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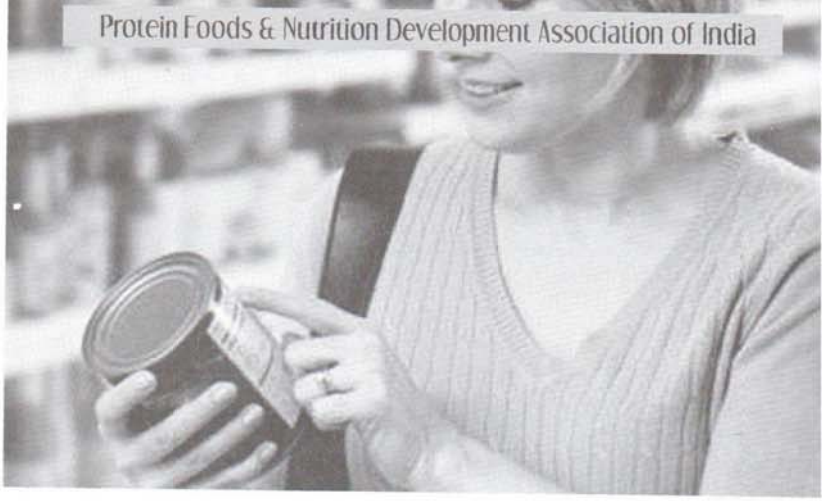
Editorial



FSSAI recently notified labelling and claims regulations. It is becoming very difficult to follow the mind of regulators when so many notifications and advisories come adding to the confusion that is already existing about Indian food laws. Although ours is not the worst place for this problems but we do not have to compete with those countries.

Labelling regulations were notified just a year and half ago and people are just getting used to them and suddenly we have some changes.

Regulators should realise that if they want all the stakeholders to follow the law of the land then rules and regulations should be clear with very little ambiguity. We have a pretty good act namely Food Safety & Standards Act 2006 but even after seven years we have not been able to get rules and regulations that could be understood adequately by food safety officers, food business operators and at times even the officers of regulators.

Every conference, symposium and workshop gets a lot of delegates if the theme is concerning food regulations. There are many questions asked regarding the interpretation of the regulations and not satisfactory answers come out showing that confusion still remains.

The Act has allowed the manufacture of many functional foods and nutraceuticals and foods for special dietary uses but we are still to make rules and regulations regarding that and consequently many products are marketed which are approved on ad hoc basis.

This uncertainty is not healthy for the industry as many opportunities remain without being realised. We hope that the Authority realises the importance of this and moves much faster in notifying regulations.

Since this group allows many ingredients having biological activity and safety of which needs to be properly evaluated both by developers as well as regulators so that safe and effective food products may be available to consumers. When regulations are clear, the system of evaluation becomes straight forward and effective.

Our notification system also needs to be better. We keep on notifying amendments or changes in such a manner that one needs to read all the amendments and the earlier notifications if any. If any is missed out then there is likely to be a misinterpretation.

In other countries the latest regulations are uploaded on the website which will give only one set of rules and regulations with all the amendments incorporated within it. So a person does not have to read all the separate notifications. We have the older rules as well as newer notifications. It then becomes necessary to depend on private publications which give the latest version of the regulations. However, if there are printing errors here the authority will not take responsibility.

We hope that a better system prevails and the confusion is removed so we get safe food which will not only provide the nutrients but also the functional foods will help us reduce the risk of many of the diseases so we remain healthy.

With greetings,

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Reducing Salt from Food Products

(Prepared from condensed articles Un-Salting the Salty Snack by Donna Berry Food Product Design July 2012 and Sodium Shakeout: Savoury with Less Salt by Kimberly Decker Food Product Design June 2007)

Major pleasure of salty snacks is the taste of salt. Human body need good amounts of sodium but when they consume excessive amounts, it contributes to hypertension, heart disease and many other diseases. Centre for Disease.

Control (CDC) USA identified snack foods like potato chips, pretzels and popcorn responsible for 44% sodium intake. It also stated that if manufacturers of these snack foods reduced their sodium content by 25%, it would help prevent an estimated 28,000 deaths per year from sodium-induced hypertension, a major risk factor for heart disease and stroke in the US. Manufacturers of snack foods have felt pressure to reduce the salt contents but it is not so easy as salt is a crucial ingredient in many foods wherein it influences safety, quality and integrity besides affecting flavour.

According to well-known radiologist Harsh Mahajan, India will have more than 4.77 million deaths a year due to cardiovascular disease (CVD) and 2.58 million deaths due to coronary heart diseases (CHD) by 2020. China, which has the world's largest population at 1.34 billion, will have 4.53 million deaths due to CVD and 1.37 million due to CHD by 2020. The figures are from the Global Burden of Diseases Study conducted by WHO.

National Nutrition Monitoring Bureau data of NIN reported that salt consumption in different states ranges from less than 5 up to 30 g while almost 40% of families consumed about 10g salt per day. In warm weather conditions, there is loss of sodium through perspiration so the requirements of sodium may increase. However, considering high incidence of hypertension and cardiovascular disease in India, it is advisable to reduce sodium intake through salt.

Salt & Health

American Medical Association (AMA) issued statement in 2006 taking food industry to task for “their current practice of adding unhealthy amounts of sodium to their products.” It also outlined remedies including halving the sodium in foodservice and processed foods over the next decade, increasing awareness to consumers about the benefits of moderate sodium reduction, and clarifying labelling of sodium with warnings added to saline offenders.

With 65 million American adults suffering from hypertension, which is linked to cardiovascular disease, stroke and other conditions, high cost of healthcare warrants taking serious consideration. American Heart Association (AHA) and US Dietary Guidelines are recommending consumption of no more than 2,300 mg salt (about 1 teaspoon) per day, with groups at risk African Americans, middle-aged and elderly and those with hypertension should consume even than 1,500mg.

Average American consumes about 6 to 10 g of salt per day as per AHA equivalent to 2,900 to 4,300 mg sodium. According to National Heart, Lung & Blood Institute (NHLBI), USA, there is a clear causal link between sodium intake and blood pressure. Other factors affecting blood pressure are insufficient intake of Ca, Mg and K and overall health. NHLBI cites trials and large scale population studies showing that lowering Na intake by 100 mmol (about 2,300 mg) per day is associated with reduction of 3 to 6 mm Hg systolic blood pressure. This would lead to 11% fewer strokes, 7% fewer coronary events and 5% fewer deaths.

Unfortunately, such reductions are beyond reality. Centre for Science in the Public Interest (CSPI) state that 77% sodium comes through processed and restaurant foods, with only 5%, 6% and 12% coming from cooking, table use and natural sources, respectively.

These numbers not only make industry uncomfortable, consumers are simply surprised as they are relatively untrained in label reading. They may not understand that MSG, sodium benzoate, disodium phosphate or even baking powder and soda as sodium sources. Among those who recognise deli meats, salty snacks, condiments and TV dinners as sources of

significant salt, few would suspect common foods like artisan bread, cheese and buttermilk of the same offense. Thus the need to cut salt will be a global one with people from more countries start consuming foods containing more salt.

In Salute to Salt

Salt or sodium is not all bad. When someone suffers a heart attach the first thing they do is hook the patient to saline solution. There are studies stating sodium should be reduced and there are others that state that sodium is good for you. Sodium problem has always been controversial.

There are studies showing that high sodium leads to cardiovascular health issues but there are also studies showing that low-sodium diets actually increases risk of cardiovascular issues than for regular diets.

Critical consensus seems that if you are sensitive to sodium or you have certain risk factors associated with coronary heart, sodium just adds to the problem. For most of us, reading nutrition label might be more prudent.

Human body requires sodium and chlorine to live. With proper electrolytic balance of sodium in blood serum and potassium in cells, we keep healthy. Solution to health cannot focus on elimination or decrease of any one component totally. Answer lies in living a balanced lifestyle and eating a variety of foods.

A characterizing ingredient Reducing sodium in salty snacks is challenging as it is the focal point of the product, salt being their characterising ingredient. It is like trying to make chocolate without cocoa. Salty snacks have constant presence, when you grab a bag of on-the-go snack, a sandwich accompaniment or a convenient carrier for dips and appetizers at social gatherings. Research shows that most consumers snack each day and frequency of snacking especially on salty ones is growing. Thus it is necessary to target them for sodium reduction.

All in Good Taste

There is a reason for excess salt intake. It just tastes so good. Salty is one of the fundamental tastes. It tremendously enhances taste of many other foods. Animals probably like the taste as nature has created this liking as all living organisms need sodium to maintain ionic balance within their bodies.

Early humans were more inclined to consume sodium along with associated nutrients. These nutrients let to better health, leading to preferential survival, leading to increased reproductive success and probably ages later out salt-seeking nature remained an artefact of that natural selection process.

One of a Kind

Salt is complicated in how it tastes in our mouths. There is an upfront salty burst, followed by mouthfeel or fullness, finished off by other attributes around salt. Full-salt products have a fairly rounded taste to them and after initial burst the salty sensation lasts a long but pleasant time. It is difficult to replace salt with a single ingredient because no other ingredient does it all singly.

Salt can potentiate sweetness. At higher sugar levels say around 30%, salt at 0.2% can replace 2% sugar. Salt has an ability to improve the perception of flavour in many foods. It makes fresh tomato taste even better. It offsets to some extent acid taste of tomato and sweetens it. Grapefruit tastes sweeter with a little salt. Formulators wanting to reduce salt have a formidable task of amplifying and balancing flavours.

Salt is also a salivation agent so it is used in snacks as appetisers to trigger appetite for main course. It also has effect on texture and mouthfeel and it provides solid, so in a low-sodium formulation one has to replace it with something without losing mouthfeel and texture.

Generally sodium in snacks is about 180 to 210mg per serving. Manufacturers want to reduce sodium in their foods to such extent that they can make a claim. “Reduced sodium” claim should have 25% less sodium than standard and for “low sodium” claimfood must contain 140mg or less sodium per serving (US FDA).

Sometimes it is better not to state lower sodium content on front-of-label packaging as many consumers immediately associate less sodium with poor taste. From the Nutrition Facts they would be pleasantly surprised to notice reduced sodium.

Tough Customers

Salt’s texture will be most glaringly missed in application where it is applied as topical seasoning: pretzels, crackers, nut mixes and chips where first component to hit tongue is the outside salt. A suitable substitute would have to undergo same immediate dissolution while activating salivation.

Seasoning on a snack is dosed at a certain rate to get even distribution and commonly it is added at 3 to 8%. A big proportion of that is salt, so when one replaces salt other bulking ingredient needs to be used.

There are many applications where salt performs functional role other than taste e.g. in processed meats, cheeses and doughs where it helps control microbes. Replacing or reducing salt here proves quite difficult as levels can only be lowered to certain minimum threshold or use other functional ingredients.

Formulators are aware of many functions of salt in snack foods such as taste, performance and even aesthetics. Sodium provides flavour enhancement, mouthfeel sensation and development of overall flavour profile in snack foods. Granulation allows when flavours are sensed in mouth; with more granular salt, flavours develop slowly while finer granulation will make flavour hit quicker and up front. Reducing sodium requires other flavour components to be stronger.

Replacing or eliminating sodium will alter texture, taste and flavour balance. There is no single solution to sodium reduction in snack foods. In many snacks, salt is on the surface which delivers initial salt hit against saltiness being carried through the whole eating experience. In developing strategy for replacing sodium in snacks, the most important factor is delivering high, characteristic initial impact leaving consumer wanting more.

Up-front flavour

The most common approach of delivering initial salty impact with less sodium involves substitution of potassium chloride for some sodium chloride. Although it has salty characteristic, potassium salt has metallic or bitter off-notes.

One patented technology minimises metallic notes providing similar perception of sodium chloride. This is based on altering crystal structure of potassium chloride to give more surface area to enhance salty intensity, which also reduces metallic and bitter aspects of potassium chloride. It allows for one-to-one replacement facilitating up to 50% reduction of sodium chloride.

Another approach is different granulation of salt. Finer particles with more salty taste allow salt reduction. Using combination of different granulation sizes gives greater flavour perception.

Working in umami

Formulating with potassium chloride is facilitated by use of umami-type flavour enhancers. Salty salts tend to be savoury and not sweet and umami enhancers complement savoury flavour profiles. Reducing sodium reduces overall mouthfeel sensation of the snack. Using umami enhancers help boost its profile giving the feeling of snack having more flavour and hence more satisfying.

Umami enhancers boost the underlying flavour without adding flavour of their own. They are quite effective in increasing salty perception and have the benefit of masking off-flavours of sodium replacers. Use of umami allows maintain and even increase flavour intensity of salty snack keeping sodium significantly lower, with typical sodium reduction of 30 to 50% with equal flavour preference of full-salt version.

New natural flavour enhancers have been produced through fermentation technology that are great source of umami-rich amino acids. They are neutral in colour and flavour and work well with salt replacers helping mask any off-flavour notes. They are labelled as soy sauce or natural flavour enhancer and are part of topically applied seasoning.

Out with the Old, In with the New Some of the older replacers had flaws e.g. potassium chloride gave undesirable off taste and bitterness. Other savoury enhancers were hydrolysed vegetable proteins (HVP) and autolysed yeast extract (AYE) have worked to some extent. However, these were rejected by consumers.

One new area is Umami which has shown some promise especially in savoury flavour where salt is reduced. Umami stimulants like amino acids glutamate and aspartic acid, MSG and ribonucleotides inosinate and guanylate attach to taste buds turning the savoury receptor on. It also in the process increases the saltiness of food. This has been exploited in fermented products like soy sauce, miso paste, fish sauce and even cheese. Fermentation of proteins in these liberates umami character due to glutamate and aspartic acid, making them enhance flavours. Even mushrooms and red ripe tomatoes have similar umami flavour.

Some of the umami boosters themselves like soy sauce, miso and other fermentation products contribute sodium. However, there are low-sodium versions available and a little of these ingredients goes a long way ultimately cutting total sodium. However these are not ultimate solutions. At present about 50% salt can be reduced by replacing with KCl and a variety of savoury enhancers and products can be quite acceptable.

Another proprietary umami-type flavour enhancer using fermentation is based on whole milk. This powdered ingredient can lower sodium contents by 25 to 50% in salty snacks boosting salt perception, savoury nuances with umami-effects. It uses maltodextrin or non-fat dry milk as carrier and does not contain MSG, hydrolysed vegetable protein or yeast extract which appeals to many label-reading consumers. Sensory panels have described snacks using this enhancer as more wholesome and balanced. Although rich in potassium, it has no potassium chloride so no metallic notes.

Yeast extracts are another option of umami effect. Yeast extract are high in sodium but are beneficial when used in smaller quantities. They deliver background and fullness to a flavour profile. Use of strong herbs or spices can lead the consumer away from a sodium reduction focus to a flavour focus.

A multi-ingredient approach

Often multiple ingredients are needed to lower sodium contents and simulate taste and flavour of salty snack. Common flavour in salty snack is cheese in which use of various dairy ingredients may work. Saltiness is inherent in cheese wherein to maintain cheese profile consideration of flavours, acids and enhancers is needed. Using creativity in mimicking mouthwatering sensation of salty cheese involves use of whey permeate coupled with acids like citric and lactic.

Acids deliver impact while supporting other flavours in seasoning. Citric acid adds sharpness to cheddar flavour and sour notes of lactic enhance taste of dairy ingredients like cheese, sour cream and yoghurt. Flavour ingredients can help provide initial flavour impact in low-sodium products such as using cheese flavour to improve the liking of sodium-reduced crackers and chips. Flavours also add ‘craveability’ to low-sodium product and add nuances of salty ingredients like Parmesan, without adding sodium itself. Cream flavour can be added in milder applications to boost overall profile.

Another ingredient that contributes dairy flavours particularly cheesy notes is enzyme-modified cheese (EMC). This is basically cheese curd treated with enzyme to produce concentrated cheese flavour ingredient. In the process, cheese curd is blended with other sources of fat and protein with water and emulsifiers forming a paste. This paste is pasteurised to inactivate microbes and enzymes. Then a blend of enzymes is added including proteases, peptidases and

lipases sometimes with some organisms. After incubation for a few days heat treatment stops further action of microbes and enzymes. EMC has about 15 to 30 times flavour intensity of natural cheeses. Their use allows lower total sodium in final product.

For most snack foods, sodium from leavening agents is minor problem but in baked snacks it should be considered. Baked potato chips use leavening containing sodium-based baking powder with sodium acid pyrophosphate. There is a patented slow-acting, calcium-based leavening agent (mixture of calcium acid pyrophosphate and mono-calcium phosphate) that has been successfully formulated into several baked potato chip and leavened snack products to reduce overall sodium content.

Substituting with Systems

A systems approach may be needed to nutritional reformulation when it comes to salt-replacement ingredients. Each application needs salt reduction and flavour enhancement products to be designed considering commercial appeal to consumer that wants low-sodium products to taste like full-sodium.

When a sensory profile on full salt product and compare that of salt-reduced product, shortfalls of reducing salt could be identified, so every single attribute could be addressed in order to balance. For example, classic chicken soup will have certain saltiness profile and also a certain mouthfeel. One must have poultry-type meatiness and characteristics of fatty notes, both of which are potentiated by salt. It gives texture triggering salivation that fits nicely into fatty profile as well. So if 50% salt is reduced, one could replace with potassium chloride which only partly restores salivation. It now has more red meaty character instead of white meat profile. Also volatiles of flavours are suppressed, so aroma is not as good.

It would be satisfactory to account for the full complexity of target profile rather than just saltiness. Potassium chloride can play a part in that system but umami stimulants from yeast extract or nucleotides must be examined. In some cases you may get compromise. Overall profile may be obtained, mouthfeel may be almost there, but you may not get saltiness of full-salt product. As long as you are on part with full-salt product in terms of overall consumer acceptance, they you have a superior product to that which has just been reduced in salt.

Making it Work

Everyone from flavour houses to dairy processor to salt suppliers is proposing new ingredient systems for salt reduction. General trend toward healthful formulation gave some flavourists experience with vitamins, nutraceuticals and other ingredients notorious for off flavours. They have designed a technology that uses benefits of potassium chloride while eliminating the undesirable notes. It clips bitter and metallic tones while building in sweetness and acidity that enhances the whole profile making reduced salt version taste like full-salt product.

Another team uses whey proteins in low-sodium formulation that contains relatively low levels of sodium about 3% but has very salty perception. This enhances salt flavours that are already in food system without introducing bitterness of potassium chloride. It can be labelled natural flavour, contains milk. It can be used in wide variety of food applications. Being liquid it not suited for topical applications but dips, dressings, sauces, soups and baked goods are all good candidates.

Low sodium salts may be blends of salt with other ingredients, less-pure forms of salt, or low-bulk density salts that yield lower sodium levels. One product, a 50% lower sodium blend with equal parts of sodium and potassium chloride has improved taste modifier technology to mask objectionable bitter aftertaste. Rather than a blend of powders and crystals that lead to stratification, it is a homogeneous crystalline product that looks, behaves and tastes like salt. It can be applied topically; it can be frozen, boiled and packaged in virtually any application.

Another ingredient is low-bulk-density salt with less sodium by volume. It has a unique hollowed-out pyramidal structure that delivers dramatically different taste perceptions. Its irregular surface and low bulk density provides

maximum flavour burst to chips and its rapid solubility avoids gritty aftertaste on crackers. Rapid solubility allows application in blended meats and in rich creamy emulsions.

Naturally evaporated sea salt is growing in popularity with requests for low-sodium options. Although not technically a sea salt, it is natural, solar-evaporated salt that naturally crystallises blend of sodium and potassium chlorides with associated trace minerals. Taste is very salty. As potassium is part of crystal it does not give chalky metallic tone and at 30 to 40% less sodium it has more rounded taste.

People's palate is changing and they are interested in looking at more flavourful foods. Better way of replacing sodium would be using robust flavours to advantage with use of substances like piperine in black pepper, gingerol in ginger, isothiocyanates in mustard and capsaicinoids in chillies to distract the palate from diminished saltiness. When you increase the amount of heat in different profile, need for more sodium is reduced. Garlic is also useful. Roast garlic profile can be used without any salt to yield a satiating flavour.

Future

Biotechnology may soon serve sodium solutions developing salt-replacement technologies by acting on salt receptors to amplify the actual signal from the receptor that is responsible for salt sensation. The possibility of reducing sodium without adding anything in its place is attractive.

Until that happens we need to be satisfied with improving the technologies available now. Initially all one could do was 10 to 15% reduction. The trend is more towards 33% now and in some applications, there are requests for more than 50% reduction. Better the system, the lower we could go.

Like so many oxymoron foods, it takes a combination of ingredients to make impossible a reality. With the right mix, it is possible to un-salt the salty snack.

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Sweetness, Sugar Wars and Sweetness Options

(Article prepared by condensing a series of articles in Food Product Design by Cindy Hazen, Sharon Palmer and Martin Schultz)

Sugar is on attack. Consumers are considering it as a wily ingredient creeping into food products and wreaking havoc with our diets. Most packages write sugars on labels which has become a hot button. Someone said that there is so much sugar in orange juice, it is better to eat an orange. Manufacturers should take notice of this change in consumer attitude while formulating foods.

Sugar Wars

The war starts with the label. Product declaring low-sugar content may win consumer attention. Buyer also gets swayed by statements suggesting natural, artificial or a specific sweetener preference. Nutrition panel gives the actual sugar content, calories, etc. which along with statements like artificial sweeteners may help make final decision.

US FDA allows reduced-sugar claim is product contains at least 25% less sugar compared to normal food product and sugars include glucose, fructose, lactose, sucrose etc. whether added or inherently present. Honey contains fructose and glucose and small amounts of maltose, tutanose and isomaltose and some oligosaccharides which are not considered sugar.

Statement like “no added sugar” applies when no sugar or ingredient containing added sugars (like jam and jelly) is used. The term sugar is used loosely but it covers a lot of ground although it is the common name for sucrose. Fructose found in fruit is about 1.5 times sweeter and glucose or dextrose is just about 70% as sweet as sucrose but both are all technically sugars and are used in food formulations. They all are nutritive sweeteners and provide 4 calories per gram

Non-nutritive sweeteners like stevia, acesulfame K, aspartame and sucralose contribute little to calories but pack a lot of sweetness in small quantity. Most have about 200 to 300 times sweetness but sucralose is 600 times sweeter than sucrose. They can be used alone or better used in combination to reduce sugar due to better taste.

Sugar alcohols or polyols are produced by hydrogenation of a sugar have lower calories. Erythritol derived from glucose has 0.2 calories per gram while maltitol from maltose has 2.1 calories.

Problem of Diabetes

In the past diabetics were told to avoid sugar and depend on sugar substitutes to sweeten their foods. Sugar was thought to be absorbed more rapidly into blood than starchy foods. It is now known that many complex carbohydrates can affect blood sugar similar to sucrose. Both amount and quality of carbohydrates affect the blood glucose levels. Although diabetics are advised to restrict sugar, they are counselled to balance carbohydrates intake over the entire day with focus on unprocessed, fibre-rich carbohydrates that produce lower and slower increases in blood sugar compared to refined carbohydrates.

Controlling Glucose

The ultimate goal for diabetics is to manage the disease to prevent serious complications like retinopathy, nephropathy, neuropathy and possibly coronary vascular disease later on. Glycemic control is very important. American Diabetes Association (ADA) suggests monitoring total carbohydrates through tools like exchanges is the key to good glycemic control. Rather than low-carbohydrate diets, 45 to 65% of total calories should come from carbohydrates.

If diabetic want sugar, they can fit it in. Foods containing simple sugars, like white or brown sugar, honey and molasses can be substituted for starchy carb sources like tortillas and potatoes. On slice of bread could be skipped for two small cookies as both contain about 15g of carbohydrates.

Many sugar-containing foods are high in carbs and calories and often low in nutrients. As amount and type of carbohydrate influences blood glucose levels, choosing foods that controls blood glucose after a meal is recommended. Thus watching glycemic index (GI) and load (GL) can be useful.

ADA recommendations are moving away from removing sugars for long time. However, many diabetics seek reduced sugar foods.

Artificially Sweet

Diabetics have counted on a large number of high-intensity sugar substitutes to satisfy their sweet cravings. They provide sweetness without calories or carbohydrates. However, as the number of artificial sweeteners has swollen, so has the controversy surrounding their safety. In fact artificial sweeteners are among the most rigorously studied additives. According to ADA, non-nutritive and reduced calorie sweeteners are safe when consumed within the acceptable daily intake levels. Following are five sweeteners approved in the US.

Acesulfame K (non-metabolised sweetener, 200 times sweeter than sucrose), Aspartame (completely metabolised, 200 times sweeter), Neotame (a dipeptide of aspartic acid and phenylalanine, 7000 to 13000 times sweeter), Saccharin (non-metabolised, stable sweetener, 300 times sweeter) and Sucralose (non-metabolised sweetener, 600 times sweeter).

It is not as simple as diluting an artificial sweetener to sugar's standard because matching sweetness is not the same as matching flavour. These sweeteners have their own unique characteristics. Sometimes best results come from combining sweeteners, rather than allowing any one to dominate.

Because of intense sweetness, they not have the bulk which provides mouthfeel of sugar-based products. They also don't taste quite like sugar with a lingering aftertaste which may be bitter, metallic or licorice and that must be masked. Thus products must be tested and evaluated in comparison to full-sugar product while formulating.

Saccharin has a bitterness but it has economic advantage when used in combination with another sweetener. Blend of 30% saccharin and 70% aspartame does not impart bitterness and reduces cost of using aspartame alone. If used alone a masking agent may be required. It is stable over a wide range of temperature and pH.

Neotame is similar to aspartame being dipeptide of phenylalanine and aspartic acid. It can enhance sweetness in beverages and chewing gum. At low level instead of sweet taste, it works as flavour modifier for example of fruit flavours. As it has its own taste, it is not used as direct sugar replacement but works well with other sweeteners. Sugar in carbonated soft drinks can be successfully replaced by a mixture of neotame, aspartame and acesulfame K.

Aspartame is made up of phenylalanine and methyl ester of aspartic acid. Many consider aspartame to have cleanest sweetness profile among alternative sweeteners coming closest to sugar as it does not introduce off-flavours. It could be used as a sole sweetener in many product formulations working well with flavours like vanilla, chocolate, fruit flavours, citrus, minty flavours etc.

Acesulfame K has important synergy in combination. It works well with other sweeteners at 20 to 30% blend. It is heat stable across moderate pH range. It can be used in baking or in moderately acidic products like carbonated beverages. It is used in chewing gum as well as in yogurt and many other applications. It is degraded only to a small extent in UHT and HTST processes but is not recommended products requiring retort processing or neutral or high pH products that are not refrigerated.

Sucralose can be used to replace some of the sugar content. It can replace up to 30% sugar without altering taste. It can be blended with other non-nutritive sweeteners or with fructose or oligofructose etc. in products making no-sugar-added, sugar-free or reduced-sugar claims.

Sugar Alcohols

Reduced calorie sweeteners approved include sugar alcohols (polyols) erythritol, hydrogenated starch hydrolysates, isomalt, lactitol, maltitol, mannitol, sorbitol, xylitol and tagatose. Unlike high-intensity sweeteners requiring in very small amounts, these are needed in about the same quantities as sucrose although their sweetness varies. Compared to sucrose, polyols have slightly less sweetness, mannitol (50%), sorbitol (60%), erythritol (70%), maltitol (90%) while xylitol is as sweet as sucrose. Polyols provide fewer calories, because they are absorbed slowly and incompletely from the intestine.

Polyols have reduced calories as well as reduced glycemic response compared to most sugars hence are useful in blood sugar control. Maltitol syrup has a GI of 52, hydrogenated starch hydrolysate 39, xylitol 13, sorbitol and isomalt 9, lactitol 6 and erythritol and mannitol have 0. In some people, excessive consumption of polyols may cause gastrointestinal symptoms like gas or laxative effects.

When calculating caloric contribution of polyols the average is 1.6 kcal per gram but maltitol provides more calories than others. Although many polyols are less sweet than sugar but they provide the bulk when intense sweeteners are used. Polyols do not have browning properties.

Xylitol is most commonly used in mints, gums and other confections with its clean sweetness with profile and intensity similar to sucrose. It has cooling effect complementary to mint flavour but works well with citrus flavours.

Lactitol is often used in bakery, dairy and sugar-free chocolate applications. It also has clean sweetness but slightly less sweet than sucrose. Maltitol is also used in confectionery, dairy and bakery products. It is most widely used polyol as it works in many diverse applications. Its sweetness is almost same as sucrose. Sorbitol is less sweet than sucrose about the same as mannitol. Both mannitol and sorbitol require laxation declaration as per FDA regulations.

Polyols not only reduce caloric intake but are suitable for diabetics and have non-cariogenic properties i.e. it will not promote dental caries. They have sweetness similar to sucrose being slightly less sweet, so they do not require bulking agents. Also they are quite stable to heat. However, they are more expensive and some have poor digestive tolerance so need to be consumed in moderation.

Naturally Sweet

Stevia has become important in low-calorie sweeteners as it is from natural source. However, sweeteners from plant Stevia reduadiana are all called stevia. Extracts from the plant containing different combinations and percentages of glycosides or steviosides, vary in sweetness and flavour profiles. An abundant glycoside rebaudioside A (reb A) is about 400 times sweeter than sugar. They don't taste the same so it is important to try out different types so an appropriate one could be chosen. Some extracts have a lingering aftertaste. Masking agents help improve the flavour profile.

Stevia sweeteners work over a wide range of flavours but work better with peach, mango and other tropical fruits flavours. Reb A works well with complex flavours like chocolate, coffee and tomato. Adding vanilla can complement the flavour profile of stevia. It takes some adjustment with acids and other flavour notes to achieve ideal sweetness of stevia. Starch or fibre thickener may mask some of its taste notes while xanthan has little effect on flavour. Stevia products have been used in all products from beverages to baked goods. They are also used in yogurt, ice cream and confectionery at levels 0.02 to 0.06% or even higher in sugar-free hard candy. They are heat and ph stable. When used at over 50% substitution, lingering flavour notes become apparent needing flavour modifiers.

Another high intensity sweetener having good promise is an extract from monk fruit (Siraitia grosvenori or luohan guo, a native of China and Thailand. The flavour is neutral in most applications. FDA has recognised the extract (having sweetness 180 to 200 times of sucrose) as GRAS. The non-nutritive sweetener components are called mogrosides of which mogroside V is the sweetest. The sweetener is stable at acid and neutral pH and in typical processes like pasteurisation. It is recommended for use in beverages, cereals, baked goods, confectionery and dairy products.

Fruit products can help increase sweetness and minimise added sugar because fructose is sweeter than sucrose. Apple contains about 10.4g sugar per 100g and over half of it is fructose. Fruit concentrates or dried form is convenient to use.

Not only do fruits provide naturally occurring sugars, but that sugar comes with vitamins, minerals, antioxidants and other healthy nutrients and they are label-friendly. Ratio of sugars varies among fruits. Apple contains more than half of its sugars as fructose the remaining being glucose and sucrose.

As sucrose, fructose and glucose, the main sugars in fruits, have different sweetness depending on the fruit juices selected and blend ratios, one can achieve the desired sweetness level. Natural fruit sweeteners are usually blends of pineapple, peach, pear, apple and/or white grape juice concentrates. Not only will they affect the final sweetness but also the colour, mouthfeel and acidity.

In some formulations organic acids from juice concentrates may interact with other ingredients so one may choose to use ion-exchanged fruit-juice derived sweetener with acid removed by the process. This process, however, also removes minerals and polyphynols. As these sweeteners are not pure sugars some amount of water also should be accounted for which is present in these.

Honey contains maltose, sucrose, isomaltose, maltulose etc. but major sugars are glucose (31 to 44%) and fructose (23 to 41%). It is generally up to 1½ times as sweet as sugar and when combined with sugar it synergises sweetness.

Corn Sugars

These include corn syrups of varying DE, high-maltose corn syrup, high-fructose corn syrup (HFCS) and dextrose. Corn starch is hydrolysed using acid or enzymes to smaller carbohydrates. As the extent of hydrolysis increases, as measured by DE (dextrose equivalence) more and more of sugars maltose and glucose are formed and it becomes sweeter. However, as both maltose and glucose have much lower sweetness they partially can replace sweetness of sugar.

Lower DE corn syrups are valued for high viscosity and binding properties. Higher DE contributes greater sweetness and humectancy. Corn syrups are used at 10 to 25% level in snack-bar application whereas many confectionery products have corn syrups roughly half the formulation. High maltose syrups are used in brewing but also valued for their ability to produce hard candies with colour stability and processing ease.

Dextrose or corn sugar has cool, mild sweetness that can enhance flavour. It supports browning and is available in various granular sizes as well as liquid syrup. It may partially replace sucrose and it can also be used as carrier for high-intensity sweeteners.

Companies offer HFCS ranging from 42 to 90% fructose. Typically 42% and 55% syrups are used for products although higher fructose may be used in reduced calorie foods as fructose is sweeter than sucrose. HFCS reduces water activity and extends shelf life. In baked goods it helps retain moisture and resists crystallisation after baking. In beverages formulated with HFCS, sweetness and flavour are unchanged due to storage temperature fluctuations or low product acidity. Due to lower freezing point of HFCS than sucrose, frozen beverage concentrates are pourable straight from freezer.

Enhancing Sweetness

Just because consumers want reduction in sugar doesn't mean they are willing to sacrifice flavour. So formulation must have complementary flavours. For a citrus drink, orange and tangerine may be used rather than lemon or lime, because lemon and lime require more acid than orange and tangerine. Less acid increases sweetness perception. When possible, sweet flavours like vanilla, maple and honey may be used. These are naturally sweet.

While using sweeteners, flavour based on sweetener system may be chosen. Citrus and fruit flavour works well with stevia because acidity enhances sweetness of stevia and diminishes bitterness. Alternatively, bitterness of roasted flavours like coffee or chocolate may actually complement bitterness of low-grade stevia. It is better to avoid use of naturally bitter substances like coffee and tea as they require a lot of sweetness to overcome bitterness.

Alternatively synergistic sugars may intensify sweeteners, for example, sucrose, glucose and fructose enhance stevia's sweetness so less is needed. Similarly, stevia and aspartame or stevia and acesulfame K have synergistic interactions.

Modifiers may also enhance sweetness. Some non-sweetener ingredients enhance perception of sugar enhancing sweetness. Many proprietary materials are available, some with GRAS status, that enable reduction of sucrose while maintaining sweetness characteristics in products like baked goods, cereals, chewing gum, condiments and relishes, confectioneries, dairy and other applications.

Another GRAS ingredient has synergistic effect with stevia to enhance its sweetness, mask bitterness and achieve overall improvement in sweet profile and mouthfeel. There is also a GRAS ingredient that reduces up to 75% sucralose in foods and beverages.

Don't Forget Function

Sweetness profile created by sugar substitute is different from sucrose, so blends are often used in mixtures to create a natural sweet sensation or better mouthfeel. Many foods like instant or ready-to-drink coffees, teas and other drinks, cold cereals, chewing gum, breath mints, gelatine, puddings, frozen desserts, yogurt, baked goods, and candies etc. could be artificially sweetened. With large increase in diabetics as projected by WHO, the sugar-free food industry may experience sweet success in years to come.

Sugar is more than sweet taste in foods. In beverages it adds body and makes the product more palatable with high-acid ingredients. It provides texture and colour in baked goods, crispiness to cookies, food for yeast in fermented doughs etc. In confectionery, sugar provides structure to hard candies and texture to grained confections. Sugars provide soluble solids which affect water activity and in turn may control microbial growth.

When sugar is removed from the formulation, something needs to be added to maintain proportions of other ingredients and for desired mouthfeel. When a high intensity sweetener having 200 times sweetness is used and original formulation has 20% sugar, the new formulation with sweetener substituting sugar will have only 80.1g per 100g of old formulation. Bulking agent will affect solubility, mouthfeel and texture in most foods and browning in baked goods. The product might not look like the previous one with sugar. It is back to work-table for another round of reformulation. There are many choices in product development toolkit but must understand how to use new ingredients to replace the functionality of sugar in each application.

Sweet soluble fibres like inulin and oligofructose are label-friendly. Inulin is 10% as sweet as sucrose while oligofructose is 30 to 65% as sweet. Both have 1.5 calories per gram as they are partially metabolised due to microbes. One can also use a natural or artificial high-intensity sweetener. Maltitol can be used with soluble fibres and colour in baked goods.

Polyols are preferred in reduced or sugar-free confections but in most polyols laxation becomes an issue. Other partially digestible carbohydrates like resistant starches, soluble fibres and gums may be alternatives. Developer must make end goal of reducing added sugar very clear and realistic. Reducing sugar is not as difficult as eliminating sugar but there are challenges. There may be restrictions on type of replacement ingredients that may be used such as natural, clean-label or allergen-friendly. Functional ingredients may be considered if nutritional claim is desired.

One company is developing a sweetener and flavour enhancer that is 20,000 times sweetener than sugar. It will be able to replace a portion of sugar and calories in product while maintaining the same taste and enhancing flavour of beverage reducing cost. One must begin by defining the qualities of the finished product and avoid those ingredients which are not consumer friendly.

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Research in Health & Nutrition

Functional Foods: A Place in the Healthy Food Landscape?

Report by Joanna Cosgrove in Nutraceuticals World October 1, 2012

There has never before been such a strong and concentrated focus promoting healthy eating. And while there are plenty of healthy food options available to consumers, iModerate Research Technologies sought to discover the factors that play into a consumer's health food choices. Specifically, the Denver, CO-based market research firm wanted to know how familiar consumers were with the tenets of healthy eating, and if they understood the differences between functional and fortified foods.

The resulting published study, "How Do Functional and Fortified Foods Fit with Healthy Eating?," polled a sample of men and women across the U.S. and found that despite the many messages promoting healthy eating, confusion still abounds, especially as it relates to functional foods (those which inherently contain biologically active compounds that provide a clinically proven and documented health benefit) and fortified foods(those that have extra nutrients added to them that are not normally present).

"People generally want to eat healthy and do what's best for them and their family," said Adam Rossow, vice president of marketing at iModerate. "However, while consumers know some of the basics and what to stay away from, there is a tremendous lack of practical information and education that would help break down the barriers for them, inspire purchases and create a loyal following."

Eighty-one consumers over the age of 18 and hailing from the Northeast, Midwest, South and West told iModerate in one-on-one interviews that they knew they should be "eating healthier," and that their food choices shouldn't be too high in fat, sugar, calories or "unpronounceable" ingredients, but they weren't exactly clear on the practical constructs of food shopping and eating.

The interviews indicated that taste and price were closely related purchase drivers. "Ultimately, the items that end up in consumers' shopping carts are those that measure up to their standards of taste, cost, convenience, and finally healthiness," the report said. "Price sensitivity makes them a bit hesitant to try new items that they aren't familiar with, out of fear that no one [in their family] will like it and it will be wasted. Taste also governs how consumers choose between like items that are similarly priced. Whether the food is functional or fortified, and regardless of the relative health benefits of either food, most will opt for whichever tastes best."

The current lack of information related to what types of foods are healthy and what specific health benefits these foods provide seems to be creating a real challenge for consumers, said Mr. Rossow. "Aside from a lack of information and prominent marketing by functional food producers and purveyors, the study found definitive barriers that prevent consumers from purchasing fortified and functional foods.

"Concerns about taste, cost, spoilage, convenience and preparation are the major hurdles when it comes to purchasing and consuming functional foods," he continued. "When it comes to fortified foods, consumers' apprehension stems from the fortification process itself, believability as to the product's health claim, the possible overconsumption of nutrients and long-term health implications."

In response to the insights gained from talking directly to consumers, iModerate offered three sets of pointers to the food industry.

Help consumers make more informed purchase decisions:

1. Create opportunities and reasons for consumers to learn more about your healthy products. For example, if consumers know that a serving of fortified cookies offers the nutrition of a cup of spinach, that information might sway them to reach for the admittedly tastier, but still nutritious, fortified option.
2. Discover what consumers value in healthy foods. Follow their lead and build these elements into your products and promotions.
3. Link information about your products to specific health problems it solves or prevents. This is where grocers and manufacturers come in; they have a unique opportunity to fill this informational void. Consumers' knowledge of their own nutritional needs is spotty at best. Capitalize on this lack of information and make your audience aware of the health issues your product solves.

Make "tasty and convenient" a no-brainer:

1. Take the guesswork out of healthy eating. Offer recipes for your products and let shoppers taste them, or create a destination set up that enables consumers to buy what they need to make a special healthy meal in one designated area.
2. Food placement also matters. Some consumers aren't keen on the produce aisle; consider presenting healthy items in more convenient "grab-and-go" locations.
3. Allow on-the-go consumers to make a healthy choice quickly. Offer fortified products and packaged produce in convenient single-serving sizes.
4. Create food pairings that make healthy food more palatable.

Market products with a palpable health purpose:

1. Clearly identify health attributes and benefits. Consumers need to be taught and reminded that products are nutritious, and will appreciate products that connect the dots between the "hows" and "whys" of their healthiness.
2. Make the most of product labeling. Fortified food labels provide a great opportunity to reinforce ad messaging about a product's nutritional perks, and drive home the ways in which those benefits play into a healthy lifestyle.

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Omega-3s Help to Slow Aging Process

October 2, 2012 Food Product Design

Improving the ratio of omega-3s to other fatty acids in a diet helps slow a key biological process linked to aging, according to a new study published in the journal *Brain, Behavior, and Immunity*.Researchers at Ohio State University found most overweight but healthy middle-aged and older adults who took omega-3 supplements for four months altered a ratio of their fatty acid consumption in a way that helped preserve tiny segments of DNA in their white blood cells. The segments, called telomeres, are known to shorten over time in many types of cells as a consequence of aging.

In the study, lengthening of telomeres in immune system cells was more prevalent in people who substantially improved the ratio of omega-3s to other fatty acids in their diet. Omega-3 supplementation also reduced oxidative stress, caused by excessive free radicals in the blood, by about 15% compared to effects seen in the placebo group."The telomere finding is provocative in that it suggests the possibility that a nutritional supplement might actually make a difference in aging," said Jan Kiecolt-Glaser, professor of psychiatry and psychology at Ohio State and lead author of the study.

In another recent publication from this study, Kiecolt-Glaser and colleagues reported that omega-3 fatty acid supplements lowered inflammation in this same group of adults.Study participants took either 2.5 grams or 1.25 grams of active omega-3 polyunsaturated fatty acids, which are considered "good fats" that, when consumed in proper quantities, are associated with a variety of health benefits. Participants on the placebo took pills containing a mix of oils representing a typical American's daily intake.

The researchers said this combination of effects suggests that omega-3 supplements could represent a rare single nutritional intervention that has potential to lower the risk for a host of diseases associated with aging, such as coronary heart disease, type 2 diabetes, arthritis and Alzheimer's disease.

Study participants received either the placebo or one of the two different doses of omega-3 fatty acids. The supplements were calibrated to contain a ratio of the two cold-water fish oil fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), of seven to one. Previous research has suggested that EPA has more anti-inflammatory properties than DHA.

The researchers stressed the importance of the ratio of omega-6 fatty acids to omega-3 fatty acids that are present in a person's blood. While the ratio of omega-6 to omega-3 fatty acids averages about 15-to-1, researchers tend to agree that for maximum benefit, this ratio should be lowered to 4-to-1, or even 2-to-1.

Both groups of participants who took omega-3 supplements showed, on average, lengthening of telomeres compared to overall telomere effects in the placebo group, but the relationship could have been attributed to chance. However, when the researchers analyzed the participants' omega-6 to omega-3 ratio in relationship to telomere lengthening, a lower ratio was clearly associated with lengthened telomeres.

"The idea we were looking at with the ratio of omega-6 to omega-3 fatty acids was an increase in the denominator to make the ratio smaller. In the United States, we need to focus on the omega-3 part because we don't get enough of those," said co-author Martha Belury.

The researchers also measured levels of compounds called F2-isoprostanes to determine levels of oxidative stress, which is linked to a number of conditions that include heart disease and neurodegenerative disorders. Both omega-3 groups together showed an average overall 15% reduction in oxidative stress compared to effects seen in the placebo group.

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Eating Cherries Reduces Gout Attacks by 35%

September 28, 2012 Food Product Design

Consuming cherries over a two-day period reduces the risk of gout attacks by 35% in patients suffering from the disease compared to those who did not eat any cherries, according to a new study published in the journal *Arthritis & Rheumatism*. The findings also suggest the risk of gout flares was 75% lower when cherry intake was combined with the uric-acid reducing drug, allopurinol, than in periods without exposure to cherries or treatment.

Researchers at Boston University recruited 633 gout patients who were followed online for one year. Participants were asked about the date of gout onset, symptoms, medications and risk factors, including cherry and cherry extract intake in the two days prior to the gout attack. A cherry serving was one half cup or 10 to 12 cherries.

Participants had a mean age of 54 years, with 88% being Caucasian and 78% of subjects were male. Of those subjects with some form of cherry intake, 35% ate fresh cherries, 2% ingested cherry extract, and 5% consumed both fresh cherry fruit and cherry extract. Researchers documented 1,247 gout attacks during the 1-year follow-up period, with 92% occurring in the joint at the base of the big toe.

"Our findings indicate that consuming cherries or cherry extract lowers the risk of gout attack," said Dr. Yuqing Zhang, professor of medicine and public health at Boston University. "The gout flare risk continued to decrease with increasing cherry consumption, up to three servings over two days."

The researchers also found further cherry intake did not provide any additional benefit; however, the protective effect of cherry intake persisted after taking into account patients' sex, body mass index, purine intake, along with use of alcohol, diuretics and anti-gout medications.

More than 8 million U.S. adults suffer with gout, an inflammatory arthritis triggered by a crystallization of uric acid within the joints that causes excruciating pain and swelling. Prior studies suggest that cherry products have urate-lowering effects and anti-inflammatory properties, and thus may have the potential to reduce gout pain.

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Curcumin Cuts Alzheimer's Risk, Heart Disease

September 28, 2012 Food Product Design

Curcumin, a compound found the popular Indian spice turmeric may help lower inflammatory markers associated with heart disease, inflammation and mental decline, according to a new study published in the Nutrition Journal.Researchers at Ohio State University conducted the study where healthy middle-aged participants aged 40 to 60 years were given a low dose of curcumin (80 mg/day) in a lipidated form. Subjects were given either curcumin or placebo for four weeks. Blood and saliva samples were taken before and after the four weeks and analyzed for a variety of blood and saliva measures relevant to health promotion.

They found curcumin lowered triglyceride values, as well as two non-lipid related measures relevant to cardiovascular health. One of the effects was an increase in plasma contents of nitric oxide, a molecule that can work against high blood pressure. The other cardiovascular-relevant effect was a lowering of plasma concentrations of intercellular adhesion molecule (sICAM), a molecule linked to atherosclerosis.

Curcumin supplementation raised plasma myeloperoxidase concentrations, a part of both normal and inflammation-related white blood cell function. Low myeloperoxidase levels are associated with lower immune function. The effect was not accompanied by a rise in plasma levels of c-reactive protein (CRP) nor ceruloplasmin values, both of which can be markers of inflammation.

Curcumin supplementation also reduced plasma contents of beta-amyloid protein, a marker of brain aging, especially in relation to Alzheimer's disease. Curcumin also lowered salivary amylase activities, which can mark sympathetic nervous system stress. Curcumin raised salivary radical scavenging capacities and plasma antioxidant enzyme catalase, singling anti-inflammatory effects. Curcumin also reduced plasma alanine amino transferase activities, a liver injury marker.

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Xylitol May Help Ward Off Diabetes

September 27, 2012 Food Product Design

Xylitol can be used not only as a sugar substitute, but also as a supplement to anti-diabetic food and other food products, according to a new study published in the Annals of Nutrition and Metabolism. The findings suggest xylitol can be an safe alternative to sugar, but also can be used to fight type 2 diabetes mellitus.

Researchers at the University of KwaZulu-Natal conducted a study to examine the anti-diabetic effects of xylitol in a type 2 diabetes rat model. Six-week-old male Sprague-Dawley rats were randomly divided into three groups: normal control (NC), diabetic control (DBC) and xylitol (XYL). Diabetes was induced only in the DBC and XYL animal groups by feeding them a 10% fructose solution for two weeks followed by an injection of streptozotocin. One week after the streptozotocin injection, the animals with a non-fasting blood glucose level of >300 mg/dl were considered to be diabetic. The XYL group was fed further with a 10% xylitol solution, whereas the NC and DBC groups were supplied with normal drinking water.

Results showed five weeks of xylitol supplementation improved food and fluid intake, body weight, blood sugar, serum fructosamine, lipid profile, serum insulin concentration and glucose tolerance. However, xylitol supplement did not change liver weight, liver glycogen and serum triglycerides in rats with diabetes.

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Lycopene-Rich Tomatoes Slash Stroke Risk in Men

October 8, 2012Food Product Design

Men who eat large amounts of lycopene-rich tomatoes and tomato products have a 55% reduced risk of stroke compared to men who lowest amounts of lycopene in their blood, according to a new study published in the journal *Neurology*.

The study involved 1,031 men in Finland between the ages of 46 and 65. The level of lycopene in their blood was tested at the start of the study and they were followed for an average of 12 years. During that time, 67 men had a stroke. Among the men with the lowest levels of lycopene, 25 of 258 men had a stroke. Among those with the highest levels of lycopene, 11 of 259 men had a stroke. When researchers looked at just strokes due to blood clots, the results were even stronger. Those with the highest levels of lycopene were 59% less likely to have a stroke than those with the lowest levels.

“This study adds to the evidence that a diet high in fruits and vegetables is associated with a lower risk of stroke," said study author Jouni Karppi, PhD, of the University of Eastern Finland in Kuopio. “The results support the recommendation that people get more than five servings of fruits and vegetables a day, which would likely lead to a major reduction in the number of strokes worldwide, according to previous research."

The study also looked at blood levels of the antioxidants alpha-carotene, beta-carotene, alpha-tocopherol and retinol, but found no association between the blood levels and risk of stroke.A March 2012 study published in the *American Journal of Lifestyle Medicine* found tomatoes and tomato products may have more health benefits than previously thought and decrease the risk of cancer, osteoporosis and cardiovascular disease.

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Watermelon Boosts Heart Health, Trims Fat

October 8, 2012Food Product Design

Eating watermelon may significantly help boost heart health and reduce weight, according to a new study published in the *Journal of Nutritional Biochemistry*. The findings suggest the compound citrulline, found naturally in watermelon, plays a key role in heart health.

Researchers from Purdue University and University of Kentucky conducted a study that showed mice fed a diet including watermelon juice had lower weight, cholesterol and arterial plaque than a control group. The research builds upon a study conducted last year at the University of Kentucky that found incorporating watermelon into a diet helped lower their risk of atherosclerosis.

"We were interested in citrulline because previous studies showed that it may lower blood pressure," said Shubin Saha, a Purdue Extension vegetable specialist and study co-author. "We didn't see a lowering of blood pressure, but these other changes are promising."

For the study, the researchers fed two groups of mice diets high in saturated fat and cholesterol. Half the mice received water containing 2% watermelon juice, while the others received the same amount of water supplemented with a

solution that matched the carbohydrate content of the watermelon juice. The mice that consumed watermelon juice gained about 30% less weight than the control group and had about 50% less low-density lipoprotein (LDL). The experimental group also had about a 50% reduction in plaque in their arteries, as well as elevated levels of citrulline.

"We know that watermelon is good for health because it contains citrulline," said Sibu Saha, a professor of surgery at the University of Kentucky. "We don't know yet at what molecular level it's working, and that's the next step."

The researchers plan to continue to look at how concentrations of citrulline and lycopene, another compound found in watermelon, affect health. They also will test other varieties to determine whether particular watermelons have more health benefits.

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Researchers Challenge Superfoods Effectiveness

October 8, 2012Food Product Design

Consumer interest in health and nutrition is helping drive the market for superfoods, such as broccoli, blueberries and whole grains, which are rich in polyphenols that help combat free radicals and inflammation. Now, researchers at Kingston University are using an approach that allows them to delve deeper into the effectiveness of health-promoting superfoods.

"Polyphenols may well work when cells are exposed to them directly, such as under laboratory conditions, but what needs to be established is how effective they are when consumed as part of a food. If they don't actually get through the gut membrane and into the rest of the body, then they're not a superfood," said Dr. Lucy Jones, deputy dean of the University's Faculty of Science, Engineering and Computing.

The researchers adapted a model developed in the early 1980s by Sloane Kettering to see if and how medicinal Chinese herbs, known to limit the growth of cancer cells, are absorbed in the body. The Caco-2 model mimics the action of the small intestine, the principal place where nutrients are taken up. The Kingston researchers have used it to assess what does and doesn't make it through the gut.

"The Caco-2 is a single layer of cells grown in a laboratory environment that develops the characteristics and functions of the micro-villi, the tiny hair-like projections that aid efficient absorption found mainly in the small intestine," they said. "This method allows us to look at what nutrients pass through into the body and could be used to test food supplements, drugs and foodstuffs. We found that while some compounds may have a local effect in the gut itself, in terms of the rest of the body the impact could be negligible."

The researchers have tested herbs, such as parsley, rosemary, sage and thyme, and they are looking into the possibility of using the model to test a dietary nitrate supplement that is currently being investigated for its impact on performance by Kingston University's sport and exercise scientists.

Beyond its use for debunking exaggerated health claims and benefits, the Caco-2 model could form a key part of a screening process to determine the effectiveness of a range of dietary compounds.

"It can also be used to study compounds in combination," Jones said. "For example, a cancer patient may want to take Chinese medicines in addition to their prescribed medication. The Caco-2 model would allow researchers to look at the pros and cons of this and provide an insight into the various interactions."

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Soy Protein Benefits Weight, Digestive Health

October 8, 2012Food Product Design

Consuming soy protein may benefit weight management, liver and colon health, according to a new study published in the journal *PLoS ONE*.The animal study was conducted on mice and explored the effects of dietary soy protein (supplied by Solae LLC) versus casein on serum hormones implicated in colon health and body fat deposition. Results showed that the mice fed the soy protein instead of casein based diets had significantly reduced body fat, blood insulin levels, fat cell size and expression of genes associated with abnormal colonic cell growth.

“Our findings support an increasing body of evidence linking healthy diets with altered metabolic states and biomarkers potentially favorable for prevention of chronic diseases," said the researchers.

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Study Affirms Resveratrol Supports Heart Health

October 4, 2012Food Product Design

HEERLEN, Netherlands—A new study affirms the beneficial role of resveratrol in the support of cardiovascular health. Presented at the 24th Scientific Meeting of the International Society of Hypertension in Sydney, the results demonstrate regular supplementation with resveratrol has a positive and sustained effect on circulatory function in obese, mildly hypertensive adults.

The double-blind, placebo-controlled trial was conducted by researchers at the University of South Australia, Adelaide. For the study, 28 subjects were supplemented with 75mg Resvida per day for six weeks. This resulted in a significant 23% increase in vasodilator function (measured by flow-mediated dilatation, FMD), compared with the placebo. The extent of improvement was greater in subjects with poorer initial vasodilator function. This is important as a decreased vasodilator response is an early biomarker for cardiovascular risk and associated with obesity and hypertension.

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Fruits & Veggies for Heart Health

By Joanna Cosgrove, Nutraceuticals World October 18, 2012

After poring over a large prospective population-based cohort study, a team of Swedish researchers have concluded that a diet including seven servings of antioxidant-rich fruits and vegetables can reduce a woman’s heart attack risk by between 20-29% over the course of 10 years. The findings were published in the *American Journal of Medicine*.

Data used were from The Swedish Mammography Cohort (from 1987 and 1990), and polled more than 32,500 women aged 49 to 83 residing in the Uppsala and Västmanland counties in central Sweden about their educational level, weight and height, reproductive factors, diet and questions on all major lifestyle factors, history of diseases, and use of some medications.

Researcher Susanne Rautiainen Lagerström, PhD, of the Division of Nutritional Epidemiology, Institute of Environmental Medicine, at the Karolinska Institutet in Stockholm, Sweden, told *Nutraceuticals World* that she and her colleagues were intrigued by the relationship of dietary antioxidants to incidences of myocardial infarction. “Previous studies have mainly focused on individual antioxidants however, in diet a wide-range of phytochemicals with antioxidant properties are present,” she said.

Dr. Lagerström made it clear that the effect was observable only through the consumption of whole foods, not

supplements. “In this study we investigated antioxidants from foods and not from dietary supplements in relation to myocardial infarction, therefore our results can only be generalized to foods and not supplements,” she said. “By looking at the study results we cannot say which source is more effective since we did not study the effect from dietary supplements.”

In their report, the researchers acknowledged that previous randomized controlled trials testing high doses of antioxidant supplements containing one to three compounds failed to see any benefit on coronary heart disease. “One randomized controlled trial that studied the effect of a low-dose mixture of five antioxidant supplements (including 120 mg ascorbic acid, 30 mg vitamin E, 6 mg beta-carotene, 100 µg selenium and 20 mg zinc) did not observe any association with ischemic cardiovascular diseases,” they said. “Notably, in a meta-analysis of high doses and very high doses of single supplements of vitamin A, beta-carotene, or vitamin E tested in several randomized controlled trials, higher all-cause mortality was reported.”

The researchers nodded to the synergistic effect of the food nutrients, in conjunction with the naturally-present antioxidants. “In contrast to supplements of single antioxidants, the dietary total antioxidant capacity reflects all present antioxidants, including thousands of compounds, all of them in doses present in our usual diet, and even takes into account their synergistic effects,” they wrote. “In addition to antioxidant effects, flavonoids also may inhibit the atherosclerotic process through other pathways. Flavonoids have been shown to improve endothelial function, to decrease blood pressure, and to have antiplatelet and anti-inflammatory effects.”

Several foods were deemed to be major contributors to antioxidant intake among respondents in the study population. “In particular, high intake of fruit and vegetables, which contributed 44% of the dietary total antioxidant capacity in our study, have been inversely related to coronary heart disease in many studies,” the researchers wrote. “Whole grains (18% of total antioxidant capacity) also are suggested to lower coronary heart disease risk. Coffee consumption (14% of total antioxidant capacity) has been inversely related to coronary heart disease in some but not in all studies. Chocolate consumption (4% of total antioxidant capacity) has been shown to have favourable effects on cardiovascular risk biomarkers such as flow-mediated dilation and diastolic blood pressure, as shown by a meta-analysis of randomized controlled trials.”

The study’s lead researcher, Dr. Alicja Wolk from the Karolinska Institute in Stockholm, told *The Telegraph* that her team’s research “contrasted with tests of single antioxidant supplements, which have largely failed to find evidence that they cut heart attacks or mortality rates.”

Worth consideration was the fact that women who ate a lot of fruit and vegetables also tended to eat less saturated fat. As reported by *TheTelegraph*, when the researchers adjusted for intake of fats, the difference in heart attack rates rose to 29%. The study did not examine overall mortality; however, all women were followed until the date of myocardial infarction, death or the end of follow-up, whichever came first.

“Regarding dietary characteristics, women in the highest quintile of total antioxidant capacity of diet, as compared with the lowest quintile, had higher consumption of fruit and vegetables (three-fold), whole grains (15%), coffee (34%), and chocolate (38%), as well as 27% lower intake of saturated fatty acids and 19% lower intake of monounsaturated fatty acids,” the researchers found.

Dr. Lagerström said she and her team plan additional investigations into the role of antioxidants in the diet and they are currently studying the association between total dietary antioxidant content and the relationship to other diseases.

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Omega-3 Supplements May Slow a Biological Effect of Aging

Science Daily Oct. 1, 2012

Taking enough omega-3 fatty acid supplements to change the balance of oils in the diet could slow a key biological process linked to aging, new research suggests.The study showed that most overweight but healthy middle-aged and older adults who took omega-3 supplements for four months altered a ratio of their fatty acid consumption in a way that helped preserve tiny segments of DNA in their white blood cells.

These segments, called telomeres, are known to shorten over time in many types of cells as a consequence of aging. In the study, lengthening of telomeres in immune system cells was more prevalent in people who substantially improved the ratio of omega-3s to other fatty acids in their diet.

Omega-3 supplementation also reduced oxidative stress, caused by excessive free radicals in the blood, by about 15 percent compared to effects seen in the placebo group."The telomere finding is provocative in that it suggests the possibility that a nutritional supplement might actually make a difference in aging," said Jan Kiecolt-Glaser, professor of psychiatry and psychology at Ohio State and lead author of the study.

In another recent publication from this study, Kiecolt-Glaser and colleagues reported that omega-3 fatty acid supplements lowered inflammation in this same group of adults."Inflammation in particular is at the heart of so many health problems. Anything that reduces inflammation has a lot of potentially good spinoffs among older adults," she said.

Study participants took either 2.5 grams or 1.25 grams of active omega-3 polyunsaturated fatty acids, which are considered "good fats" that, when consumed in proper quantities, are associated with a variety of health benefits. Participants on the placebo took pills containing a mix of oils representing a typical American's daily intake.

The researchers say this combination of effects suggests that omega-3 supplements could represent a rare single nutritional intervention that has potential to lower the risk for a host of diseases associated with aging, such as coronary heart disease, Type 2 diabetes, arthritis and Alzheimer's disease.The study is published online and scheduled for later print publication in the journal *Brain, Behavior, and Immunity*.

Participants received either the placebo or one of the two different doses of omega-3 fatty acids. The supplements were calibrated to contain a ratio of the two cold-water fish oil fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), of seven to one. Previous research has suggested that EPA has more anti-inflammatory properties than DHA.

In the case of fatty acids, omega-3 supplementation alone doesn't tell the whole story of how this dietary change can affect health, explained Martha Belury, professor of human nutrition at Ohio State and a co-author of the study. Also important is the ratio of omega-6 fatty acids to omega-3 fatty acids that are present in a person's blood.

Omega-6 fatty acids come from vegetable oils, and since the 1960s, research has suggested that these oils, too, can help protect the cardiovascular system. However, the typical American diet tends to be heavy on omega-6 fatty acids and comparatively low in omega-3s that are naturally found in cold-water fish such as salmon and tuna. While the ratio of omega-6 to omega-3 fatty acids averages about 15-to-1, researchers tend to agree that for maximum benefit, this ratio should be lowered to 4-to-1, or even 2-to-1.

The long chains -- or bigger molecules -- that make up EPA and DHA fatty acids are believed to be the secret to their effectiveness, Belury said.

Both groups of participants who took omega-3 supplements showed, on average, lengthening of telomeres compared to overall telomere effects in the placebo group, but the relationship could have been attributed to chance. However, when the researchers analyzed the participants' omega-6 to omega-3 ratio in relationship to telomere lengthening, a lower ratio was clearly associated with lengthened telomeres.

"The idea we were looking at with the ratio of omega-6 to omega-3 fatty acids was an increase in the denominator to make the ratio smaller. In the United States, we need to focus on the omega-3 part because we don't get enough of those," Belury said.

The researchers also measured levels of compounds called F2-isoprostanes to determine levels of oxidative stress, which is linked to a number of conditions that include heart disease and neurodegenerative disorders. Both omega-3 groups together showed an average overall 15 percent reduction in oxidative stress compared to effects seen in the placebo group.

When the scientists revisited their earlier inflammation findings, they also found that decreases in an inflammatory marker in the blood called interleukin-6 (IL-6) were associated with telomere lengthening. In their earlier paper on omega-3s and inflammation, they reported that omega-3 supplements lowered IL-6 by 10 to 12 percent, depending on the dose. By comparison, those taking a placebo saw an overall 36 percent increase in IL-6 by the end of the study."This finding strongly suggests that inflammation is what's driving the changes in the telomeres," Kiecolt-Glaser said.

Telomeres are a hot topic in science, and their tendency to shorten is associated with such age-related problems as heart disease and early mortality. These short fragments of DNA act as caps at the end of chromosomes, and can be likened to the protective plastic at the end of a shoelace.

"If that plastic comes off, the shoelace unravels and it doesn't work anymore," said study co-author Ron Glaser, professor of molecular virology, immunology and medical genetics and director of the Institute for Behavioral Medicine Research (IBMR) at Ohio State. "In the same way, every time a cell divides, it loses a little bit of its DNA at the ends, and over time, that can cause significant problems."

Kiecolt-Glaser noted that this population was disease-free and reported very little stress. The study included 106 adults, average age 51 years, who were either overweight or obese and lived sedentary lives. The researchers excluded people taking medications to control mood, cholesterol and blood pressure as well as vegetarians, patients with diabetes, smokers, those routinely taking fish oil, people who got more than two hours of vigorous exercise each week and those whose body mass index was either below 22.5 or above 40.

"People who are less healthy than this group, and especially those who experience chronic stress, may gain even more benefits from omega-3 supplementation," she said.

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Zinc Deficiency Mechanism Linked to Aging, Multiple Diseases

Science Daily Oct. 1, 2012

A new study has outlined for the first time a biological mechanism by which zinc deficiency can develop with age, leading to a decline of the immune system and increased inflammation associated with many health problems, including cancer, heart disease, autoimmune disease and diabetes.

The research was done by scientists in the Linus Pauling Institute at Oregon State University and the OSU College of Public Health and Human Sciences. It suggests that it's especially important for elderly people to get adequate dietary intake of zinc, since they may need more of it at this life stage when their ability to absorb it is declining.

About 40 percent of elderly Americans and as many as two billion people around the world have diets that are deficient in this important, but often underappreciated micronutrient, experts say.

The study was published in the *Journal of Nutritional Biochemistry,* based on findings with laboratory animals. It found that zinc transporters were significantly dysregulated in old animals. They showed signs of zinc deficiency and had an enhanced inflammatory response even though their diet supposedly contained adequate amounts of zinc.

When the animals were given about 10 times their dietary requirement for zinc, the biomarkers of inflammation were restored to those of young animals.

"The elderly are the fastest growing population in the U.S. and are highly vulnerable to zinc deficiency," said Emily Ho, an LPI principal investigator. "They don't consume enough of this nutrient and don't absorb it very well."

"We've previously shown in both animal and human studies that zinc deficiency can cause DNA damage, and this new work shows how it can help lead to systemic inflammation," Ho said.

"Some inflammation is normal, a part of immune defense, wound healing and other functions," she said. "But in excess, it's been associated with almost every degenerative disease you can think of, including cancer and heart disease. It appears to be a significant factor in the diseases that most people die from."

As a result of this and what is now know about zinc absorption in the elderly, Ho said that she would recommend all senior citizens take a dietary supplement that includes the full RDA for zinc, which is 11 milligrams a day for men and 8 milligrams for women. Zinc can be obtained in the diet from seafood and meats, but it's more difficult to absorb from grains and vegetables -- a particular concern for vegetarians.

"We found that the mechanisms to transport zinc are disrupted by age-related epigenetic changes," said Carmen Wong, an OSU research associate and co-author of this study. "This can cause an increase in DNA methylation and histone modifications that are related to disease processes, especially cancer. Immune system cells are also particularly vulnerable to zinc deficiency."

Research at OSU and elsewhere has shown that zinc is essential to protect against oxidative stress and help repair DNA damage. In zinc deficiency, the risk of which has been shown to increase with age, the body's ability to repair genetic damage may be decreasing even as the amount of damage is going up.

Medical tests to determine zinc deficiency are rarely done, scientists say, and are not particularly accurate even if they are done. The best approach is to assure adequate intake of the nutrient through diet or supplements, they said, especially in the elderly.

Even though elderly people have less success in absorbing zinc, the official RDA for them is the same as in younger adults. That issue should be examined more closely, Ho said.

Levels of zinc intake above 40 milligrams per day should be avoided, researchers said, because at very high levels they can interfere with absorption of other necessary nutrients, including iron and copper.

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Ensuring High-Quality Dietary Supplements With 'Quality-By-Design'

Oct. 3, 2012 Science Daily

If applied to the $5-billion-per-year dietary supplement industry, "quality by design" (QbD) -- a mindset that helped revolutionize the manufacture of cars and hundreds of other products -- could ease concerns about the safety and integrity of the herbal products used by 80 percent of the world's population.

That's the conclusion of an article in ACS' *Journal of Natural Products*.

Ikhlas Khan and Troy Smillie explain that the U.S. Food and Drug Administration (FDA) regulates dietary supplements as a category of foods, rather than drugs. Manufacturers are responsible for the safety of their products. However, they need not obtain FDA approval to market supplements that contain ingredients generally regarded as safe. While manufacturers, packagers and distributors are required to follow good manufacturing practices, variations in growing, processing and even naming the plants used to make supplements opens the door to problems and introduces challenges with reproducibility. As a result, "the consumer must take it on faith that the supplement they are ingesting is

an accurate representation of what is listed on the label, and that it contains the purportedly 'active' constituents they seek," Khan and Smillie note. The authors looked for solutions in a review of more than 100 studies on the topic.

They concluded that a QbD approach -- ensuring the quality of a product from its very inception -- is the best strategy. One key step in applying QbD to dietary supplements, for instance, would involve verifying the identities of the raw materials -- the plants -- used to make supplements. "It is clear that only a systematic designed approach can provide the required solution for complete botanical characterization, authentication and safety evaluation," they say.

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Know Your Risk Factors to Help Prevent Dementia

Oct. 5, 2012 Science Daily

Research shows that managing and treating vascular disease risk factors are not only beneficial to preventing heart disease and stroke, but also common forms of dementia.

Dr. Gustavo C. Roman, director of the Nantz National Alzheimer Center at the Methodist Neurological Institute in Houston, summed up decades of dementia-related research in a review paper in *Alzheimer's Disease and Associated Disorders*. Roman said although more definitive research is needed, focusing on the following risk factors can go a long way to helping reduce the risk of vascular dementia and mixed dementia (the combination of vascular dementia and Alzheimer's disease). By 2050, 11 to 16 million Americans will suffer some form of dementia.

Hypertension: Controlling blood pressure reduces the risk of stroke and heart disease. Studies are also beginning to show that hypertension increases the likelihood that people with mild cognitive impairment will eventually have dementia later in life.

Hyperlipidemia: Epidemiological studies show that in addition to cardiovascular disease, high blood pressure and diabetes, high blood cholesterol is an important risk factor for dementia, including Alzheimer's.

Smoking: Not only is smoking associated with increased risk of lung cancer, cardiovascular disease and emphysema, but it also adversely affects blood flow to the brain which can lead to cognitive decline and dementia.

Diabetes: Studies have already linked the obesity epidemic to increased risk of high blood pressure, metabolic syndrome, cardiovascular disease, stroke, renal failure, peripheral vascular disease, obstructive sleep apnea, and type 2 diabetes mellitus. In fact, people with this form of insulin resistant diabetes are two-to-three times more likely to face an Alzheimer's diagnosis, in part because of vascular complications.

Diet and Exercise: An overall healthy lifestyle decreases risk of dementia as people age, particularly vascular dementia. Here, the focusis on a low body mass index (25 or lower), healthy diet (based on dairy, meat, fish, fruits, vegetables, cereals, low alcohol, and the ratio of monounsaturated to saturated fat), and aerobic exercise.

Hyperhomocysteinemia: Homocysteine is an amino acid in the blood, and high blood levels are linked to an increased risk of developing Alzheimer disease. People who already exhibit signs of dementia and test positive for high levels of homocysteine are more likely to respond well to large doses of B vitamins. Research has proven that taking large doses of B-complex vitamins can reduce the rate of brain shrinkage by half in elderly people with memory problems and slow the progression of dementia.

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Fruits and Vegetables: Seven-A-Day for Happiness and Mental Health

Oct. 9, 2012 Science Daily

Happiness and mental health are highest among people who eat seven portions of fruit and vegetables a day, according to a new report.Economists and public health researchers from the University of Warwick studied the eating habits of 80,000 people in Britain. They found mental wellbeing appeared to rise with the number of daily portions of fruit and vegetables people consumed. Wellbeing peaked at seven portions a day.The research was carried out in conjunction with Dartmouth College in the USA and is due to be published in the journal *Social Indicators Research*.

Most western governments currently recommend '5 a day' for cardiovascular health and as protection against cancer risk.In Britain today, a quarter of the population eat just one portion or no portions of fruit and vegetables per day. Only a tenth of the British population currently consume the magic number of seven or more daily portions. The study does not distinguish among different kinds of fruits and vegetables and it defines a portion as approximately 80 grams.

Study co-author Professor Sarah Stewart-Brown, Professor of Public Health at Warwick Medical School, said "The statistical power of fruit and vegetables was a surprise. Diet has traditionally been ignored by well-being researchers."She emphasized that much remained to be learned about cause-and-effect and about the possible mechanisms at work, and that randomized trials should now be considered.

Fellow co-author, economist Professor Andrew Oswald from the Centre for Competitive Advantage in the Global Economy (CAGE) in the Department of Economics at the University of Warwick, said: "This study has shown surprising results and I have decided it is prudent to eat more fruit and vegetables. I am keen to stay cheery."

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With a Little Exercise, Your Fat Cells May Coax Liver to Produce 'Good' Cholesterol

Oct. 9, 2012 Science Daily

With a little exercise and dieting, overweight people with type 2 diabetes can still train their fat cells to produce a hormone believed to spur HDL cholesterol production, report medical researchers from The Methodist Hospital and eight other institutions in an upcoming issue of the *Journal of Lipid Research* (now online).

"What we're learning is that even overweight people who are physically active and eating a healthy diet are getting benefits from the lifestyle change," said principal investigator Christie Ballantyne, M.D., director of Methodist's Center for Cardiovascular Disease Prevention. "When you exercise and diet, you're improving the function of your adipose tissue, your heart and vascular systems, and even muscle performance. You're getting a lot of benefits that you may not see by just looking at the weight on a scale."

The Center for Cardiovascular Disease Prevention is part of the Methodist DeBakey Heart & Vascular Center.

Ballantyne said that while a causal relationship between adiponectin production and increases in blood HDL cholesterol levels is not yet proven, this latest study supports models putting the fat hormone somewhere in the controlling pathway of liver HDL cholesterol synthesis. Adiponectin's role in fat burning and sugar storage is well established.

Ballantyne and his team examined patient data from Look AHEAD, a project intended to clarify the relationship between obesity, diabetes, and cardiovascular disease. Look AHEAD is funded by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). To be eligible for Look AHEAD, participants must have been diagnosed with type 2 diabetes, and also deemed overweight or obese. Enrollees consent to an "intenstive lifestyle intervention" in which they become more physically active and limit their calorie intake.

Look AHEAD participants have had their blood drawn at regular intervals, with testing for various biomarkers, including HDL cholesterol and the fat hormone adiponectin, in its many forms. Study participants are also weighed and given a fitness (exercise stress) test.

After one year, Look AHEAD participants' adiposity (a measure of total fat), fitness, blood glucose levels, and fat levels were, on average, significantly improved. Levels of LDL, the so-called "bad cholesterol," did not change. But Adiponectin levels and HDL cholesterol did. Total adiponectin produced by fat cells increased about 12 percent relative to a control group, in which people received diabetes and obesity education but no intensive lifestyle modification. And HDL cholesterol went up nearly 10 percent.

HDL cholesterol correlates positively with overall cardiovascular health. It is not yet known for sure whether low HDL cholesterol causes cardiovascular problems, or whether both (low HDL and CV problems) are controlled in parallel by another, as-yet-unknown effector.

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Prebiotic May Help Patients With Intestinal Failure Grow New and Better Gut

Oct. 15, 2012 Science Daily

Adding the right prebiotic to the diets of pediatric patients with intestinal failure could replace intravenous feeding, says a new University of Illinois study.

"When we fed the carbohydrate fructooligosacharide (FOS) as a prebiotic, the gut grew and increased in function," said Kelly A. Tappenden, a U of I professor of nutrition and gastrointestinal physiology. "The study showed that using the correct pre- and probiotic in combination could enhance these results even more."

When FOS enters the intestines, bacteria convert it into butyrate, a short-chain fatty acid that increases the size of the gut and its ability to digest and absorb nutrients, she said.

But today's IV solutions don't contain butyrate and adding it would entail drug development trials and regulatory red tape. She wanted to see if adding this carbohydrate to the diet while continuing to provide most nutrients intravenously would cause the gut to start producing butyrate on its own. It worked.

According to Tappenden, at least 10,000 U.S. patients are totally reliant on intravenous feeding because their intestines have been surgically shortened.

Many of these patients are premature infants who develop necrotizing enterocolitis, a kind of gangrene of the intestine. In the U.S., one in eight infants is a preemie, and removing necrotized, or dead, intestine is the most common surgical emergency in these babies.

"Surgery saves their lives, but with so much intestine removed, they're unable to digest or absorb nutrients. These babies are also at risk for long-term complications, such as bone demineralization and liver failure. Our goal is to take kids who've had this resection and cause their gut to grow and adapt," she said.

She tested her hypothesis about butyrate using newborn piglets, an excellent model for the human infant in metabolism and physiology. Piglets with intestinal failure were assigned to one of four groups: a control group; a group whose diet contained FOS, a carbohydrate given as a prebiotic to stimulate the production of butyrate by beneficial bacteria; a probiotic, or actual live bacteria; and a combination of pre- and probiotics.

"We believed that bacteria in the gut would use the prebiotic to make butyrate and support intestinal growth. But we thought that might only happen in the group that received both pre- and probiotics because we didn't know if the newborn gut would have enough bacteria to make this important short-chain fatty acid."

Actually, the neonatal piglets did have enough bacteria in their guts, and the prebiotic alone was effective in increasing intestinal function and structure, she said.

"In fact, the probiotic that we used in one of the groups eliminated the beneficial effect of the prebiotic. That shows us that we need to be exceptionally careful in selecting the probiotic we use, matching it to the specific disease," she noted. Many consumers believe all probiotics are equal, but the effect of specific bacterial strains is different, she said.

"At this point, we can only recommend consumption of the FOS prebiotic alone," she added.

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New Ways of Eating Fruit

Oct. 16, 2012 Science Daily

Fruit must be an essential part of our diet. Experts recommend eating at least five servings of fruit and vegetables a day. However, the reality is quite different, since we are witnessing a gradual decline in consumption, especially among children. This is one of the reasons that made a team of Valencian researchers develop new products that could promote fruit consumption.

The main drawback affecting the stability and useful life of fruit is its high water content. So the scientists studied the best way to obtain more durable products that conserve most of its properties. For this they applied the techniques of lyophilisation, also called freeze-drying, and spray drying.

Grapefruit, kiwi and strawberries are the first fruits the researchers have turned into powder ready to sprinkle on other foods or as a functional ingredient in juices, purees, milk or tea. Another product they have presented is dried fruit slices that are perfect for a healthy snack. This is a new way to enjoy fruit with all its natural taste without losing its nutritional benefits.

According to Nuria Martínez Navarrete, researcher at the CUINA group from the Universitat Politècnica de València, fruit consumption is so low because fresh fruit only lasts a few days and this clashes with our current lifestyle that in many occasions prevents us from shopping daily, and because of this we consume more processed products that are long-lasting and easy to prepare. This tendency could change thanks to projects such as this one, as soon as the results are transferred to food companies.

"We are working with grapefruits, kiwis and strawberries. Grapefruit is a citrus fruit with great nutritional and functional value but its consumption is very small because, among other reasons, it is very bitter. Meanwhile, strawberries are a seasonal fruit. In powder, however, would open more markets" says Nuria Martínez. "We chose kiwis because of its high vitamin C content, an especially labile component that has enabled us to strengthen the result for the study of the impact of the technologies applied in the functional value of fruit."

The research results show that freeze-drying conserves the bioactive compounds that are responsible for the beneficial effects that grapefruit has on our health and also maintains its antioxidant property. According to the researchers, per 100 grams of fresh grapefruit, between 10 and 15 grams of powdered grapefruit are obtained. Half of this dose could flavour a serving of salad, for example, or if we add 85 millilitres of water we would be drinking the juice of half a grapefruit.

Another product the Universitat Politècnica de València is working on is dried fruit snacks, mainly of grapefruit and 'lulo', a typical fruit from Colombia whose acidity prevents consuming fresh. As part of a cooperation project with a Colombian University, the researchers plan to apply their discoveries to other Colombian typical products. The project also includes a part of nutrition information to help improve the diet of the local population.

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Consuming green tea often may lower the risk of digestive cancer

IFT Weekly Newsletter October 31, 2012

A study published in the *American Journal of Clinical Nutrition* shows that older women who regularly drink green tea may have slightly lower risks of colon, stomach, and throat cancers than women who don't drink tea.

The researchers used data from a long-running health study of 69,310 middle-aged and older Chinese women. More than 19,000 were considered regular green-tea drinkers, meaning that they consumed the beverage at least three times per week. None of the women smoked or drank alcohol regularly. And the researchers collected information on their diets, exercise habits, weight, and medical history.

Over 11 years, 1,255 women developed a cancer of the digestive system. The researchers found that in general, the risks were somewhat lower when a woman drank green tea often and for a long time. For example, women who said they'd regularly had green tea for at least 20 years were 27% less likely than non-drinkers to develop any digestive system cancer. And they were 29% less likely to develop colorectal cancer, specifically.

However, the researchers note that this study can't prove cause-and-effect and there is a need for clinical trials.

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Flavonoids may reduce stomach cancer risk for women

IFT Weekly Newsletter October 31, 2012

A study published in the *American Journal of Clinical Nutrition* shows that consuming flavonoids through food may be linked to a lower stomach cancer risk in women.

The researchers examined ongoing research following 477,312 men and women in 10 European countries who participated in the European Prospective Investigation into Cancer and Nutrition (EPIC) study. All of the participants were between 35 and 70 years old, and had been part of the study for about 11 years. Validated dietary questionnaires and lifestyle information were collected at baseline. A food-composition database on flavonoids and lignans was compiled by using data from U.S. Dept. of Agriculture and Phenol-Explorer databases.

During the 11 years, there were 683 cases of stomach cancer, of which 288 occurred in women. The researchers analyzed the participants' food diaries to see how many flavonoids they ate on average, and then they checked to see whether or not that amount was linked to the participant's cancer risk. They found that women who got more than 580 mg of flavonoids per day had a 51% lower risk of developing stomach cancer than women who consumed no more than 200 mg a day.

However, there was no link between flavonoid consumption and stomach cancer risk for men. In addition, it should be noted that other factors, such as a healthier lifestyle, may play a role in the findings.

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Increased flavonoid intake may reduce risk for aggressive prostate cancer

IFT Weekly Newsletter October 24, 2012

A study presented at the 11th Annual AACR International Conference on Frontiers in Cancer Prevention Research shows that a high total intake of flavonoids may help lower the risk of highly aggressive prostate cancer.

Prior preclinical studies have shown that flavonoids have beneficial effects against prostate cancer, but few studies have examined the effect of flavonoids on prostate cancer in humans.
The researchers used data from 920 African-American men and 977 European-American men in the North Carolina–Louisiana Prostate Cancer Project who were newly diagnosed with prostate cancer. Participants completed a self-reported dietary history questionnaire to assess flavonoid intake, which was measured using the U.S. Dept. of Agriculture's (USDA) 2011 Database for the Flavonoid Content of Selected Foods.

The researchers found that men with the highest total intake of flavonoids had a 25% lower risk for aggressive prostate cancer compared with those men with the lowest flavonoid intake.

"We found that higher total flavonoid intake was associated with reduced odds for aggressive prostate cancer in both African-American and European-American men, but no individual subclass of flavonoids appeared to be protective independently, suggesting that it is important to consume a variety of plant-based foods in the diet, rather than to focus on one specific type of flavonoid or flavonoid-rich food," said Susan E. Steck, Associate Professor at the Arnold School of Public Health at the University of South Carolina.

In addition, the risk for aggressive prostate cancer was even lower in those men younger than 65 and in current smokers with the highest levels of flavonoid intake. Dietary questionnaire results revealed that citrus fruits and juices, such as oranges and grapefruits, tea, grapes, strawberries, onions, and cooked greens were the top contributors to total flavonoid intake among the participants.

"The results support public health recommendations and guidelines from organizations such as the American Institute for Cancer Research to consume a more plant-based diet," said Steck. "In particular, consuming more flavonoid-rich foods may be beneficial for those people who are at increased risk for cancer, such as smokers."

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News in Food Science & Industry

GMO Cow Produces Hypoallergenic Milk

October 2, 2012 Food Product Design

HAMILTON, New Zealand—Researchers in New Zealand have successfully bred the first cow in the world to produce high-protein milk that may be hypoallergenic, according to a new study published in the journal Proceedings of the National Academy of Sciences (PNAS). The breakthrough has enormous implications due to its potential to reduce the significant impact milk allergies have on children.

Scientists at AgResearch's Ruakura campus were successful in greatly reducing the amount of beta-lactoglobulin (BLG), a milk whey protein that is not present in human breast milk and which can cause allergic reactions. The discovery is significant because 2% to 3% of infants are allergic to cow's milk, and BLG allergies make up a large part of that percentage, the researchers said.

The scientists first tested the process in a mouse model engineered to produce the sheep form of BLG protein in mouse milk. Employing a technique called RNA interference, two microRNAs (short ribonucleic acid molecules) were introduced into the mouse to knock-down the expression of the sheep BLG protein. This resulted in a 96% reduction in the sheep BLG protein in mouse milk.

Next, the scientists produced Daisy, a female calf genetically engineered to express the same two micro RNAs, this time to target the BLG protein that is also a normal constituent in cow's milk. They then hormonally induced Daisy to lactate. The resulting milk collected from Daisy had no detectable BLG protein and, unexpectedly, also had more than twice the level of the casein proteins that also normally occur in cow's milk.

"People have long looked into reducing this enigmatic protein, or completely knocking it out, because there has been no definitive function able to be assigned to it. So, we developed this scientific model to investigate the effect of knocking BLG protein out on the composition and functional properties of milk, and to determine whether the absence of BLG produces cow's milk that is hypo-allergenic," said co-author Dr. Stefan Wagner. "This is the real discovery component to this project, and Daisy provides us with the opportunity to answer a lot of those questions."

To avoid the delay of two years before a natural lactation, the milk the scientists analyzed was from an induced lactation. They only obtained small quantities over a few days for these initial studies. They now want to breed from Daisy and determine the milk composition and yield from a natural lactation. They also want to investigate the origin of Daisy's taillessness, a rare congenital disease in cows.

In the future, the basic process of using designer microRNAs to target other genes could provide an efficient tool to change additional livestock traits, for example to produce animals with enhanced disease resistance and/or improved lactation performance, the scientists said.

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Fish Oil As a Replacement Oil in Nutrition Bars

October 1, 2012 Food Product Design

CHICAGO—Partially replacing canola oil with fish oil in nutrition bars can provide the health benefits of omega-3 fatty acids without affecting the taste, according to a new study published in the Journal of Food Science.

Producers have been hesitant to incorporate omega-3 fatty acid rich fish oil into foods because it tends to give off a fishy taste or smell, therefore, requiring additional processing steps to eliminate these unwanted qualities.

For the study, scientists at the University of Maine successfully fortified nutrition bars with non-encapsulated, non-emulsified fish oil to deliver 178 mg eicosapentaenoic acid (EPA) and docosahexaenoic (DHA) per 35 g serving. The bars were sealed in opaque bags and stored in a stability chamber at 25°C and 50% relative humidity for 10 weeks to assess oxidative stability. The results showed oat and soy-based nutrition bars fortified with the lowest replacement level (20%) of fish oil did not affect consumer acceptance or purchase intent.

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Dietary Fiber Market to Reach $3.25 Billion by 2017

Nutraceuticals World October 29, 2012

A new report from Markets and Markets predicts the global dietary fiber market will expand to $3.25 billion by 2017, driven by an aging population and growing understanding of health benefits.

The report, titled "Dietary Fiber Market by Product Type (Conventional/ Novel & Soluble/ Insoluble) and Application (Food & Pharmaceuticals) - Global Trends & Forecasts up to 2017," defines and segments the global dietary fiber market with analysis and forecasting of the global volume and revenue for dietary fibers and novel fibers in particular. It also identifies driving and restraining factors for the global dietary fiber market with analysis of trends, opportunities, burning issues and challenges.

The market is segmented and revenues are forecasted on the basis of major regions such as North America, Europe, Asia-Pacific and Rest of the World (ROW). The key countries are covered and forecasted for each region. Further, market is segmented and revenues are forecasted on the basis of applications, types, and sub-types of dietary fibers.

According to the report, the vegetable oil market will be valued at an estimated $1.4 billion in 2011. This value is expected to increase at a CAGR of 14.1% from 2012 to 2017. North America leads the global dietary fiber market with share of 36% followed by Europe (31%) and Asia-Pacific (17%) in terms of revenue in the year 2011.

The major drivers for dietary fiber global market growth are the ever-growing aging population, growing consumption by the supplement segment, the advantage provided by its low cost and growing consumer perception about health benefits of fibers. The heavy level of regulation from the FDA poses the most formidable barrier to entry in this industry sector, as product testing and approval can be a lengthy and costly process. Also compliance with existing regulations during the manufacturing stage can increase production costs to prohibitive levels for all but the well-capitalized firms. Such factors can act as restraints in an otherwise promising market scenario.

North America holds major market share in dietary fiber market. Europe is the second largest consumer. R&D initiatives by companies and government has helped manufacturer to get the first mover advantage, on the basis of stability during processing and also the desired health benefits to the end-consumer.

North America market share is 36% in the global dietary fiber revenue market; Europe has 31% of share. However it is still the Asia-Pacific region that is on the rise with a CAGR of 20% from 2012 to 2017. The dietary fiber market by application is segmented into the key segments as food and pharmaceutical applications. Although, the food applications occupy a major share in the consumption market, the dietary supplement segment, boosted by the soluble fiber requirements, is expected to be the fastest-growing segment, going ahead.

Among various types of dietary fiber marketed, insoluble conventional dietary fibers occupy in excess of 55% of the

market share. However, with extensive R&D investments, growing need for alternative sources of fibers, technological limitations in the use of insoluble fibers and the burgeoning supplement market, soluble novel fibers are increasingly becoming the variant of choice in most applications.

The dietary fiber market report also touches on various other important aspects of the market. It includes an analysis of the competitive landscape and the patent analysis. In addition, 20 key players of this market have also been profiled.

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How Food Marketers Can Help Consumers Eat Better While Improving Their Bottom Line

Oct. 11, 2012 Science Daily

Food marketers are masters at getting people to crave and consume the foods that they promote. In this study authors Dr. Brian Wansink, co-director of the Cornell University Center for Behavioral Economics in Child Nutrition and Professor of Marketing and Dr. Pierre Chandon, professor of Marketing at the leading French graduate school of business, INSEAD challenge popular assumptions that link food marketing and obesity.

Their findings presented last weekend at the Association for Consumer Research Conference in Vancouver, Canada point to ways in which smart food marketers can use the techniques that peak consumer appetite for calorie-dense fast foods to help people eat better -- and improve their bottom line as well.

"People generally want food that tastes good while being affordable, varied, convenient and healthy -- roughly in that order. Our research suggests that consumption of healthy and unhealthy food respond to the same marketing tactics, particularly price reduction. In this study we present food marketers with a 'win-win' situation in which they can turn the tables, compel consumers to eat healthier foods, and maintain profitability. For example, marketers can steer consumers away from high-calorie sugary drinks by offering meal discounts if a person buys a diet drink -- or by offering a healthy habit loyalty card when consumers opt for milk, juice or water instead of sugary drinks. "When all sides win, no one resists," Wansink said.

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Regulatory & Safety News

Dietary Supplements: Structure/Function Claims Fail To Meet Federal Requirements

Nutraceuticals World October 3, 2012

The U.S. Department of Health & Human Services Office of Inspector General has issued a report warning that many weight loss and immune support supplements are illegally labeled and lack the scientific evidence warranted to use those structure/function claims. The agency sampled and analyzed 127 weight loss and immune support dietary supplements and found 20% bore illegal claims.

"Overall, substantiation documents for the sampled supplements were inconsistent with FDA guidance on competent and reliable scientific evidence," the agency stated in a press release. "FDA could not readily determine whether manufacturers had submitted the required notification for their claims. Seven percent of the supplements lacked the required disclaimer, and 20% included prohibited disease claims on their labels. These results raise questions about the extent to which structure/function claims are truthful and not misleading.

"We recommend that FDA seek explicit statutory authority to review substantiation for structure/function claims to determine whether they are truthful and not misleading," the press release continued. "We recommend that FDA improve the notification system for these claims to make it more organized, complete, and accurate. We also recommend that FDA expand market surveillance to enforce the use of disclaimers for structure/function claims and to detect disease claims. In its comments on the draft report, FDA did not explicitly concur with our first recommendation, but said it would consider it. FDA concurred with our second and third recommendations."

Following are responses from the supplement industry.

Council for Responsible Nutrition – Steve Mister, president and CEO:"We are disappointed that despite the fact that the large majority of dietary supplement companies in this industry are holding up their end of the bargain with consumers, there are still some companies that are not meeting their obligations under the law. Further, we are concerned by FDA's apparent lack of enforcement against problems that are easily visible and clearly illegal. Both the industry and FDA should do better on behalf of the more than 150 million Americans who take dietary supplements."

CRN said consumers need to be aware that dietary supplements cannot be sold with labels that specifically promise to treat, cure, prevent or mitigate a disease, to which Mr. Mister added, "We hope that FDA will take immediate action against these companies whose mislabeling makes those products adulterated under the law."

CRN said it was "also dismayed at the lack of supporting science provided by some of the companies whose products were reviewed—one even using a handwritten college term paper to support its structure/function claims. Companies selling legitimate products need to have in their possession reputable scientific literature to support claims, and we believe our member companies do. Handwritten papers, your own advertisements, or your mother's blessing just don't cut it. What is acceptable for structure/function claims under the government's regulations is a variety of credible evidence including results from animal, observational, and randomized clinical trials."

CRN also stated that the IOG report is not a representative sample of the industry's products.

National Products Association – John Shaw, executive director and CEO:“More than half of all Americans take dietary supplements safely and effectively as part of a healthy lifestyle. The Office of Inspector General reviewed just 127 supplements out of an estimated 29,000 products on the market. This small sample of supplements shouldn’t smear the entire industry. The report itself says they do not intend for the results to be generalized to all dietary supplements.

“Nevertheless, this report puts supplement makers on further notice about their responsibilities under the law. The Natural Products Association is concerned any time a violation may be found with a supplement label and it’s an issue we take seriously. Supplement makers must be sure to register their facilities with the FDA, include a phone number or address for adverse event reports, keep substantiation on file for any structure/function claims, notify the FDA before marketing their products, and not make disease claims.

“It’s important to emphasize that dietary supplements are part of a fully-regulated industry. NPA has been steadfast in supporting increased resources for the FDA. We agree with the OIG that the FDA should streamline the notification process and expand market surveillance, and we encourage the FDA to take swift and appropriate action against those who have shown a blatant disregard for the law.”

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Beijing Invests $11M in Food-Safety Rapid Test

October 3, 2012Food Product Design

BEIJING—China Health Labs & Diagnostics Ltd. announced it received an $11.6 million order from the Beijing municipal government for food-safety products and its Type B BK Food Safety Rapid Test System (BK-iRT) that was launched in March 2012. The move by the Beijing government is part of China’s commitment to significantly improve food safety by increasing its budgets for monitoring and enforcement of regulations.

On June 15, 2012, China released a 5-year plan to upgrade its food-safety regulations as part of the country's latest efforts to address critical food-safety concerns. As outlined by the plan, the government will improve national food-safety standards by revamping outdated standards, reviewing and abolishing any contradicting or overlapping standards and working out new regulations. Currently, China has more than 2,000 national food regulations and more than 2,900 industry-based regulations—many of which are overlapping or contradict each other, since multiple government agencies were given the responsibility of compiling their own standards years ago.

The BK-iRT is a compact and mobile food-safety testing solution and can conduct approximately 100 rapid and accurate types of tests, including food additives, physicochemical, veterinary drug residues, biotoxin tests, heavy metal residues and prohibited additives. The solution also includes an information management module equipped with a 3G telecommunication function to transmit and communicate data with a network of mobile and stationary labs, which allows data sharing, real-time monitoring and dynamic instructions. Other target markets for the BK-iRT include food distribution centers and facilities, such as canteens for large organizations, hospitals and universities.

Commenting on the deal, Wilson Yao, CEO and President of China Health, said: "We are pleased to win the bid with the Beijing municipal government to deliver our BK-iRT product and other food safety products, which will be used by Beijing's food safety detection units in monitoring the thousands of food preparation and distribution nodes in Beijing. The company is well positioned with its past success in delivering to the Chinese government effective solutions to address food-safety concerns and also in developing new products to meet future demands."

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