must be added with skim milk so that the total solid is equal to buffalo milk Dadih. The purpose of this research was to determine protein content, fat, yield, organoleptic properties of Dadih. This research was an experimental study with two treatments and two replications and analyzed using a 5% T-test. The results obtained from this study were significant differences in protein, fat, and color between cow milk Dadih and soybean. Whereas from the organoleptic test results showed 60% of panelists like pure soybean Dadih compared with cow milk.

*Keywords: functional food, dadih, cow's milk, soybean milk, organoleptic.*

*GJMR-L Classification: NLMC Code: QU 145.5*

COMPARISONOFNUTRITIONALQUALITYANDORGANOLEPTICOFDADIHMINANGKABAUTRADITIONALYOGURTOFCOWMILKANDSOYMILKASFUNCTIONALFOODPROBIOTICS

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# Comparison of Nutritional Quality and Organoleptic of Dadih (Minangkabau Traditional Yogurt) of Cow Milk and Soy Milk as Functional Food Probiotics

Oktariyani Dasril [α], Gusliani Eka Putri [σ] & Syamsul Amar B [ρ]

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*Keywords: functional food, dadih, cow's milk, soybean milk, organoleptic.*

## I. Introduction

In an effort to fulfill the demands of society needs for nutritional value the government has planned a diversification program for food products, especially on traditional food, which has the opportunity to be recommended as a functional food. [1]

Functional foods were defined as foods that are not only nutritious but also have a positive impact on health, because they contain certain components or substances that have felicitous physiological activity. [2]

Functional food can be in the form of maximum and minimum originating from animal and vegetable. Although the concept of functional food has only become popular in recent years, many types of traditional food actually fulfill the requirements to be called functional food. Examples of sand ginger rice drinks, ginger, turmeric-acid, sherbet, Dadih, tempeh, tape and others. [3]

Dadih is one of the traditional foods favored by the people of West Sumatera, because besides being useful as a traditional food (Cultura Food) it also functions as a source of society nutrition. Among rural societies, Dadihs are often consumed or as side dishes for rice. [4]

Dadih was quite beneficial for the health of the human body. One of the benefits of Dadih is to reduce blood cholesterol. Some studies show that Dadih contains Lactic Acid Bacteria (LAB) which are potential as probiotics.[5]

Dadih making was very simple, the freshly milked buffalo milk is put into a bamboo tube and covered with banana leaves. The buffalo milk is left or fermented naturally at room temperature for 1-2 days to form clots.[6]

Dadih making from cow's milk and soy milk was relatively cheaper because cheap raw materials are obtained. While the raw material for making Dadih from buffalo milk only exists in a number of places such as Bukitinggi, Sijunjung, Solok but only managed by certain communities. [7]

## II. Research Methods and Materials

The tools that used for making Dadih are: electric scales, measuring instruments, thermometers, pans, spoons, blenders, filters, bamboo tubes, incubators. Whilst the tools that used to test the analysis are: micro Kjeldahl, beaker, measuring cup, measuring pipette, test tube, burette, conductor, electric scales, dictalio apparatus, scales, stirring rods, sucker pipettes, erlenmeyer tube, litmus paper, oven.

The ingredients used for making Dadih are fresh cow'smilk, soybeans and skim milk. Fresh cow's milk is purchased at the Faculty of Animal Husbandry Andalas University as much as 2 kg. While as much as 1 kg of soybeans and 100 grams of skim milk. The starter used is buffalo milk Dadih purchased in Bukittinggi.

Material to be used was tested levels of protein and fat are acid $H_2SO_4$ (sulfuric acid) $Na_2SO_4$ (sodium Tio sulfate), Hg (mercury), Sodium Sulfide, potassium sulfate, Granules ink, Boric acid, an indicator methyl red, methyl blue , HCl, Aquades, fenolftalein. [8]

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*a) The Process of Making Soy Milk*

The ingredients used for makingSoy Milk is 1kg soybean which has been sorted soaked in water for a day or approximately 12 hours. Then drain and simmer for 30 minutes. Soybean peel is separated by squeezing it with water several times. Soybeans milled in a blender. The slurry obtained is added to boiling water so that the total amount of water reaches 10 times the weight of dry soybeans. Watery porridge is filtered with gauze and the titrate is raw soy milk.

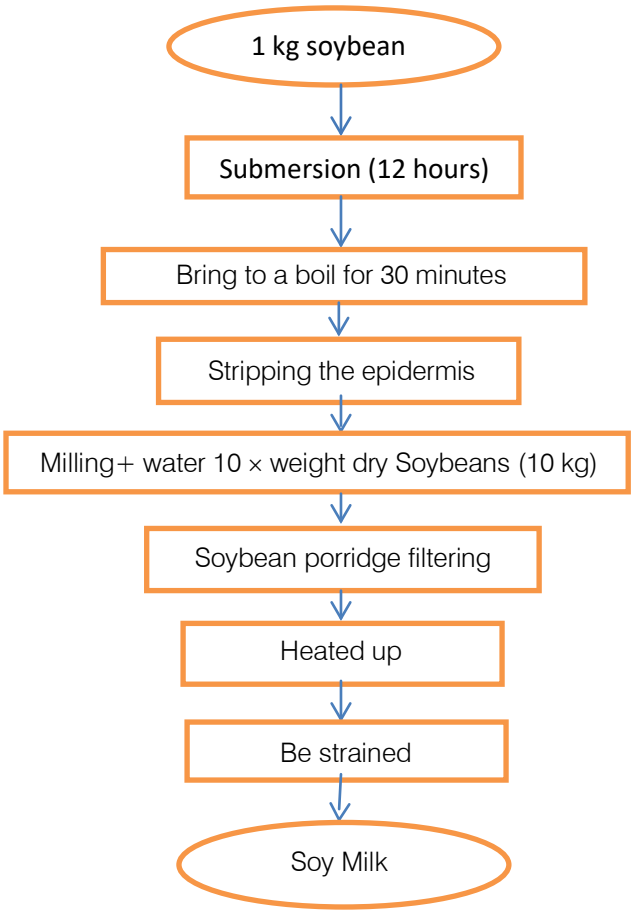



*Image 1:* Scheme For Making Soy Milk [11]

*b) The Process of Making Soy Milk/ Cow's Milk Dadih*

Pure soy milk is heated to a temperature of 70$^0$C for 20 minutes. Then it is cooled to 30$^0$C. Added skim milk as much as 10% of pure soy milk, then added stater as much as 4% taken from buffalo milk Dadih. Pour into bamboo and cover with banana leaves. Then incubate at 30$^0$C for 48 hours. During the addition of skim milk and the stater is carried out stirring.

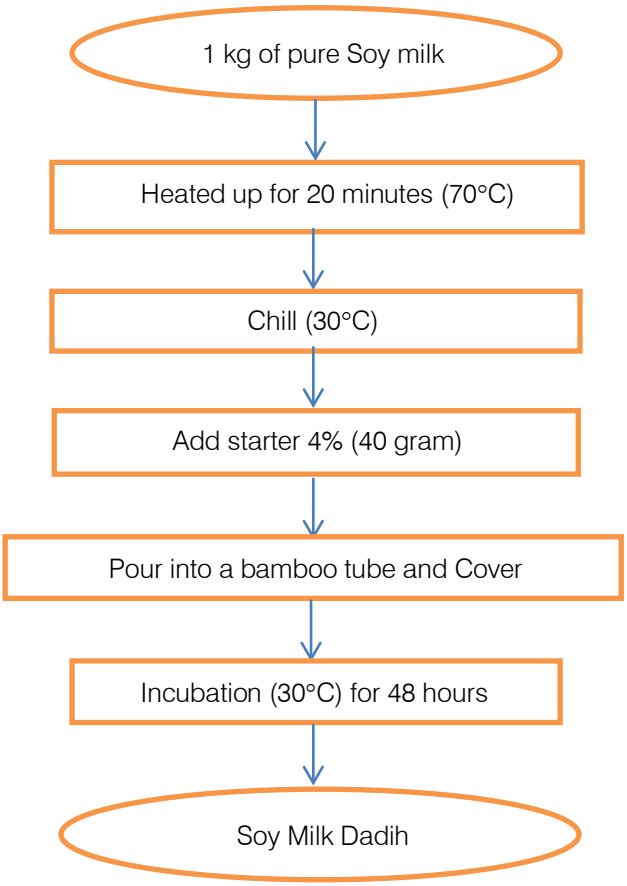



*Image 2:* Scheme for Making Soy Milk or Cow's Milk Dadih[11]

*c) The Process of Making Cow's Milk Dadih*

Cow's milk is heated to a temperature of 70$^0$C for 20 minutes. Then it is cooled to 30$^0$C. Added 10% skim milk from cow's milk, then 4% added stater. Pour into bamboo tubes and cover with banana leaves. Then incubate at 30$^0$C for 48 hours. During the addition of skim milk and the stater is carried out stirring.

*d) The Form of Serving Dadihs*

Dadih was consumed directly with riceafter being given slices of red onion and red chili, ormixed in cold drinks with chipssticky rice, coconut milk, and brown sugar. Dadih is also consumedfor breakfast, varied with ampiang (rice crackers) and coconut sugar. Dadih was consumed as a side dishfood, snack food, complementary traditional ceremonies, andas traditional medicine.

*e) Data Processing Method*

The design used in the study was an experiment with two treatments and two repetitions. The treatment was taken based on preliminary research that had been carried whereby the use of 4% starter and 10% skim milk produced good Dadih with its density.[8]

The data obtained were analyzed by the SPSS program with a T-test statistical test at the level of 5%.



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The organoleptic test results were analyzed based on preference levels using a mode score for color, aroma, and texture. Whereas for products that can be accepted, it is taken from the overall percentage of panelists' preference.

## III. Results and Discussion

A total of 250 grams of raw soybeans processed into soy milk obtained 1.9 liters of soy milk with two filters using household coconut milk filters.

Table 1 shows the differences in the physical properties of cow's milk Dadih and soy milk Dadih seen in terms of color, taste, aroma and texture. While the results of the yield of cow's milk Dadih are lighter compared to soy milk Dadih. This is because fermented cow's milk is compared to soy milk.[9]

*Table 1:* Physical Character of Cow's Milk Dadih and Soybean Milk Dadih

| Physical Character | Cow's Milk Dadih | Soybean Milk Dadih |
|---|---|---|
| Color | Yellowish white | Less white |
| Taste | Sour | Unpleasant and acidic |
| Aroma | Specific sour milk | Specific |
| Texture | Rather solid/ semi-solid | Less solid/thick liquid |

Table 2 shows the average protein levels of cow's milk Dadih and soy milk Dadih. The protein from cow's milk Dadih is of high quality because animal-derived proteins can provide essential amino acids. Whereas soy milk Dadih is of low quality. This is because soybeans have a limiting amino acid (methionine). Protein levels in cow's milk Dadih and soy milk Dadih have been accepted in indutralization because SNI requires that the protein contained in it at least 3.5% protein is described as the most reactive component among the components of food.[10,11]

*Table 2:* Differences in the Average Value of Protein in Cow's Milk Dadih and Soybean Milk Dadih

| Variable | Mean | SD | P value | n |
|---|---|---|---|---|
| • Proteinsin cow's milk Dadih | 9,79 | 0,29 | 0,004 | 2 |
| • Proteinsin soybean milk Dadih | 4,65 | 0,22 | | |

Table 3 shows the average fat content of cow's milk Dadih and soy milk Dadih. Fat is a food substance that is important for maintaining the health of the human body. Fats derived from animal and vegetable. Animal fat contains a lot of sterols while vegetable fats contain phytosterol and contain more unsaturated fatty acids. [9]

*Table 3:* Differences In The Average Value of Fats in Cow's Milk Dadih and Soybean Milk Dadih

| Variable | Mean | SD | P value | N |
|---|---|---|---|---|
| • Fats in cow's milk Dadih | 7,03 | 0,04 | 0,003 | 2 |
| • Fats in soybean milk Dadih | 2,91 | 0,10 | | |

Table 4 shows the difference in the average of organoleptic cow's milk Dadihs and soy milk terms of aroma, flavour, texture and colour.

*Table 4:* Differences In The Average Value Of Organoleptic Test On Cow's Milk Dadih And Soybean Milk Dadih

| Variable | Mean | SD | P value | n |
|---|---|---|---|---|
| • The aroma of cow's milk Dadih | 2,50 | 0,82 | 0,797 | 30 |
| • The aroma of soy milk Dadih | 2,55 | 0,67 | | |
| • Taste of cow's milk Dadih | 2,0 | 0,63 | 0,424 | 30 |
| • Taste of soy milk Dadih | 2,1 | 0,64 | | |
| • Texture of cow's milk Dadih | 2,4 | 0,56 | 0,142 | 30 |
| • Texture of soy milk Dadih | 2,6 | 0,64 | | |
| • Color of cow's milk Dadih | 2,7 | 0,79 | 0,047 | 30 |
| • Color of soy milk Dadih | 3,1 | 0,85 | | |

The aroma of cow's milk Dadih and soy milk Dadih is almost the same which is distinctive smelling. This is caused by mixing the aroma of milk with bamboo and the role of Laktobacillus bacteria in the fermentation process to decompose lactose. [12]

The taste of Dadih is less favored by the general public because Dadihs are usually consumed by certain people who are used to consuming it since childhood. The taste of cow's milk Dadih and soy milk Dadih almost matches the taste of buffalo milk Dadih. [12]

The color of cow's milk Dadih and soy milk Dadih are very different. This is because cow milk contains colloidal fat grains, calcium caseinate and calcium phosphate and carotene and riboflavin. Whereas soy milk has a low limestone content of only 18.5% of cow's milk. This is what causes the color of cow's milk Dadih and soy milk Dadih to be different.[13]

The organoleptic test results conducted by 30 panelists on cow's milk Dadih and soy milk Dadih showed that the total number of panelists received was 18 people (60%) favoring pure soy milk Dadih.

## IV. Conclusion

Making Dadih milk and soy milk by pasteurization before fermentation is useful to kill the contaminating organisms contained therein. Cow's milk freezes to become Dadih faster than soy milk because



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cow's milk containing casein quickly provides better and more uniform consistency in the final product. The organoleptic test results between pure cow's milk Dadih and pure soy milk Dadih showed that 60% of panelists liked pure soy milk Dadih.

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# Nutritional Requirements for a Healthy and Graceful Aging

By Ayenigbara Israel. O. & Adeleke Olasunkanmi. R.

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*Abstract-* Today, People are now living longer around the world as many people can hope to live into their sixties and more. Interestingly, by 2050, the world's population between 60 years and above is expected to total 2 billion, up from 900 million of what it was in 2015. Healthy aging is the way towards creating and keeping up the functional ability that gives sound health as one age. Functionality entails having the capabilities that enable every individual to do what they enjoy doing, and that which provides them joy and pleasure and have reason to value in good health, this incorporates an individual's capacity to: meet their fundamental needs; to learn, grow and to make decisions, to be mobile, to be social, and most importantly, to add to the society. Importantly, in the realization of this, Nutrition is very paramount. Hence, the need for a review of the nutritional requirements that will aid healthy and graceful aging. This review brings together some of the crucial areas of food and nutrition affecting an individual's health as one age. Therefore, this review will help health practitioners, educators and caregivers to provide sound advice and support to people, in the hope of having healthy and graceful aging.

*Keywords:* *nutrition, healthy, graceful, aging, requirements.*

*GJMR-L Classification:* *NLMC Code: QU 145*




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# Nutritional Requirements for a Healthy and Graceful Aging

Ayenigbara Israel. O. [α] & Adeleke Olasunkanmi. R. [σ]

*Abstract-* Today, People are now living longer around the world as many people can hope to live into their sixties and more. Interestingly, by 2050, the world's population between 60 years and above is expected to total 2 billion, up from 900 million of what it was in 2015. Healthy aging is the way towards creating and keeping up the functional ability that gives sound health as one age. Functionality entails having the capabilities that enable every individual to do what they enjoy doing, and that which provides them joy and pleasure and have reason to value in good health, this incorporates an individual's capacity to: meet their fundamental needs; to learn, grow and to make decisions, to be mobile, to be social, and most importantly, to add to the society. Importantly, in the realization of this, Nutrition is very paramount. Hence, the need for a review of the nutritional requirements that will aid healthy and graceful aging. This review brings together some of the crucial areas of food and nutrition affecting an individual's health as one age. Therefore, this review will help health practitioners, educators and caregivers to provide sound advice and support to people, in the hope of having healthy and graceful aging.

*Keywords: nutrition, healthy, graceful, aging, requirements.*

## I. Introduction

The importance of Nutrition as one is age is enormous; this is because nutrition itself is a fundamental and relevant part of the aging process as it helps to provide the energy one needs. Their is an upsurge in the increment of malnutrition in the elderly population, which according to [1], are attributed to various changes in the biological and physiological nature of the body due to old age. Some of these changes include; reduced functional ability, reduction in the way the muscle functions, reduction of the bone mass in the body, the inability of the immune system to function well, anemia and reduction in the cognitive level [1].

Malnutrition or Hunger is characterized as a state in which there is an insufficiency or uneven distribution of the required body nutrients as a result of one not eating food in the right and correct proportion, in turn, causing adverse and unfavorable effects on body shapes and form, and functioning ability of the entire body system [2]. Understandably, there is a high prevalence and a projected increase of malnutrition in the elderly population as a result of biological and physiological changes of the body due to aging process [1]. Statistically, 16% of the people over 65 years of age and 2% of people over 85 years are classed as malnourished [3]. It is crucial to note that these figures are anticipated to rise significantly in the following 30 years. Malnutrition of the elderly population is not only limited to the underdeveloped and developing countries, as a study carried out by [3] revealed that in developed countries, 15% of home and community-bound elderly have malnutrition problems. Also, 23% to 62% of hospitalized patients and up to 85% of nursing home occupants experience the ill effects of hunger.

According to [4], People are now living longer around the world, and most people can hope to live up to sixties and even more. Interestingly, it was projected by WHO [4] that by the year 2050, the world's population between 60 years and above is expected to total 2 billion, a significant increase it will be from 900 million of what it was in 2015. Presently, 125 million people are aged 80 years or above, and, by 2050, 120 million of those will be living in China alone and 434 million people in this age bracket worldwide. Furthermore, by 2050, low and middle-income countries will account for 80% of all the elderly people worldwide [4]. The above statistics and projections by the world health organization indicate that, there would be many elderly people in the world over the coming years. Although, it is a good thing to see and live with our elderly ones for many period of years, importantly, in good and sound health. Hence, this paper did a review on some of the important nutritional needs for a Healthy and Graceful Aging.

## II. Method

This is theoretical research and the review centers on the important areas of food and nutrition affecting the aging process. The literature review was gotten from Google, PubMed, and Springer Link data bases. Furthermore, major international and national health sites, to name a few, the World Health Organization, U.S. Department of Health and Human Services and U.S. Department of Agriculture, Ministry of Health. Importantly, these data bases and sites were searched to get the latest and valid information for the topic at discourse. Year of publication was not a major factor in the literature search, but the articles were limited just to those written in English.

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## III. Concept of Healthy Ageing

Everyone in each nation, on the planet should have the opportunity to live a long and healthy life. However, the environmental conditions in which we live are very important, as it can either favour health or be harmful to it. Notably, environmental factors are very influential on health as one age; our exposure to health risks in the environment, for instance, pollution and violence, our access to good food and housing, clean water, quality health services and social care, all affect the aging process [4]. The World Health Organization [4] defines healthy aging "as the process of developing and maintaining the functional ability that enables wellbeing in older age." Functional ability entails having the capabilities that enable every individual to be able to do what they enjoy doing, and that which gives them joy and pleasure, and have reason to value in good health, this incorporates an individual's ability to: meet their fundamental needs; to learn, grow, and to make decisions, to be mobile, to be social; and most importantly, to add to the society. Importantly, healthy eating combined with regular physical activity helps improve one's functional ability, thereby making an individual live a full, active life, preserving independence into older age [5]. Notably, for one to have a healthy aging, extraordinary consideration and attention should be given to certain nutrients in the food consumed [6]. Although, the nutritional requirements one needs are generally similar to the general population. However, some nutrients require special attention as one age.

## IV. Nutritional Requirements for a Healthy Aging

The wholesome nutritional needs change as one age. Understandably, the changes are due to numerous factors such as physiological, psychological, social, monetary, and the environment where one lives, which influences an individual's ability to plan and prepare healthy food, which the body needs. Invariably, lack of this healthy food affects the body nutritional constituents and needs [7]. Although, there are many nutrients in diet composition, the most important ones an individual needs for healthy aging are discussed.

*a) Protein*

Proteins are of significant importance in dietary composition because it helps to build and repair worn out tissues, helps in hormone production, aids the immune system response to infections and it is needed for other body functions. Insufficient protein consumption predisposes an individual to increased skin fragility, decreased immune function, poorer healing, and longer recuperation from illness [8]. In light of this, the protein needs for individuals of more than 70 years of age are 25 percent higher than that of adolescents, and younger adults [7]; this is because muscles mass in the body decreases as one age. Nevertheless, the formation of muscle protein in the body can still be stimulated by higher consumption of protein. Thus, it is essential and advised that adequate protein consumption is consumed throughout one's life course [8]. The primary sources of protein are milk, beef and veal, fish/seafood, pork, poultry, beans, peas, eggs, nuts, seeds, and soy products [9]. The suggested requirement of protein consumption is 0.8 g protein/kg body weight every day for all adults regardless of age [10], as this is the base measure of protein consumption required to prevent progressive loss of body mass and to avoid slender weight. Furthermore, protein consumption of more than the recommended 0.8 g protein/kg body weight enhances muscle mass in the body, the strength, and function in elderly people [11], additionally; this intake also enhances the immune system, fast wound and injury healing, and blood pressure [11]. The fears that higher consumption of protein has deleterious health effects on bone, renal function, neurological function and cardiovascular function are untrue, it is advised that, the consumption of 1.5 g protein/kg body weight every day is a sensible proportion for elderly people to balance protein intake in terms of health and function [12].

*b) Carbohydrates*

The essential function of carbohydrate is to give energy to cells in the body. Among all the classes of food, Carbohydrates gives the biggest single sources of energy in the eating routine, which is usually in glucose form. Importantly, carbohydrate helps to balance the blood glucose levels, and also helps in gastrointestinal health and functioning [7]. Furthermore, carbohydrate is additionally important to prevent ketoacidosis, which is a serious type of ketosis, usually seen in diabetic elderly patients; in which so much ketone is produced in the body that acidosis occurs. Based on the effects on risk of heart disease and obesity in healthy middle-aged adults, [13], the Institute of Medicine recommends that American and Canadian adults get between 45–65% of dietary energy from whole-grain carbohydrates [14]. The Food and Agriculture Organization and World Health Organization jointly recommend that national dietary guidelines set a goal of 55– 75% of total energy from carbohydrates, but only 10% directly from sugars [15]. The essential dietary sources of carbohydrates are bread, vegetables, potatoes, fruits, wheat, rye items, rice, legumes, wheat, oatmeal, popcorn, brown rice and seeds [9]. In addition, Whole grain is a viable source of carbohydrate, in support of this; a 2017 Cochrane Systematic Review study by [16] concluded that there was insufficient evidence to support the claim that whole grain diets can affect cardiovascular disease.

*c) Fats / Oil*

Fats help in the absorption of vitamins A, D, E, and K, and are the most concentrated type of energy for

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the body. Additionally, Fat also gives energy, helps with satiety and improves tastefulness in adults. Some unsaturated fats are important in the eating routine and furthermore influence the development of chronic disease in the body. Essentially, the type of fat consumed matters, as some aids the creation of some chronic disease conditions, notably cardiovascular disease in the body [7]. Unsaturated fats incorporate monounsaturated and polyunsaturated fats; they lower blood cholesterol levels and low-density lipoprotein (LDL) cholesterol [17]. Furthermore, polyunsaturated fats, which are mostly linoleic acid, help to reduce the frequency of, and mortality from coronary diseases [7]. Basic polyunsaturated fats are required in the daily eating routine because the body cannot produce them, as they are essential for the structural integrity of all cell membranes in the body; in addition, they are the precursors to the biologically active eicosanoids that have roles in physiological processes, for example, reproduction, blood pressure, hemostasis and inflammation [18]. Notable sources of important fat the body needs are olive oil, nuts, seafood, vegetable oil, coconut oil, soybean oil, palm, palm kernel oil, coconut oil, canola, corn, olive, sunflower and peanut oil [9].

*d) Calcium*

Calcium is one of the major essential nutrients required in the body for the development and maintenance of the skeleton. Also, calcium is required for the normal functioning of neuromuscular and cardiovascular function in the body. Notably, Calcium is usually found and abundant in bonny parts of the body and teeth, where it provides them with structure and strength. Although, there could be a deficient of calcium in the body as the low level of calcium have been related to a low bone density which is also called Osteoporosis. Osteoporosis is a disease, usually common in women following menopause, in which the bones become extremely porous and weak and are subject to fracture or breakage. For example, in New Zealand, Osteoporosis is a major cause of morbidity among older New Zealanders, especially post-menopausal ladies [7]. Importantly, calcium consumption throughout one's life is a main determinate influencing the occurrence of osteoporosis and other related calcium deficiency diseases. However, different factors, prominently of which are vitamin D status in the body and exercise, additionally influence the rate of Osteoporosis [7]. The calcium level in the body is different among people since individual's have different amounts of bone tissue measures as the skeleton develop and grows [19], but one begins to have considerable bone loss at 50 years old in ladies and 65 years old in men [20]. Furthermore, from about these ages, age-related loss of bone has been assessed at 0.5 to 1.0 percent every year [7]. The loss of calcium in ladies is related with menopause and a decrease in intestinal calcium retention as well as an increase in calcium excretion through urination [7]. Importantly, regular physical activity enhances the retention of calcium in the bone at all ages [19]. The important sources of calcium in the diet includes grain, bread, dairy items, cheddar, vegetables, soy milk, and canned fish with bones, nuts, vegetables, dried fruits, legumes, tofu and so on [19].

*e) Vitamins D*

Vitamin D is a fat-solvent vitamin which also serves as hormones in the body. It balances calcium and phosphate in the body and also regulates bone health and muscle function. According to [21], Vitamin D with or without calcium also helps in the prevention of falls. Notably, the lack of vitamin D in the body results in insufficient mineralization and demineralization of the skeleton and other bone structures. Furthermore, in grown-ups, insufficiency of vitamin D can trigger an increased bone turnover and osteoporosis and osteomalacia; a medical condition which is a porous bone, resulting in bone and muscle pains, and weakness. Also, older individuals are especially in danger of vitamin D insufficiency due to lack of exposure to sunlight since they have restricted mobility, are house-bound, or live in a care homes. Also, those with dark skin or who dependably covers their skin and additionally wear a shroud are likewise going to suffer from vitamin D deficiency [21]. To augment the level of vitamin D in the body, a walk in hours around twelve, with the face, arms, and hands uncovered, is suggested [21] as bodily required needs of vitamin D is difficult to get through food alone [7]. In situations and circumstances where walking in the sun is not possible due to other challenges or health diseases, for instance, skin cancer, then Vitamin D supplementation should be recommended by a medical doctor. Vitamin D can be gotten in little amounts in a couple of diet, for example, greasy fish, Ocean salmon, herring and mackerel, liver, eggs, and fortified foods, for example, margarine; some low-fat dairy items like grain and yogurt contain a minute quantity of vitamin D [7].

*f) Iodine*

Iodine is a fundamental part of the thyroid hormones called thyroxine (T4) and 3, 5, 3'-triiodothyronine (T3). These hormones are required for the development and growth of tissues in the body, most importantly, the central nervous system (CNS). Also, they have a more extensive part in the maturation of the overall body cells. Furthermore, they are imperative for the synthesis of energy in the body and oxygen consumption in cells, in this manner regulating the body's metabolic rate [7]. Iodine insufficiency is a pathway to an extensive variety of health problems medically known as 'iodine deficiency disorders' (IDD) [22]. Universally, IDD is a typical medical issue. As indicated by the WHO, in 2007, almost 2 billion people had suffered from iodine insufficiency [23]. The nature



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and seriousness of IDD can differ broadly, and depends on the severity and length of the iodine deficiency and the age range of the people affected [24]. Also, lack of Iodine in the body may result in goiter; which is an enlargement of the front sides of the neck caused by inflammation of the thyroid gland. Also, the complication of goiter causes hypothyroidism, impaired mental function and iodine-induced hyperthyroidism [25]. Seafood's like seaweed and kelp are rich sources of iodine. Furthermore, Iodine is found in milk, so milk and milk products are viable sources. Also, iodine is gotten from eggs, some meat and grains, and bread; when sweetened with iodized salt [9].

*g) Folate*

Folate' is a collective name for more than 100 compounds that have the same vitamin activity. Importantly, folate is a nutrient needed for aging because it helps in DNA formation, and without folate, the partition of living cells cannot occur in the body [7]. Deficient of folate and vitamin B12 can both cause an abnormally large red blood cell in the body, medically known as megaloblastic anemia. Insufficiency of Secondary folate in the body may result from impaired absorption due to infection of the small digestive system such as coeliac disease and Crohn's disease, as well as chronic alcohol consumption [26]. Furthermore, smokers are likewise in danger for folate insufficiency because smoking of cigarette may deter smokers from eating high quantity of folate-containing foods, such as vegetables and fruit [27]. Folate is abundant in green leafy vegetables, legumes, liver, fruit, fruit juices, nuts, and seeds. However, heat and steam when cooking can destroy the folate constituents in food; it is advised that uncooked vegetables and fruits are preferable sources of folate over cooked ones and should be eaten in raw form.

*h) Zinc*

Zinc is a part of different enzymes that maintain the structural integrity of proteins and regulates gene expression in the body. Zinc is an essential element needed in the body, as of lack of zinc in the body causes impaired immune responses, thereby, rendering the immune system susceptible to diseases and infection. Furthermore, zinc helps to prevent the age-related decline in immune system function [28, 29, 30]. Zinc nutrient is gotten from meat, fish and poultry products. Also, Oats, milk and milk items are other great sources of zinc in food. Also, peanuts, almonds, cashew nuts, and sesame seeds are high in zinc [31]. Preferably, dark red meat has higher zinc content than white meat and fish [19].

*i) Vitamin B12*

Vitamin B12 is needed in the body for the production of fatty acids in myelin, and also with folate, for DNA formation. Consumption of vitamin B12 is fundamental for the normal blood and neurological functions in the body and blood capacity. Although, there is a significant amount of vitamin B12 stored in the body, nevertheless, there is still the need for secretions of gastric acid and pepsin from the stomach for the absorption of vitamin B12 to take place. As one age, these secretions are reduced and sadly, in older people with atrophy of the stomach mucosa, or atrophic gastritis, these secretions are diminished, hence reducing the bioavailability of vitamin B12 [32]. The Inadequacy of Vitamin B12 in the body causes two major side effects; namely hematological and neurological. The hematological effects are megaloblastic anemia which could results in skin whiteness, lowered energy and exercise tolerance, fatigue, shortness of breath and palpitations. Neurological side effects include; sensory disturbances in the extremities, motor disturbance, and cognitive changes ranging from memory loss to dementia [7]. There may also be visual disturbances, impotence, and impaired bowel and bladder control [19]. Virtually, all dietary sources of vitamin B12 originate from animal foods, and they include; milk, hamburger and veal, fish and eggs. Plants based sources of vitamin B12 are algae and plants exposed to bacterial action or contaminated by insects [7]. As the bioavailability of vitamin B12 is reduced in older individuals with atrophic gastritis, they may require vitamin B12 supplements or intramuscular infusions. Also, people who do not eat meat or animal products (vegans) will require vitamin B12 supplementation [7].

*j) Sodium*

Sodium is an essential part of the extracellular fluid in the body and is imperative for the transportation of molecules across cell membranes. Furthermore, sodium is likewise a key factor in the retention of fluids in the body. Albeit, sodium is a basic nutrient needed in the body. Unfortunately, its consumption in developed countries enormously surpasses the requirements needed daily. Notably, there is substantial evidence of a relationship between dietary salt intake and high blood pressure which is a major risk factor for cardiovascular disease, most importantly stroke and coronary heart disease, and renal diseases inclusive [7]. Furthermore, high Sodium consumption antagonistically affects calcium balance in the body through the promotion of urinary calcium loss, which is a major implication for bone breakage or fracture (Osteoporosis) [32]. In developed and western nations, up to 60– 85 percent of the salt intake is found in processed foods [33, 34, 35].

*k) Supplements*

Dietary supplements are products taken to make up for a dietary deficiency. Supplements could be recommended by a doctor or self-chosen, and are usually in diverse forms and shape, for example, tablets, capsules, powders, and liquids. Additionally, a single



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nutrient supplement is consumed alone or multiple nutrient supplements, and examples of supplements include vitamins, minerals, herbals and herbal preparations, oils, for example, fish oil and products that give glucosamine as well as chondroitin. If one eats well, supplementation is rarely needed in the body, it should be noted that intake of dietary supplement may be of concern as one age and most importantly, among older people. The likely reasons to that include adverse health effects related to the continued use of large quantity of specific vitamins and minerals in excess of the body requirements, for example vitamin A and iron; interactions among minerals and trace elements when one supplemental nutrient intake exceeds the body needs, for example, excess intake of zinc reduces copper status in the body; the risk of supplements interfering with prescribed medicines; over-reliance on dietary supplements instead of healthy diet [36, 37, 38, 39]. Importantly, Supplementation of any type should not be prescribed except under strict medical supervision because of the adverse outcomes which come along with it, for example, beta-carotene and cancer risk. Furthermore, individual requirements should come first in prescribing any supplementation [7]. Additionally, health specialists and practitioners need to know about the dangers and advantages related to supplements use in older individuals, the most appropriate types and doses required for this group.

*I) Water*

Water is characterized as an important nutrient in the body because it is required in the quantity that surpasses the body's capacity to deliver it. Interestingly, every single biochemical reaction in the body happens in water. Furthermore, water fills the spaces in and between cells and helps forms the structures of large molecules, for example, proteins and glycogen in the body. Water is needed for other functions in the body such as digestion, transportation, absorption, nutrients dissolving, waste product elimination and thermoregulation [7]. As one age, the more the level of water required in the body. Although, older people might be at more danger of lack of hydration than younger adults because the thirst system reduces with age, medications frequently used by older populations, for example, diuretics and laxatives can cause loss of liquids, and deterioration of the renal functioning with age. Cognitive changes can cause insufficient water consumption as elderly people may be more sensitive to heat stress, and subsequent water depletion leading to heat exhaustion, loss of consciousness and heat stroke [40]. Liquid intake can likewise influence the level and quantity of saliva produced in the mouth, which is fundamental for oral health. Diminished body water is related to salivary dysfunction; this is usually common among older people [7]. Sources of water-riched foods that help the body stay hydrated includes; watermelon, strawberries, cantaloupe, peaches, oranges, skim milk, cucumber, lettuce, broth and soup, zucchini, celery, plain your gut, tomatoes, bell pepper, cauliflower, cabbage, grapefruit, coconut water, cottage cheese [41].

## V. Conclusions

The importance of Nutrition cannot be underestimated as it was reviewed heavily in this paper; this is because nutrition is an important component of health as it influences the aging process. Notably, healthy aging is the process of developing and maintaining the functional ability that enables wellbeing in older age [4], to making sure an individual enjoy sound health during old age, eating of food with the required nutrients, coupled with physical activity is essential.

*Conflict of Interest*

The authors' declares no conflict of interest.

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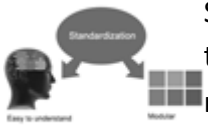



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The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

*The Institute will be entitled to following benefits:*

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After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

**The following entitlements are applicable to individual Fellows:**




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- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

**Note :**

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

# Preferred Author Guidelines

**We accept the manuscript submissions in any standard (generic) format.**

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

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- Writings
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**Acknowledgments**

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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## Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



## Format Structure

***It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.***

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The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

**Author details**

The full postal address of any related author(s) must be specified.

**Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

**Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

**Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

**Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

**Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

**Tables, Figures, and Figure Legends**

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

**Figures**

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

## Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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## Tips for writing a good quality Medical Research Paper

***1. Choosing the topic:*** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

***2. Think like evaluators:*** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

***3. Ask your guides:*** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

***4. Use of computer is recommended:*** As you are doing research in the field of medical research then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

***5. Use the internet for help:*** An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



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***6. Bookmarks are useful:*** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

***7. Revise what you wrote:*** When you write anything, always read it, summarize it, and then finalize it.

***8. Make every effort:*** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

***9. Produce good diagrams of your own:*** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

***10. Use proper verb tense:*** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

***11. Pick a good study spot:*** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

***12. Know what you know:*** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

***13. Use good grammar:*** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

***14. Arrangement of information:*** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

***15. Never start at the last minute:*** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

***16. Multitasking in research is not good:*** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

***17. Never copy others' work:*** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

***18. Go to seminars:*** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

***19. Refresh your mind after intervals:*** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

***20. Think technically:*** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

***21. Adding unnecessary information:*** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

***22. Report concluded results:*** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

***23. Upon conclusion:*** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## Informal Guidelines of Research Paper Writing

***Key points to remember:***

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

**Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

**The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

**General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



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*Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

**Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

**Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

**Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

**Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

**Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

**Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

**Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

**Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

**What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

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- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
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**Approach:**

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- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

**Approach:**

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| ***References*** | Complete and correct format, well organized | Beside the point, Incomplete | Wrong format and structuring |

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