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Development of value added Bread using Amala Pomace Powder and its Nutritional Evaluation

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Abstract

Amala pomace (AP) is a by product of amala juice processing industry. It contains large amounts of dietary fiber and other valuable compounds. Drying increases shelf life of AP. Consumption of bakery products increasing. But that contain negligible fiber therefore, continuous consumption may lead to major chronic diseases. Bakery products are easily modified into therapeutic products. Therefore, the present study was planned to develop bread utilizing AP and evaluate its nutritional composition. For that, AP was dried, ground, sieved to 240µ (APP), packed in polythene bag and stored until used. For product optimization Maida was replaced with 1, 3, 5 and 7% APP in the commercial bread formula and evaluate sensorily (6 panelists X 3 times) using 9 point hedonic scale. The processing changes include increased proofing temperature and decreased time and vice-a-versa in baking. The sugar level was increased to 10% in the formula. 5% APP replacement resulted into pour volume & texture. Thus APP replacement level narrowed down to 1, 2, 3 and 4% for primary selection and 1, 1.5, 2 and 2.5% for final selection using composite scoring test. The 2% APP replacement scored the highest. That is considered as Experimental Bread (EB). A consumer survey showed that 77.88% liked EB. Raw material, control and experimental bread were analysed for various nutrients using standard methods. The protein of APP found about one fourth as compared to Maida. The APP contained 17.87% and 2.75% fiber and mineral, respectively. EB contains 11.43% more fiber and 1.56% more minerals then CB.

Keyword: Health food; Bread; Amala Pomace: Fiber.

Introduction

Demand for the medicinal plants is increasing in both the developing and developed countries due to a growing health consciousness. Amla fruit (*Emblica officinalis*), known as Indian Gooseberry, is widely cultivated in India and is is one of the most frequently used Ayurvedic herbs in the traditional Indian medicine[3]. Amala pomace, a by product of amala juice processing industry, contains large amounts of valuable compounds including dietary fiber. Thus could be explored in the development of food ingredients and dietary supplements[1].Bakery products bear negligible fiber therefore its continuous

consumption may lead to chronic diseases. Increasing health consciousness and easy modification of bakery products has led to their development as therapeutic products[4]. A few authors used amala pomace to develop bakery products. Therefore, a study was planned to develop the amala pomace powder bread on the sensory characteristics. The nutritional composition of bread was studied.

Materials and Methods

Preparation of Amala Pomace Powder

Amala pomace produced as byproduct after juice extraction as a part of experiential learning for the students for commercial purpose was collected from the Center of Fruit Processing, Department of Horticulture, B A College of Agriculture, Anand Agricultural University, Anand, Gujarat, India. For juice extraction, amala (Anand-1) variety was obtained from the university farm, sorted, cleaned with water, blanched and juice extracted in centrifugal juicer. The pulp left was dried and converted to powder as shown in Figure 1 and used for further analysis and product development.

Product Development

Bread was developed in the laboratory following scientific method as detailed below.

Recipe Optimization

Good quality raw materials, except APP, were purchased from the local market, cleaned, packed in airtight PET jar and stored at refrigeration temperature until used. Bread was prepared by replacing APP at different levels to Maida in the commercial bread formula using no dough time method of bread bred preparation[5]. Repeated trials with changes in quantity of raw materials (yeast, water and acetic acid) as well as processing conditions (time and temperature for proofing and baking) were carried out to standardize the recipe. The formula was also changed as per the panelists' suggestions.

Sensory Evaluation

Recipe optimization was carried out on the bases of sensory evaluation using three steps namely preliminary trials, primary selection and final selection. The preliminary trials were scored on the bases of nine point hedonic scale[6] were as for primary and final selection composite scoring test was used [7]. The breads prepared using the adopted formula were sliced, randomized and presented to the panelists for evaluation of sensory characteristics. The breads were evaluated for acceptability by 6 members X 3 replications on the day of preparation. For this, products were served on randomly coded paper plates at room temperature. Panelists were supplied with tap water for cleansing the palate between samples. Product evaluation was carried out under 'day light' illumination and in isolated booths within the laboratory. The panelists evaluated volume, colour and nature of crust, symmetry of shape and uniformity of bake, texture and grain, crumb colour, taste and aroma and overall acceptability.

Bread prepared using the commercial formula (i.e. 0% APP) served as the control bread (CB) and was used for comparison. The sensory scores assigned by panelists were analysed statistically. The bread that scored the highest among APP incorporated bread was selected for further refinement i.e. from preliminary to primary and followed by final selection. Replacement rate of APP was narrowed down in such a way that percent replacement of APP of "selected product" remains some were in the middle. At the time of final selection, the bread ranked highest overall acceptability among APP incorporated bread was considered as the Experimental Bread (EB) and used for subsequent study.

Consumer Survey

Once after evaluation by experts the consumer survey was carried out through sensory evaluation using five point hedonic scales. Total 200 respondents from among faculty members of Anand Agricultural University were randomly selected. Out of that 113 respondents assigned their selection. The samples were provided almost in similar fashion to preliminary screening at a time of meeting.

Nutritional Evaluation

Maida, APP, CB and EB were analysed for various nutrients namely moisture, protein (macro-Kjeldahl method), fat (soxhlet method), carbohydrate (anthrone method), energy (calculated), fiber (by digestion) and ash (muffle furnace burning) using standard methods.

Data Analysis

The standard SPSS program was run to analyse the data. All the data were tested for significance using the ANOVA / Duncan's test[9].

Results and Discussions

Present study was planned to develop value added bread using APP and also to assess its nutritional quality. The results obtained are discussed in to these four categories.

Product Development

Recipe Optimization

When Maida was replaced with APP in the CB formula, quantity of yeast and acetic acid was increased from 1.5 to 2.0% and 0.04 to 0.06%, respectively in order to speed up the proofing. For the same purpose proofing temperature was increased from 37^{0}C to 45^{0}C. As a result proofing time was decreased by 5 minutes. The baking was carried out at 225^{0}C for 15 minutes instead of 205^{0}C for 20 minutes. As suggested by the panelists sugar level was increased to 10% to neutralize the sour taste. The final formula and process flow chart adopted for bread processing is described in Table 1 and Figure 2, respectively.

Sensory Evaluation

During preliminary trials, breads were prepared by replacing 1, 3, 5 and 7% APP. Among that 5 and 7% APP replaced breads resulted in to pour volume and texture when judged using nine point hedonic scales. Therefore, it was decided to prepare bread with 1 to 4% (with 1% interval) APP replacement level for primary selection for further refinement. Among that bread prepared using 2% replacement of APP scored the highest. Therefore, it was decided to prepare bread with 1, 1.5, 2 and 2.5% APP replacement for final selection.

It can be seen from Table 2 that all the characteristics of the APP replaced breads scored more than acceptable with no significance difference but were significantly differ with CB. It was also observed that almost all the characteristics were increased upon increasing the APP replacement level in bread preparation up to 2% and there after that were decreased. However, breads prepared up to 1% supplementation of amala powders, prepared using different drying techniques, found acceptable.[3] While[8] reported that breads incorporated with amala powder up to 5% did not affect the sensory qualities. That may be due to varietal difference.

Consumer Survey

Most of the faculty members (77.88%) found the EB acceptable i.e. liked excellent, very good and good and was found at par with the CB in all the likings. About half and one fourth consumers rated the EB good and very good, respectively. The detail liking of CB and EB are represented as Chart 1.

Nutritional Composition

The protein content of APP found about one fourth as compared to Maida. All the proximate composition for Maida found more or less similar to reported by Baljeet [2]. The ash (2.75%) and protein (3.17%) content of APP found almost equivalent (1.99 to 2.36%) and (2.96 to 3.26%), respectively to reported by Dina[3] for amala powder prepared using different techniques. However, the fiber content (17.87%) was almost double (8.23 to 9.98%) while fat content (0.45%) was one fifth (2.36 to 2.96%). These may be due varietal difference. The fiber and ash content of EB was increased by 11.43% and 1.56%, respectively as compared to CB. The ash (1.17%) and carbohydrate (83.14%) content found slightly higher as compared to reported by Rajeswari[8] (i.e. 72.13% and 0.66%, respectively on 5% addition of amala powder) while protein content was found decreased (11.24%) then Rajeswari[8] (14.75%). Nutritional compositions of principle raw ingredients as well as commercial and developed breads are depicted in Table 3.

Conclusion

Acceptable quality bread by replacing maximum 2% Maida with APP could be prepared by the optimized formula and procedure. It contains 11.43% more fiber and 1.56% more minerals as compared to CB. Thus it may be useful in the dietary management of patient suffering from chronic diseases to replace the normal bread.

Future Scope

Like bread other bakery products such as biscuits, cookies, cakes and pastries could be modified to make it useful for life style diseases.

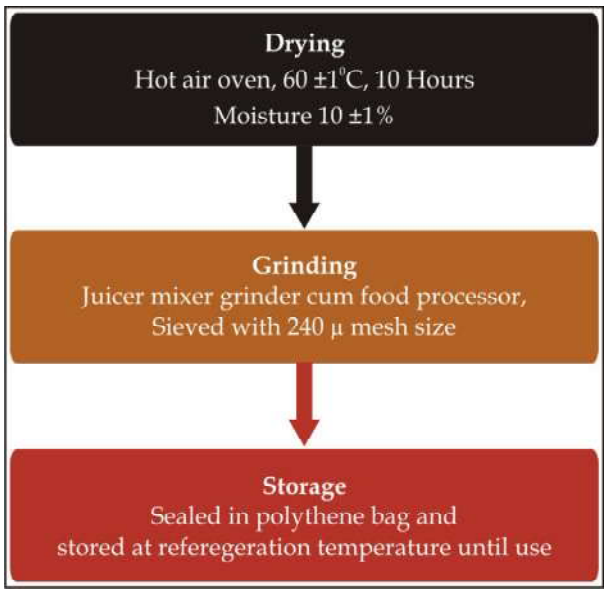

Fig. 1: Process Flow Chart of Amala pomace drying.

Table 1: Formula for control and amala pomace powder replaced breads.

Product/ Ingredients	Quantity (baker's percentage)	
	Control Bread (A)	APP Replaced Bread (C)
Flour	**100**	**98.0**
APP	**Nil**	**2.0**
Oil	2.0	2.0
Sugar (powdered)	**5.0**	**10.0**
Yeast (Dry)	**1.5**	**2.00**
Gluten	1.0	1.0
Salt	2.0	2.0
Water	64	68
Acetic acid	**0.04**	**0.06**

Processing conditions	Temperature	Time (Minute) / Use of
Weighing	RT	15
↓		
Kneading	RT	20, Spiral mixer
↓		
Scaling	RT	Cutter
↓		
Rounding	RT	Hand
↓		
Intermediate proofing	37^{0}C	10, Proover
↓		
Moulding and Panning	RT	5
↓		
Proofing	37^{0}C (C)	60, Proover
↓	45^{0}C (E)	55, Proover
Baking	205^{0}C	(C)20, Oven
↓	225^{0}C	(E)15, Oven
Cooling	RT	60, Cooling rack
↓		
Slicing and Packing	RT	5, Slicer

C = Control, E = Experimental

Fig. 2: Process flow chart for control and APP replaced bread.

Fig. 2a: Experimental bread

Table 2: Sensory score of control and amala pomace powder replaced bread.

Characteristic/ Produ	Volume 15	Crust character$ (5)	Shape and bake@ (10)	Crumb colour (10)	Texture and Grain (30)	Taste and aroma (20)	Overall acceptability (10)
Control	13.17^a ± 0.23	4.42^a ± 0.06	8.47^a ± 0.18	9.11^a ± 0.16	26.50^a ± 0.75	18.17^a ± 0.27	8.89^a ± 0.13
1% APP	10.83^b ± 0.74	3.49^b ± 0.22	7.08^b ± 0.48	6.97^c ± 0.46	21.75^b ± 1.48	14.72^b ± 0.95	7.22^c ± 0.47
1.5% APP	11.00^b ± 0.24	3.60^b ± 0.10	7.44^b ± 0.22	7.17^{b,c} ± 0.22	20.67^b ± 0.52	14.72^b ± 0.39	7.08^c ± 0.12
2% APP	11.75^b ± 0.22	3.74^b ± 0.08	7.65^b ± 0.26	6.83^b ± 0.12	20.83^a ± 0.56	16.06^b ± 0.24	8.00^b ± 0.09
2.5% APP	10.67^b ± 0.25	3.44^b ± 0.10	7.28^b ± 0.19	6.78^c ± 0.21	21.33^b ± 0.80	14.50^b ± 0.38	6.97^c ± 0.16
'F' Value	6.85**	10.22**	3.55*	12.95**	8.01**	9.05**	11.29**
CV%	14.55	14.09	15.98	14.76	16.41	13.93	13.39

APP = Amala Pomace Powder

Control = 100% Maida (Baker's %)

$ Crust character = Colour and nature of the crust

@ Shape and bake = Symmetry of shape and uniformity of bake.

All the replacements are based on baker's percentage.

Values are Mean ± SEM scores of a composite scoring test by a panel of 6 judges X 3 replications

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Values in parentheses indicate number of maximum score.

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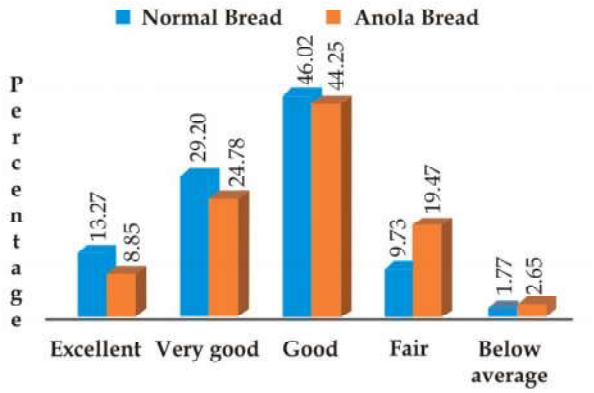

Chart 1: Consumer liking for control and experimental bread.

Table 3: Nutritional composition of control and experimental bread.

Nutrient	Maida	APP	Control Bread	Experimental Bread	% Change
Moister (g%)	13.12 ± 0.12	9.87 ± 0.22	36.36 ± 0.25	36.33 ± 0.36	-0.08 ± 0.00
Protein (g%)	11.28 ± 0.15	3.17 ± 0.01	11.37 ± 0.11	11.24 ± 0.19	-1.14 ± 0.01
Fat (g%)	1.57 ± 0.01	0.45 ± 0.00	3.81 ± 0.02	3.80 ± 0.02	-0.26 ± 0.00
Carbohydrate (g%)	85.39 ± 1.10	75.76 ± 1.12	83.13 ± 0.63	83.14 ± 1.16	0.01 ± 0.00
Calorie (K. Cal.)	400.82 ± 10.10	319.77 ± 8.18	494.96 ± 9.35	476.18 ± 24.00	-3.79 ± 0.00
Fiber (g%)	1.08 ± 0.10	17.87 ± 0.32	1.05 ± 0.01	1.17 ± 0.00	11.43 ± 0.15
Ash (g%)	0.68 ± 0.01	2.75 ± 0.02	0.64 ± 0.05	0.65 ± 0.01	1.56 ± 0.01

Control bread (0% APP)

Experimental bread (2% APP)

Values are Mean ±SEM of 3 replications

All the data except moisture is reported on dry weight bases.

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Review Article

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Quercetin: A Versatile Flavonoid Antioxidant

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Summery

Quercetin which belongs to the class flavonols, one of the five subclass of flavonoid compounds. Flavonoid observed in vegetables, fruits, tea, and wine. Quercetin is ubiquitously present in foods such as onions, berries, nuts, tea, cauliflower, and cabbage. Flavonoids occur in foods primarily as glycosides or aglyconesform which breaks down to various extents in thedigestive column. Quercetin is usually found in the in the glycoside form. Quercetin act as a potent antioxidant molecule and may exerts beneficial effects on its free radical scavenging function which prevent the formation of stabilized phenoxyl radicals. Quercetin plays important role in improvement of cancer disease, heart-related disease, diabetes, asthma and allergy and much more. Quercetin metabolism occurred in the small intestine, the kidney and the liver which sufficiently reduce plasma oxidant status. Quercetin and its compound based on the flavan nucleus and positions, numbers and type of substitutions affect radical scavenging activity.

Keyword: Aglyconesform; Quercetin; Antioxidant.

Introduction

The main sources of the production of free radicals are radiation process, the action of pesticides, pollution, and smoking. Free radicals are found in the normal metabolism and respiration process of the human body. These are very unstable molecules as it contains one electron and reacts easily with our body macromolecules such as protein, lipid, and nucleic acids. Each material consists of the atom which can be linked to form large molecules. Proton and electrons are responsible for the formation of one single atom. These single atoms are in search of the other atoms for the formation of molecules by donating or receiving electrons from other sources. Chemical structure of any material changed by donating an electron to another molecule by free radicals and affect the destruction of the cell. To neutralise the activity of free radicals in the material antioxidants are used. Antioxidants are chemicals which give their electron to the free radical and protect the cellular damage. Now a day, the risk of

cancer and heart disease spread quickly due to the action of free radicals. Control of these free radicals can be achieved by the use of natural antioxidant obtained from plant and vegetable sources such as quercetin (Baghel et al., 2012)

Free Radical forms

Free radicals formed with help of oxygen atoms and called reactive Oxygen Species (ROS) such as hydrogen peroxide, hydroxyl radical, superoxide ion and singular oxygen.

Superoxide Ion

Superoxide ionconsists of oxygen molecules with one or more electron. This is responsible for damage to brain and DNA. Superoxide ionsneutralise with the help of superoxide dismutase antioxidant.

Hydroxyl Radical

The main effect of hydroxyl radical on thedamage of DNA, protein, lipids and carbohydrate. Hydroxyl radical formed with reduction of oxygen molecules in the electron chain. These are very active with short life and react the molecules within the vicinity. Hydroxyl radical cannot be destroyed by the action of anenzyme, unlike the superoxide ion.

Singlet Oxygen

Oxidation of lipid is caused Singular oxygen and is available in our immune system.

Hydrogen Peroxide

Hydrogen peroxide is not a free radical but it is available in the production of many reactive oxygen species. Hydrogen peroxide is a byproduct of oxygen metabolism and is neutralized by peroxidases enzyme.

Reactive Nitrogen Species (RNS)

Unpaired electrons are found in the metals such as iron and copper and can act as free radicals. An example of reactive oxygen molecules is nitric acid. These free radicals can easily donate or accept the electron from another molecule.

Oxidative Damage:

Free radicals mainly attack damage of DNA and alter the DNA base structure. Lipids are easily attracting to the free radicals to form the oxidative damage which is also called lipid peroxidation. The main reason behind the outbreaks of cancer disease is mutation form due to the action of free radicals and DNA. Also. Free radicals are responsible for the Parkinson's, atherosclerosis and Alzheimer's disease (Kaneda et al., 2002).

Quercetin

In human body production of reactive oxygen species(ROS) and reactive nitrogen species (RNS) occurred that showed different physiological functions, such as muscle relaxation, xenobiotics mechanism, and the respiratory burst to kill invading micro-organisms (Moncada et al., 1991). Quercetin is a member of bioflavonoid family. Name came from latin word 'quercetum' which means 'oak forest', 'quercus oak'. Flavonoids are part of the natural substances and found in the vegetable, fruits, flowers, tea and wine (Middleton, 1998). Quercetin has the ability to produce the free radical scavenger activity and plays an important role in the control of diseases outbreaks (Valls-Pedret et al., 2012). However, there is a limitation for application of quercetin as free radical scavengers alone due to its low bioavailability and capacity to absorb phenolic compounds (Sharma et al., 2015). Even though, quercetin has the capacity to scavenge the free radicals directly and exert the antioxidant effect through several mechanisms. These mechanisms consist of development of endogenous antioxidant enzyme which helps to reduce the development of reactive nitrogen and oxygen species (Halder et al., 2008). Antioxidant mechanisms of the quercetin are mostly occurring in the mitochondrial part. For the production of superoxide anion free radical, the mitochondria aresuitable place and effective against oxidative stress (Han et al., 2001; De Olivera, et al. 2016).Due to the hydrophilic characteristics of quercetin i.e glycosides help to utilise in the gastrointestinal track by apassive mechanism (Griffiths, 1982). However, Hollman et el. (1995) reported that not only quercetin glucosides but also aglycone absorbed in the small intestine.

Structure and Properties of Quercetin

Quercetin is available in many of the food and consumed almost daily. It comes under flavonols group of flavonoids which have a common flavone nucleus consist of two benzene rings combine together with a heterocyclic pyrone (Fig. 1). The chemical formula of the quercetin is 3, 3, 4, 5, 7- pentahyroxyflavone and its structure is given below.

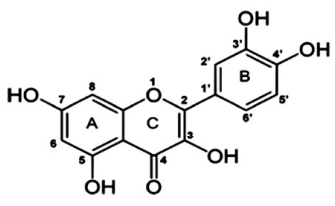

Fig. 1: Molecular structure of Quercetin.

Generally, quercetin available in the form of glycosides (sugar derivatives) such as rutin in which the hydrogen of the four hydroxyl atom is changed by disaccharide. Quercetin is also called aglycone or sugarless form of rutin. It is found in the yellow colour with crystalline solid and has abitter taste. Quercetin is soluble in glacial acetic acid and alkaline solution while insoluble in water. Animals are incapable to synthesis flavones nucleus as compared to that of the plant. Because of this reason quercetin is exclusively found in the vegetables and fruits (Lakhanpal & Rai, 2007).

Table 1: The functional properties of quercetin.

Density	1.799 g/cm3
Colour	Yellow
Boiling point	Sublimes
Melting point	316.5 0C
Solubility	In water: 60 mg/mL at 16 °C Very soluble in methanol, ether; Soluble in pyridine, ethanol, acetone.
Decomposition	During heatingit emits acrid smoke and irritating fumes.

(Source: National Library of Medicine, United States, 2009)

Quercetin Source

Quercetin is obtained from various vegetables and fruits sources includes, apricots, cauliflower, onions, grapes andchili peppers (Table 2). Quercetin is available in the form of glycosidic in the plant. The amplesttypes are rutin (quercetin-3-rutinoside), isoquercitrin, (quercetin-3-glucoside) and quercetin-3, 4-diglucoside. Olive oil, cherries, blue berries and clack berries are also anabundant source of quercetin (De Olivera et al., 2016).

Table 2: Quercetin sources from the plant and their contents.

Plant name	Common name	Tissue	Concentration (g/kg)	Reference
	Onion	Bulb	0.347	Hertog et al., (1992)
			0.221	Lombard et al., (2005)
Allium cepa	Patrik onion	Bulb	3.830	Caridi et al., (2007)
	Red onion	Bulb	0.307	Lombard et al., (2002)
Brassica oleracea	Broccoli		0.030	Hertog et al., (1992)
Brassica oleracea	Cauliflower	Vegetable	0.219	Miean and Mohamed (2001)
Brassica oleracea	Kale		0.110	Hertog et al. (1992)
Allium fistulosum	Welsh onion	Leaves	1.498	Miean and Mohamed, (2001)
Aloe barbadensis	Aloevera	Leaves	0.095	Sultana and Anwar, (2008)
Arontiamitschurinii	Chokeberry	Fruit	0.089	Häkkinen et al., (1999)
Calamus scipronum	Semambu	Leaves	1.188	Miean and Mohamed (2001)
Capsicum annuum	Red chili	Fruit	0.800	
Euphorbia helioscopia	-	Plant	3.570	Liu et al. (2011)
Euphorbia wallichii	-		1.460	Taskeen et al., (2009)
Ficus religiosa	Peepal	Fruit	0.256	Sultana and Anwar, (2008)
Helichrysum chionophyllum	-	Aerial parts	0.015	Albayrak et al., (2010)
Helichrysum compactum	Apple	Leafy	0.006	Suzgeç et al. (2005)
Malus pumila	Apple	Pomace	0.036	Hertog et al., (1992)
	Mango		0.067	Schieber et al., (2001)
Mangifera indica	Sohanjana	Fruit peel	0.469	Ribeiro et al., (2008)
Moringa oleifera	Mulberry	Leaves	0.281	Sultana and Anwar, (2008)
Morus alba	Bean	Fruit	0.359	
Phaseolus vulgaris	Apricot	Vegetable	0.039	Hertog et al., (1992)
Prunus armeniaca	Cherry (sweet)		0.322	Sultana and Anwar, (2008)
Prunus avium Hartland	Cherry (sour)	Fruit	0.028	Kim et al., (2005)
Prunus cerasus Schattenmorelle	Black currant		0.025	
Ribes nigrum ojebyn	Apple		0.044	Hakkinen et al., (1999)

Antioxidant Properties of quercetin

Quercetin is the potential flavonoids which prevent the human body from anattack of free radical such as reactive oxygen species (ROS) and reactive nitrogen species (RNS), developed in the normal respiration process. Quercetin acts as a potent antioxidant property due to its ability to capture free radicals by donating hydrogen atom. Lipid peroxidation is inhibited by use of quercetin. Lipid peroxidation processes in which the unsaturated fatty acids are converted to free radicals by adetachment of hydrogen (Young & MzEneny, 2001). Lipid peroxidation in the

body create the detrimental effects includes cardiovascular and neurodegenerative disease which can be prevented by the use of quercetin antioxidant. Inflammation can also control by scavenging free radical quercetin(Shoskes et al. 199). Furthermore, During the smoking process, most dangerous environmental cause free radical developed is scavenged by thequercetin and protect the body. Begum & Terao (2002) described that damage of erythrocytes during the smoking could protect by the quercetin and their metabolites. Quercetin prevents the development of oxidative stress by athlete's exercise.

Mechanism of action

Antioxidative action

Lipid peroxidation leading to the cell death by interfering the cellular mechanism in the body. To avoid this cell death and protect the body from theformation of reactive oxygen species there is aneed to developed antioxidant defence mechanism in the living organisms. This includes enzymatic and non-enzymatic antioxidants that control the outbreak of reactive oxygen species.The first defence mechanism by enzymes result into the neutralization of ROS and consist of superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase. The second defence mechanism is achieved by the development of free radical scavenging antioxidants such as quercetin which impede the oxidation process and retard the propagation phenomenon (Bahorun et al., 2006).

Direct radical scavenging action

In animal cells, thefree radical formation is common practice and development of free radical result into the outbreaks of many human diseases. Quercetin act as free radical scavengers and help to protect the tissue damage. Quercetin has the ability to scavenge the free radicals directly and inhibit the LDV oxidation process (Bhagel et al., 2012)

Nitric oxide syntheses inhibitory action

Reduction of ischemia-reperfusion injury in thehuman body is prevented by intake of quercetin. Quercetin has the potential to perform nitric oxide synthase activity which is responsible for the occurrence of . Different types of cells produced nitric oxide including endothelial cells and macrophages (Huk et al., 1998). Regular supply of blood to the bold vessel in human body depend on the production of nitric oxide by the nitric oxide synthase activity. The higher concentration of nitric oxide developed by inducible nitric oxide synthase in macrophages resultsin oxidative damage. This leads to the production of nitric oxide and free radical as superoxide anion. Nitric oxide reacts with free radicals and producing high damaging peroxynitrite. Peroxynitrite can directly oxidize LDL resulting into damage of cell. Quercetin prevents the action superoxide anion to the nitric oxide by scavenging and prevent the cell death (Van Acker et al., 1995).

Bioavailability of Quercetin

Bioavailability is the ratio between thequantity of quercetin orally ingested in the body and amount which is metabolised or absorbed in theintestine and then available for physiologic function (Jackson, 1997). Quercetin is entering in the diet in the form of glycoside conjugates. Direct absorption of glycoside in the body is not possible due to its high molecular weight and hydrophilic properties (Formica & Regelson, 1995). For the absorption of quercetin in the body, quercetin is hydrolysed to glycoside and available of the lipophilic aglycone. The effects on the bioavailability of quercetin glycoside are observed in the small intestine by hydrolysis of isoquercitrin, (quercetin-3-glucoside) and quercetin-3,4-diglucoside with intestinal ß-glucosidases enzyme (Reinboth et al., 2010). While unhydrolysed quercetin glycoside in the small intestine enters into the large intestine and hydrolyzed by gut microflora hydrolyses. However, rhamnosides, quercetin rutinosides, andgalactosidesare not effectively hydrolysed in the gastrointestinal tract. In the large intestine plenty of enterobacteria available for the hydrolysis of quercetin and their metabolites.The majority of the quercetin undergoes bacterial fission and only small portion of the quercetin are absorbed. (Graefe et al., 2001). The hydrolysed quercetin glycoside (aglycone) in the small intestine found soluble with the help of surrounding liquid and help to transfer into the enterocytes. These takes part into phase-II metabolism which includes methylation, sulfation, and glucuronidation (Day et al., 2000). In liver part, quercetin and its factionendure phase-I reaction. Quercetin undergoes different reactions such as hydrolysis, oxidation, and reduction and makes it suitable for phase-ii metabolism. Kidney removed the water-soluble metabolites of quercetin. Quercetin conjugated metabolites are passed in the serum albumin and circulate in the blood stream. In humans, quercetin-3-glucoside (isoquercitrin) and quercetin-4-diglucoside were absorbed rapidly after 1 hrs ingestion. In plasma, only quercetin glucuronides could be observed and showed antioxidant (Manach et al., 1998). Fiorani et al. (2010) worked on the effect of quercetin on the mitochondrialproperties of human lymphoblast cells. They found that quercetin accumulates in the mitochondrial cell at a concentration

of 35 mM when cells were treated at 50 µM quercetin for 10 min.

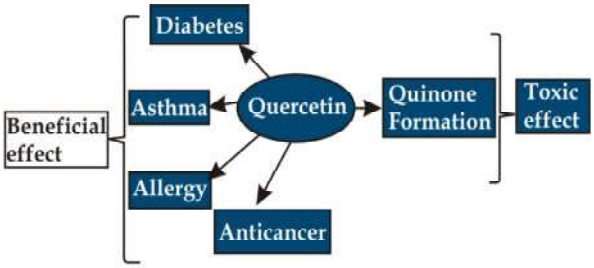

Fig. 2: **Beneficial and toxic effect of quercetin**

Allergies, fever, and hives

Quercetin has the capacity to stabilize the cell membrane and mast cell to inhibit the outbreak of histamine and other allergic metabolites which help in the fever and hives like allergies (Lombard, 2005). Environmental and emotional stress is controlled by mast cell and observed in different neuropathological processes. The neurodegenerative process caused by protease tryptase product of mast cell in thebrain. Like histamine, quercetin inhibits the growth of malignant cells and acts as anticancer properties. Quercetin blocks the metabolites produced in the allergies and ultimately reduce the production of tryptase, IL-6 and MCP-1 and histidine decarboxylase (HDC) from mast cell lines (ShaiK et al., 2006)

Anti-Cancer

Free radicals such as reactive oxygen species (ROS) and reactive nitrogen species (RNS) responsible for the outbreak of the cancer disease. ROS have been shown to be carcinogenic effect by causing damage to DNA and also altering cell signaling pathways and gene expression. It has been observed that 7-31 % of cancer could be reduced by consumption of fruits and vegetable in the daily diet (Muhammad et al., 2006). Quercetin consists of antioxidant property block the production of ROS and RON induces DNA damage and leading to mutational changes. Caltagirone et al. (2000) studied therelationship between quercetin intake and incidence of lung cancer. They found that quercetin inhibits the growth of melanoma cell. Quercetin also having the capacity to inhibit the protein kinases which is responsible for cell growth in cancer (Russo et al., 2014). Reiter et al. (2009) worked on antioxidant effects of quercetin and coenzyme in mini organ cultures of human nasal mucosa cells. They described damage of nucleic acid (DNA) due to the oxidative stress is a risk factor for neck and head cancer. Quercetin available in the red wine and tea play a significant role to prevent the formation of oxidative stress by reactive oxygen species (ROS). Quercetin concentration 5 µM and 50µM found best after 24 h incubation for the control of human nasal mucosa cancer.Effective action of quercetin mostly observed in the lung, brain, blood and salivary gland cancer. Quercetin effect on the melanoma of having high cytotoxic activity and observed higher in aggressive cells than those of slow growing cells (Sak, 2014).

Diabetes:

Jeong et al. (2012) worked on theeffect of antioxidant, hypoglycemic and hypolipidemic properties quercetin on the melitus (type 2 diabetes) in animal tissue. Diet was prepared with 0.04% quercetin and fed for 6 weeks to the animals. Insulin, plasma glucose, adiponectin, lipid, and lipid peroxidation of the liver were investigated. Plasma levels reduced in the diet fed with quercetin than that of thecontrol group. Also, 0.08 % quercetin increased in plasma adiponectin, decreased plasma cholesterol. Formation of diabetic cataracts due to the conversion of glucose to sorbitol in the eye by aldose reductase enzyme. It has been reported that quercetin has the ability to inhibit aldose reductase and efficiently prevent polyol accumulation in rat lenses (Lai et al., 2012). Quercetin prevents the diabetic action by uptake of glucose through insulin process which consists of monophosphate-activated protein kinase leads to the glucose replacement to the plasma membrane (Eid et al., 2015).

Asthma:

Many researchers reported that worked on the relationship between quercetin intake and its effect on asthma (Knekt et al., 2002).Hirano et al. (2009) studied the effect of an enzymatically altered isoquercitrinon allergic symptoms. They reported that feeding of isoquercitrinon at the rate of 100-00 mg/day for eight weeks showed relief of ocular symptoms but not significantly relief of nasal symptoms caused by pollen.

Toxic effect:

In vitro study revealed that quercetin has agenotoxic effect. In bacterial cell mutagenic effect of quercetin mostly observed and are suggested to form quinone formation as mediators (Silva et al., 2000). Quercetin has the capacity to induce DNA and subsequent mutation in theanimal cell. In contrast, intake of quercetin in mice or rats with aorta restriction could protect against DNA damage.This help to protect against the development of lung cancer and to attenuate cardiac hypertrophy (Jin et al., 2006)

Conclusion

Quercetin has the potential to act as powerful antioxidant activities.Quercetin could be effective against several chronic diseases. Quercetin has versatile biological effects which include health benefit, the growth of physical and mental activity, and other physiological functions. Bioavailability of quercetin and its metabolites is essential to understand theeffect on the metabolism and help to prevent the outbreak of various diseases. In vitro experiments by the use of cell culture and in vivo trial in the animal model were showed that quercetin could be effective in thetreatment of various types cancer, asthma, diabetes and allergies.

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A Review: Emotions Modulations and Loss of Control eating in Individual Obesity

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Abstract

It is the effect to over eat in response to change or modulations in emotions. People who are prone to emotional eating reach to food several times with slight emotions modulations also. They feel uncomfortable with this eating time and again due to modulations in emotion which lead to several hormonal changes and leads to weight gain, means that when a set of people eat a lot during emotion modulations are actually eating to cope up with the negative emotions, but that eating is not at all beneficial to their body and in turn results in low metabolism which leads to weight gain. Mostly negative emotions is assumed to create void that results in excessive eating.

Keyword: Binge Eating; Emotions; Eating Disorder; Emotional Distress; Emotional Eating; Emotion Modulation.

Introduction

It is been observed that negative emotions may lead to a feeling of emptiness or an emotional void. These people may even feel awkward or feel a sense of shame due to continuous eating that leads to excessive weight gain.[1-2] Negative emotions are the reasons of this continuous eating which is assumed to fill up the void with continuous eating. Finding comfort in food is common and is part of practice called emotional eating. There are many reasons resulting to emotional eating it could be work stress, financial issues, health issues, relationship struggles etc, affecting both the category of sexes and is more dominant in female category.[3]

Literature Review

Emotions Modulation

The study of emotion modulation is recently now a topic of research in which a great variety of physiological disciplines are involved. It is crucial to understand some aspects that emotions have. Gross characterizes an emotion process as a series of casually cascaded events. that occurs with a stipulated interval of time. An event or situation produces a divergence in the attention focus of a particular

subject developing in several emotions. Finally the emotions causes causal behavioral, experiential and physiological responses.[4, 19]

Negative emotions is described as any feeling that causes us to be miserable, confused, depressed and sad. These negative emotions make you dislike yourself and others, also it makes us feel negative entirely and because of this negative emotions we tend to percept each and everything in a negative way, reducing your confidence and self-esteem, and general life satisfaction. These negative emotions are situational based that creates void within self and the void is filled up with calories intake.[20] Emotions are complex reactions involves many biological and physiological processes within our bodies. Our brain responds to our thoughts by releasing hormones and chemicals, which send us into a state of arousal. All emotions come about in this way, whether positive or negative.[4, 20]

Emotional Eating

Emotional eating includes eating in response to any emotion, whether that be positive or negative. Most frequently, people refer to emotional eating as "eating to cope with negative emotions". In these situations, emotional eating can be considered a form of abnormal eating and is defined as "an increase in food intake in response to negative emotions" and can be considered a maladaptive strategy.[21] More specifically, emotional eating in order to relieve negative emotions would qualify as a form of emotion-focused coping, which attempts to minimize, regulate, and prevent emotional stress. Research shows that emotional eating does not reduces stress but in fact it builds up a feeling of shame after excessive eating.[5] Those who are having a habit of eating to cope up with negative emotions are more likely to develop or are at a high of developing binge eating disorder.[22]

Most people experience emotional eating during many times a day , for example it could be eating just to mingle with friends even though you are not hungry, it could be eating chips because you are feeling bored or else eating a big bar of chocolate after a stress out day. If Emotional eating happens frequently or becomes the sole reason a person is dealing with emotion then their life, heath, happiness and weight can be negatively be affected.[6]

Contributing factors to emotional Eating

Effect of Negative Emotions

High levels of the negative affect trait are related to emotional eating. Negativity is a personality trait, involving negative emotions and poor self concept. Negative emotions include anger, sadness, guilt, depression, anxiety and nervousness. It has been found that certain negative affect regulation scales predicts emotional eating.[5] An individual not able to express and identify one's emotions makes him feel inadequate and uncomfortable to cope up with regulating negative effect and are more likely to engage in emotional eating . Further scientific studies regarding the relationship between negative affect and eating find that, after experiencing a stressful event, food consumption or calories intake is associated with reduced feelings of negative affect (i.e. feeling less depressed or sad) for those suffering from high levels of stress. This relationship between eating and feeling better suggests a self-satisfying cyclical pattern between high levels of stress and consumption of high calories foods as a mechanism to cope up with high level of stress resulting in negative emotions.[6]

Pattern Since childhood

For some people emotional eating is learned or habituated since childhood. Parents out of extreme love and emotions feed child time and again even when the body requirement is not there and from then child is habituated to eat time and again and that is continued till he is grown up. Even in many cases parents make a pattern to feed child with all junk food at time of occasions for example if a child scores well in examinations parents emotionally gives child a treat again in the form some calories (Junk food) or in some cases just to make child quite when he is crying or to make him feel pleasant in even of sadness or depression that emotional void is filled up with food . Actually it is assumed that food intake is an option in both positive and negative emotions since childhood. So parenting is also one of the major factors causing emotional eating and is continued till end leading in weight gain.[7]

Correlation between Emotional eating and Related Disorder

Emotional eating is assumed as a means to cope with emotions may be a reason to developing eating disorders such as binge eating or bulimia nervosa (It is a life threatening eating disorder). The relationship between emotional eating and other disorders is largely due to the fact that both emotional eating and these disorders share key characteristics. More specifically, they are both are focusing to cope up with emotions, not adjusting with natural strategies of coping up with stress, and a strong dislike to negative feelings. It is important to note that the causes which leads direction to emotional eating has not been definitively established. The latter hypothesis shows that emotional eating happens in response to another eating disorder which shows that emotional eating to

be more common among individuals already suffering from bulimia nervosa. It is also shown that hormonal changes due to the changes in emotions produces chemical changes in mind leading to binge eating and to different disorders in which one is bulimia nervosa.[21] Bulimia Nervosa is physiological disorder in which a person experiences episodes of binge eating and if it is related with emotions modulations together will cause worst consequences.[5]

Biological and environmental factors influencing Emotional Eating

Stress is the main influential factors affecting the type of food intake.[8] Many of the studies and research shows that emotional and physical distress increases the food intake that are high in calories, sugar, fats. It is been studied that when fats and sugars are ingested inside the body it supresses the stress related responses and emotions and theses high fats and sugar food releases dopamine and opioid (a chemical which evolves pleasure) that supresses the effect of negative emotions.[9] It is studied that these foods are comfort foods and it is assumed that these foods high in fats and sugar counteracts stress. But the studies done on rat shows that these foods high in fats and sugar when intermittently accessed will release opioid which can become neurologically addictive, hence we can see many people in event of emotion modulations are craving for sweet or some junk foods.[9] Few examples from American diet includes food such as pizzas, burgers, French fries, sausages, pastries etc. The most common food craving preference are from decreasing order from sweet energy dense food, non-sweet energy dense food, fruits and vegetables.[10]

Different people response in different way in response to stress, it is individual based reaction and personal differences in physiological reactivity. If we compare both the sexes women's are more prone to emotional eating then men in coping up with emotional mechanism for stress.[11]

In one study women's were exposed to an hour long social stress and a neutral to go condition. These women's were exposed to each condition on different days and after the task got completed women's were invited to a buffet which includes both heathy and unhealthy snacks. Women with high chronic stress consumed more calories rich in fats and sugars in the form of chocolate cake, than women with low level of chronic stress.[12]

(Cortisol, the primary stress hormone, increases sugars (glucose) in the bloodstream, enhances your brain's use of glucose and increases the availability of substances that repair tissues)

High cortisol levels, combined with high insulin levels, may be responsible for stress induced eating, as research shows that high cortisol reactivity is associated with hyperplasia, it is an abnormally increased appetite for food, during stress. Furthermore, since glucocorticoids trigger hunger and specifically increase one's appetite for high fat and high-sugar foods, those whose adrenal glands naturally secrete larger quantities of glucocorticoids in response to a stressor are more inclined toward hyperplasia.[13]

Macht (2008)[14] described a five-way model to explain the reason behind stressful eating: (1) Emotional control of food choice, (2) Emotional suppression of food intake, (3) Impairment of cognitive eating controls (attempting to restrict intake as a means of weight regulation) (4) Eating to regulate emotions, and (5) Emotion-congruent modulation of eating. These break down into subgroups of: Coping, reward enhancement, social and conformity motive. Thus, providing an individual with are stronger understanding of personal emotional eating.

Effect of emotional Eating on Positive Emotions

Geliebter and Aversa (2003) conducted a study comparing individuals of three weight groups: underweight, normal weight and overweight. Both positive and negative emotions were taken into account. When individuals were experiencing positive emotional states or situations, the underweight group were reported eating more than the other two groups.[15]

It is seen that underweight people eat less and eat even less during the time of stress. It is also been studied that people in positive emotional stress indulge themselves more in food then people in negative emotional stress. Research have also shown that people during negative emotions eat more than the requirement with their ongoing negative thought process and don't even realize it , which are more to be seen now in pandemic situation resulting in weight gain.[15]

Impact of Emotional Eating on Health

Emotional eating is qualified as one of the way of coping up with chronic level of stress. [16] In Coping methods of negative emotions there are many categories but emotional eating comes under a category where it gives partial or time being suppression to stress and does not give sustainable solutions in fact it leads into negative impact on health.[5]

Additionally due to the consumption of foods rich in fats and sugar levels as a solution to the recovery of stress it triggers the secretion of glucocorticoids creates the enzymes that stores away the nutrients circulating in the bloodstream after an episode of the

emotional eating which will locate fats in the abdominal area .Therefore, those who struggle with emotional eating are at greater risk for abdominal obesity, leading to a greater risk for metabolic and cardiovascular disease.[5]

Discussion

Measures to combat with Emotional Eating

There are many ways in which individual can cope up with emotional distress without engaging in emotional eating. The most basic thing is to minimize unnatural things and to maximize natural strategies to balance with emotional distress. A study conducted by Corstorphine et al. in 2007 investigated the relationship between distress tolerances and disordered eating. These researchers specifically focused on how different coping strategies impact distress tolerance and disordered eating. They found that individuals who engage in disordered eating mostly try to avoid facing negative emotions rather are more focused on just supressing the emotions for instant. If the individual faces negative emotions strongly they choose to avoid overeating by engaging themselves in different activities (playing, listening music, being with friends etc.) which balances their distress. The most obvious way to limit emotional avoidance is to confront the issue through techniques like problem solving. Corstorphine et al. showed that individuals who engaged in problem solving strategies boosts one's ability to tolerate emotional distress. Since emotional distress is correlated to emotional eating, the ability to better manage one's negative affect should allow an individual to cope with a situation without resorting to overeating.[17]

Mindfulness techniques is one way to combat emotional eating. An individual can judge himself weather the craving for eating is actually hunger or due to emotional distress, because emotional distress trigger spontaneous cravings for foods rich in fats and sugar and can avoid overeating.[18] An individual can take time to note his/her bodily sensations hunger pangs, and coinciding emotions, like guilt or shame, in order to make conscious decisions to avoid emotional eating. Emotional eating can also be improved by evaluating physical facets like hormone balance. Female hormones, in particular, can alter cravings and even self-perception of one's body. Additionally, emotional eating can be exacerbated by social pressure to be thin. The focus on thinness and dieting in our culture can make young girls, especially, vulnerable to falling into food restriction and subsequent emotional eating behaviour.[19]

Emotional eating disorder predisposes individuals to more serious eating disorders and physiological complications. Therefore, combatting disordered eating before such progression takes place has become the focus of many clinical psychologists.

Conclusion

It has been seen that Emotions modulation are the basic reason of binge eating, many theories have also shown the way to combat with these emotion modulations and in general emotion eating but the main reason of concern is

- How to overcome this pattern of habituated eating in case of instantaneous emotion modulation both positive and negative.
- How to make people to imply the other methods to combat emotional eating.

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The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Materials, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 keywords.

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State the background of the study and purpose of the study and summarize the rationale for the study or observation.

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The methods section should include only information that was available at the time the plan or protocol for the study was written such as study approach, design, type of sample, sample size, sampling technique, setting of the study, description of data collection tools and methods; all information obtained during the conduct of the study belongs in the Results section.

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Include summary of key findings (primary outcome measures, secondary outcome measures, results as they relate to a prior hypothesis); Strengths and limitations of the study (study question, study design, data collection, analysis and interpretation); Interpretation and implications in the context of the totality of evidence (is there a systematic review to refer to, if not, could one be reasonably done here and now?, What this study adds to the available evidence, effects on patient care and health policy, possible mechanisms)? Controversies raised by this study; and Future research directions (for this particular research collaboration, underlying mechanisms, clinical research). Do not repeat in detail data or other material given in the Introduction or the Results section.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O,

Guidelines for Authors

Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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