REVIEW OF LITERATURE
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RELATED STUDIES

Gamlath and Ravindran (2009) investigated on the effects of fenugreek flour (Trigonella foenum-graecum) and de-bittered fenugreek polysaccharide (FenuLifeReg.) inclusion on the physical and sensory quality characteristics, and glycemic index (GI) of chickpea-rice based extruded products. Based on preliminary evaluation with different proportions of chick pea and rice, a blend of 70:30 chickpea and rice was chosen as the control for further studies. The control blend, replaced with fenugreek flour at 2%, 5% and 10%, or fenugreek polysaccharide at 5%, 10%, 15% and 20%, was extruded at the optimum processing conditions as specified in the detailed study. The extruded products were evaluated for their physical (moisture retention, expansion, hardness, water solubility index (WSI) and water absorption index (WAI)), sensory (flavor, texture, color and overall acceptability) characteristics and in vitro GI to evaluate their suitability as extruded snack products. Due to the distinct bitter taste, inclusion of fenugreek flour was not acceptable at levels more than 2% in extruded chickpea based products. Addition of fenugreek polysaccharide resulted in slight reduction in radial expansion (P<0.05), while longitudinal expansion increased. WAI increased while WSI decreased compared to the control (P<0.05). The mean scores of sensory evaluation indicated that all products containing fenugreek polysaccharide up to 15% were within the acceptable range. There were no significant differences (P>0.05) between products containing 5-15% fenugreek polysaccharide in their color, flavor, texture and overall quality. Fenugreek, in the form of
debittered polysaccharide (FenuLifeReg.) could be incorporated up to a level of 15% in a chickpea-rice blend to develop snack products of acceptable physical and sensory properties with low GI Index.

Radovanovic et al., (2015) studied the use of dry Jerusalem artichoke (JA) as a functional nutrient in developing food products with enhanced nutritional characteristics and low glycemic index (GI). Three different formulations based on buckwheat and JA was developed and processed using extrusion technology. Nutritional properties including the levels of total dietary fibre (TDF), protein, inulin, total carbohydrates and lipids were analyzed. A clinical study was performed on ten healthy volunteers (aged between 21 and 56) to determine the level of GI and glycemic load (GL). The results revealed that JA significantly (P< 0.05) increased the levels of TDF and inulin whilst decreasing carbohydrates, lipids and proteins. The resulting products had a significant (P< 0.05) effect on IAUC between reference food and extruded products, GI and GL. Samples containing 80% of Jerusalem artichoke were considered as a low GI food whilst samples containing 30% and 60% of Jerusalem artichoke as a medium GI food. A similar trend was seen in terms of GL.

Demi et al., (2010) investigated on raw and cooked chickpea flours (CPF) used in eriste (a Turkish wheat noodle product) formulations at different levels (10, 20, 30, 40 and 50% w/w) with and without whole egg addition. Some selected properties of eriste, including colour, wt. and vol. increased. Cooking loss, ash, protein, minerals, phytic acid (PA) contents, and sensory properties were determined. Eriste containing cooked CPF without egg showed the darkest colour. While egg addition improved the cooking quality,
CPF at >20% addition level decreased wt. and vol. increase values significantly (P < 0.05). Ash, protein, Ca, K and P contents increased with egg addition and increasing amount of CPF. Use of cooked CPF decreased the PA content from 376.4 to 320.2 mg/100 g. However, CPF substitution increased the PA content up to 515.3 mg/100 g. Eriste made with 30-40% raw CPF and egg showed the highest overall acceptability score. It is concluded that raw CPF at a level of 20-30% with whole egg addition can be used in eriste formulation for nutritional enrichment with minimum adverse affect on colour and functional properties.

Wang, (2014) studied the preparation of gluten-free pasta/noodle products from pulse starches and flours by high temperature extrusion process, and how factors such as processing parameters and properties of raw materials affect product quality characteristics were discussed. Gluten-free pasta/noodle products from pulses will be nutritional and functional alternatives to wheat-based pasta for consumers who are allergic to wheat gluten.

Bourre et al., (2014) evaluated the effect of adding high or low protein yellow pea flour on the physical and sensory properties of steam deep fried and steam air dried instant noodles. Yellow pea flour was produced by collecting different streams of a roller milled yellow pea flour and combining them to produce a flour with a high (26.4%) and low (21.2%) protein content. These flours were blended with Canadian western red spring wheat at levels of either 5 or 15% and processed into noodles using an Ohtake noodle machine. Dough crumb and dough block properties were evaluated during processing. The elasticity and stickiness of the cooked noodles were
evaluated using a TA_XT Plus texture analyzer. A trained sensory panel evaluated the noodles for color, flavor, aroma and texture. Instrumental texture evaluation showed that noodles containing 5% yellow pea flour were significantly more elastic (P <= 0.05) than those formulated with 15% yellow pea flour. Noodle elasticity was also affected by protein content with the high protein content flour producing noodles that were significantly less (P <= 0.05) elastic than those made with low protein yellow pea flour. Similarly to what was observed with instrumental texture, the trained sensory panel was able to detect differences among the noodles. Significant differences (P <= 0.05) were observed for color, flavor and different texture attributes. However, the trained panelists found greater differences between the levels of inclusion compared to the use of high and low protein yellow pea flours.

Bilgicli, (2013) investigated on some legume (chickpea and soya), pseudo-cereal (buckwheat and quinoa) and cereal (maize and rice) flour blends were used in gluten-free noodle formulations. All flour blends were gelatinized at a level of 25% in order to improve the dough forming ability. Noodle containing chickpea, soya, buckwheat and quinoa flours (flour blend 1) showed higher levels of protein (194.2 g/kg), ash (27.8 g/kg), lipids (81.2 g/kg), calcium (562.85 mg/kg), copper (9.20 g/kg), iron (56.29 mg/kg), potassium (295.21 mg/kg), magnesium (661.78 mg/kg), manganese (24.07 g/kg), phosphorus (042.88 mg/kg) and zinc (40.24 mg/kg) contents than other gluten-free noodles and control noodle made with wheat flour. Phytic acid content increased up to 9.2 times in gluten-free noodle samples compared to control. Noodle containing buckwheat, quinoa, maize and rice flours (flour
blend 3) was liked the most by the panel lists in terms of overall acceptability score, though less than the control noodle.

Ning et al., (2014) investigated on starches from several varieties of field pea and lentil was extracted using a laboratory wet milling procedure, and noodles from those starches were prepared by high temperature extrusion process. Physico-chemical properties of the starches and characteristics of their noodles were investigated. Pea starch had significantly higher amylose content than lentil starch. Mean starch granule size for pea starch was larger than that for lentil starch. Lentil starch exhibited significantly higher swelling power, but lower solubility than pea starch. Pasting temperature and peak and breakdown viscosities were significantly higher, whereas setback and final viscosities were significantly lower for lentil starch than for pea starch. Amylose content was positively correlated with solubility ($r = 0.693, p < 0.05$) and setback ($r = 0.851, p < 0.01$) and final ($r = 0.797, p < 0.05$) viscosities, but negatively correlated with swelling power ($r = -0.796, p < 0.05$). Pea starch noodles prepared by extrusion cooking displayed significantly lower expansion ratio, and were less bright in color than lentil starch noodles. Noodles from pea starch exhibited significantly lower cooking loss and higher cooked weight than those from lentil starch. Textural analysis showed that cooked pea starch noodles displayed significantly higher firmness values, but lower surface stickiness than cooked lentil starch noodles. Cooked noodles from starch of smaller granule size, lower amylose, higher swelling power, and lower setback and lower final viscosities exhibited lower firmness, but higher surface stickiness. Cooked pea and lentil starch
noodles exhibited superior texture when compared to the commercial mung bean noodles prepared by traditional method.

Pragati and Sharma, (2014) investigated on noodles produced by blending varying proportions (20, 30, 40, 50, and 60% levels) of taro flour with remaining equal proportions of rice and pigeon pea flour, which were evaluated for anti-nutritional, cooking, textural, and sensory properties and possible correlations between various noodles' properties were established using principal component analysis. Anti-nutritional evaluation of noodles revealed a decrease in phytic acid content, as the percentage of taro flour in the noodles increased. Pasting properties of the blends were also measured, which differed significantly (P < 0.05). Taro flour addition produced noodles with decreased gumminess, adhesiveness, $b^*$ value, and increased $a^*$ value as compared to the control sample (100% wheat flour). Significant correlations among various noodle properties were established using principal component analysis. Texture and color can be adopted as distinguished parameters for analyzing the noodle samples using a principal component analysis loading plot. Noodles containing 50% taro flour, with remaining equal proportions of rice and pigeon pea flour resulted in the highest scores for color, taste, firmness, and overall acceptability.

Nagi, (2012) studied the uses of processed legumes (chick peas and pigeon peas) as ingredients in bread, cookies and pasta products. The legumes were processed by germination, boiling, pressure cooking and roasting, and were added to durum wheat semolina at concentration of 0, 5, 10, 15, 20 and 25% for the preparation of bakery products and pasta. Results indicated that addition of legumes at levels of <=15% led to acceptable bread
and cookies. Loaf bread vol. decreased with increases in legume contents. Addition of 5% legumes led to max. spread ratio in cookies. Cooking time of noodles supplemented with processed legumes was similar to control values. Water absorption and gruel losses increased with increases in legume contents. Legume-enriched pasta products were acceptable at up to 20%. Colour quality was affected at higher supplementation levels. Best results were achieved by addition of legumes subjected to germination followed by boiling.

Endo, (2006) developed the process for low-carbohydrate noodle. A low carbohydrate, high protein noodle consists of: wheat flour (100 parts wt.); soy meal (60-500 parts wt.); activated gluten at 15-60 parts wt. based on 100 parts wt. of soy meal; and devil's tongue (elephant yam) powder at 1-10 parts wt. based on 100 parts wt. of soy meal. Patent

Ota, (2011) developed the process for low calorie noodle. A method for producing low calorie noodles is described, in which a sol based on glucomannans, such as konjac (elephant yam) glucomannans, as a main ingredient is blended with starch or cereal powder, mixed with an alkali metal salt as a coagulant, continuously extruded through a perforated plate and boiled. Patent

Brennan et al., (2008) worked on five dietary fibre rich ingredients used at 5, 10 and 15% replacement levels in a white flour cereal base to produce an extruded cereal product. The inclusion of the dietary fibres into the flour bases had no significant effect on the expansion ratio of the products. However, the bulk density of the extruded products increased with inulin addition. The pasting properties of the raw flour and fibre base, as well as the
extruded products, were altered with the incorporation of dietary fibre, with guar gum enriched products showing elevated peak and final viscosity readings. This appeared to be related to moisture manipulation and hence the regulation of gelatinization. In vitro starch hydrolysis of the raw bases and the extruded samples illustrated that the extrusion process significantly increased the availability of carbohydrates for digestion. Additionally, the inclusion of dietary fibres in the raw bases significantly reduced the rate and extent of carbohydrate hydrolysis of the extruded products. As such, the addition of dietary fibres to extruded products reduced the amount of readily digestible starch components of breakfast products and increased the amount of slowly digestible carbohydrates.

Smrckova et al., (2015) investigated on the influence of composition of an extrusion mixture and processing parameters of extrusion on content of SDS in extrudates. Model mixtures contained fine corn grits used as the basic component and the following additional components: pea flour or three chemically modified starches (A-starch, Moramyl ZBH or Moramyl ZB). Water addition was 5 and 10 wt%. Extrusion was performed on a laboratory scale using a KE 19/25 laboratory extruder (Brabender, Germany). Feed rates, screw speeds, compression ratios of the screw, temperature distributions along the extrusion barrel, die diameters, and pressure on the head were monitored during extrusion. SDS content in extruded corn grits was 57.4%. The highest value of SDS content was reported for an extrudate from a model mixture with 10% of modified starch Moramyl ZBH and 10% of water addition. Application of pea flour (20%) resulted in 67.2% of SDS content. The highest value of SDS (66.8%) in the extrudate in combination with acceptable sensory
properties was found for a formula with 10% fraction of cross-linked starch Moramyl ZBH and 5% water addition.

Bharath and Prabhasankar, (2015) assessed the influence of Pea Flour (PF) in noodle processing, thermally processed pea flour was incorporated at 20 % and 40 % in the preparation of noodles using Lab scale Noodle Making Machine. Evaluation for Physico-chemical, rheological and noodle making characteristics, in vitro starch digestibility (IVSD) and microstructure of noodles were carried out. Cooking quality did not show any significant difference among the samples, with solid leach out ranging from 6.7 to 7.2 % against control (6.5 %). Colour measurement showed the presence of greenish colour in PF incorporated samples. Texture was firmer in fresh noodles (FN) (5.52 Newton (N), 6.00 N) and dried noodles (DN) (7.60 N, 7.86 N) compared to control (4.38 N-FN, 6.88 N-DN). Sensory analysis of noodles revealed that the samples (FN, DN) were acceptable at 20 % and 40 % levels with overall quality score (>8.5). In vitro analysis revealed that with increase in PF content there was a significant decrease in the availability of glucose in DN followed by FN compared to control. Overall RDS was reduced and SDS was increased in 40% PF incorporated FN. Scanning-electron microscopy revealed the presence of fiber matrix around the starch granules.

Ping et al., (2014) evaluated starch constitution and nutritional quality of several kinds of starch noodles by determining total starch, apparent amylose, soluble amylose, insoluble amylose, and crystal structure. The results indicated that Legumes starch noodles (Pea starch noodles and Mung bean starch noodles) have higher apparent amylose, insoluble amylose, and resistant starch (RS) than others and had lower eGI (estimated glycemic
index) value (101.47 ~ 102.8), Kudzu starch noodles has the highest rapidly
digestible starch (RDS) content (p<0.05) and possessed the highest
hydrolysis index (125.53). The eGI value has apparently negative correlation
with RS content and insoluble amylose content. The results also showed that
Legumes starch noodles owned lower eGI than other experimental subjects,
which is more suitable for patients with non-insulin dependent diabetes,
diabetes and cardiovascular disease to limited intake.

Ranawana et al., (2009) studied the glycemic response in 9 types of
rice (white basmati, brown basmati, white and brown basmati, easy-cook
basmati, basmati and wild rice, long-grain rice, easy-cook long-grain rice, Thai
red rice, Thai glutinous rice) and 2 types of rice vermicelli (Guilin rice
vermicelli, Jiangxi rice vermicelli) commercially available in the United
Kingdom were compared against a glucose standard in a non-blind,
randomized, repeated-measure, crossover design trial. 14 healthy subjects (6
males, 8 females), mean age 38 (s.d. 16) yrs and mean body mass index 21.3
(s.d. 2.3) kg/m2, were recruited for the study. Subjects were served portions
of the test foods and a standard food (glucose), on separate occasions, each
containing 50 g available carbohydrates. Capillary blood glucose was
measured from finger-prick samples in fasted subjects (-5 and 0 min) and at
15, 30, 45, 60, 90 and 120 min after the consumption of each test food. For
each type of food, its glycemic index (GI) was calculated geometrically by
expressing the incremental area under the blood glucose curve as a
percentage of each subject’s average incremental area under the blood
glucose curve for the standard food. The 10 foods exhibited a range of GI
values from 37 to 92. The study indicated that rice noodles, long-grain rice,
easy-cook long-grain rice and white basmati rice were low-GI foods, whilst all of the other foods were medium-GI and high-GI foods.

Hyeon et al., (2015) investigated on brown rice flour utilized as a functional ingredient in instant fried noodles and their quality attributes were characterized from the standpoint of physicochemical characteristics. The pasting results showed that there was an increasing tendency in the peak, trough, and final viscosities of wheat flour with increasing amounts of brown rice flour. The thermal conductivity of the noodle dough with brown rice flour had a lower value of thermal conductivity. When the noodles were subjected to frying, the brown rice flour did not play a negative role in the oil absorption of the instant fried noodles. The use of brown rice flour contributed to retarding the oxidative deterioration of the instant fried noodles during storage. While the breaking stress of instant fried noodles before cooking increased with increasing amount of brown rice flour, the tensile properties of the noodles were lowered after cooking.

Jeong and Suyong, (2014) investigated on brown rice flour, utilized as a health-functional ingredient for extruded gluten-free noodles. Thus, its functional qualities were evaluated. Brown rice flour had greater resistance to dough mixing, whereas the thermo-mechanical values were reduced during heating and cooling. During extrusion, the presence of more non-starch components in brown rice flour led to a lower degree of gelatinization that could be related to the lower cold initial viscosity and expansion ratio of noodles. The structural matrix of the noodles seemed to be weakened by brown rice flour, thereby reducing the breaking strength and tensile properties of the noodles and increasing their cooking loss. However, brown rice noodles
exhibited significantly higher 2,2-diphenyl-1-picrylhydrazyl radical scavenging activity, ferric reducing powder, and 2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid radical-scavenging activity by 21-, 28-, and 21-fold, respectively, than white rice noodles. Thus, extruded noodles with enhanced antioxidant activities were successfully produced with brown rice flour, probably encouraging food industry to develop a variety of brown rice products with health benefits.

Nestel et al., (2004) investigated on the effects of chick pea-based and wheat-based foods on insulin sensitivity in healthy, middle-aged men and women in acute and long term studies. In the acute study (n = 19), plasma glucose, insulin and an index of insulin sensitivity (calculated homeostasis model assessment; HOMA) were measured on 3 separate days for >3 h after consumption of 50 g carbohydrate loads from either chick peas, wheat-based foods (mainly wholegrain cereals) or white bread. The long term experiment (n = 20) was a randomized, cross-over study in which chick peas and wheat-based foods were eaten for 6 wk each. Plasma glucose concn. were significantly lower 30 and 60 min after the single chick pea meal than after the other 2 meals (P<0.05), and plasma insulin levels and HOMA were significantly reduced after 120 min (P<0.05). However, the long term study failed to show significant differences in plasma glucose, insulin or HOMA, either in the fasting state or after a glucose load.

Silva et al., (2010) studied on cooked seeds of 3 Mexican pulses (black bean, chick pea, and lentil) were evaluated regarding their chemical composition, in vitro starch digestibility, polyphenols content and antioxidant capacity. The highest protein contents were recorded in chick peas and lentils
with no difference between them. Black bean presented the highest dietary fibre, resistant starch, and total indigestible fraction contents. The highest polyphenols and anthocyanins contents were shown by lentil and black bean, respectively. However, black bean exhibited the highest antioxidant capacity, which suggested an important role for anthocyanins in this effect. Present data confirm these legumes as a good source of indigestible carbohydrates and natural antioxidants; their consumption might have a role in preventing diabetes and other chronic degenerative diseases.

Hannan et al., (2007) investigated on Trigonella foenum-graecum (fenugreek) seeds, as a traditional plant treatment for diabetes. This study evaluated the antidiabetic properties of a soluble dietary fibre (SDF) fraction of T. foenum-graecum. Administration of SDF fraction (0.5 g/kg body wt.) to normal, type 1 or type 2 diabetic rats significantly improved oral glucose tolerance. Total remaining unabsorbed sucrose in the gastrointestinal tract of non-diabetic and type 2 diabetic rats, following oral sucrose loading (2.5 g/kg body wt.), was significantly increased by T. foenum-graecum (0.5 g/kg body wt.). The SDF fraction suppressed the elevation of blood glucose after oral sucrose ingestion in both non-diabetic and type 2 diabetic rats. Intestinal disaccharidase activity and glucose absorption were decreased and gastrointestinal motility increased by the SDF fraction. Daily oral administration of SDF to type 2 diabetic rats for 28 days decreased serum glucose levels, increased liver glycogen content and enhanced total antioxidant status. Serum insulin and insulin secretion were not affected by the SDF fraction. Glucose transport in 3T3-L1 adipocytes and insulin action were increased by T. foenum-graecum. These findings indicate that the SDF
fraction of *T. foenum-graecum* seeds exerts anti-diabetic effects mediated through inhibition of carbohydrate digestion and absorption, and enhancement of peripheral insulin action.

Priyali *et al.*, (2000) demonstrated the beneficial hypoglycaemic effects of millets, fenugreek seeds and legumes in diabetic subjects. However, the bitter flavour of fenugreek seeds and coarse nature of millets have limited their use. In this study, combinations of millets, fenugreek seeds and legumes, after suitable processing, were used to formulate 3 nutritious food products: dhokla (leavened steamed cake), uppuma (kedgeree) and laddu (sweet balls), which are popular traditional snack foods in India. Evaluation of these food products for glycemic response in 5 normal and 5 diabetic subjects showed hypoglycemic effects in terms of glycaemic-index (GI). The highest GI was observed for dhokla (34.96), followed by laddu (23.52) and uppuma (17.60) in normal subjects. All 3 food products differed significantly from each other in GI. Comparison of GI of all 3 food products in normal subjects with diabetes did not show significant differences (P approx. 0.05). Food products were well tolerated and acceptable to subjects and it is suggested that they may be useful in dietary management for diabetic people and may cater for their needs on a large scale if commercialized.

Hye *et al.*, (2015) investigated on the effects of hydrocolloid type (guar gum, sodium alginate, xanthan gum) and addition levels (0%, 2%, 4%) on the retardation of in vitro starch digestibility in noodles made by various cereal flours (wheat, whole wheat, buckwheat) and their cooking and textural qualities were evaluated. The predicted GI (pGI) of noodles made by wheat or whole wheat flour was significantly decreased by adding hydrocolloids.
However, the pGI of buckwheat flour-based noodles with hydrocolloids was slightly increased. Nonetheless, adding hydrocolloids in all noodles positively modified cooking quality regardless of flour type. The hydrocolloids addition in wheat flour-based noodles produced noodles with improved cooking quality and a texture similar to control noodle while still providing reduced starch hydrolysis and pGI. Thus, the nature of flours, the levels and type of hydrocolloids, and their appropriate combination can be used to control in vitro starch digestibility and noodle quality.

Renjusha et al., (2015) studied the effect of a resistant starch source, NUTRIOSEReg. FB06 at 10%, 15% and 20% in sweet potato flour (SPF) and 5% and 10% in sweet potato starch (SPS) in reducing the starch digestibility and glycaemic index of noodles was investigated. While NUTRIOSE (10%) significantly reduced the cooking loss in SPF noodles, this was enhanced in SPS noodles and guar gum (GG) supplementation reduced CL of both noodles. In vitro starch digestibility (IVSD) was significantly reduced in test noodles compared to 73.6 g glucose/100 g starch in control SPF and 65.9 g in SPS noodles. Resistant starch (RS) was 54.96% for NUTRIOSE (15%) + GG (1%) fortified SPF noodles and 53.3% for NUTRIOSE (5%) + GG (0.5%) fortified SPS noodles, as against 33.8% and 40.68%, respectively in SPF and SPS controls. Lowest glycemic index (54.58) and the highest sensory scores (4.23) were obtained for noodles with 15% NUTRIOSE + 1% GG.

Vaibhav et al., (2014) showed that the blends prepared with different levels of chickpea flour (CF) and durum semolina (0-60%) and were utilized for understanding their influence on product quality. Proximate analysis and rheological characterization of blends were carried out. Noodles were
developed and subjected to different physico-chemical, nutritional, cooking quality and sensory analysis, scanning electron microscopy (SEM). Optimized noodles on the basis of its sensory and cooking quality characteristics were improved with different hydrocolloids. Rheological studies revealed that with the increase in the CF content, Farinograph water absorption and dough stability decreased; simultaneously increase in dough development time. Maximum over pressure and curve configuration decreased with increase in CF. Based on the sensory and cooking loss of noodles 50% formulation was improved with hydrocolloids. Noodles cooking loss reduced to 5.9% with the addition of guar gum. Sensory scores for the noodles were above 8 in 15 cm scale. Colour value showed an increase in "b" value, indicating increase in yellowness of samples. Texture of noodles became firm with the addition of CF. IVSD (in vitro starch digestibility) reduced from 71 to 29%. There was a network like formation due to hydrocolloids was observed in SEM, which is the reason for slow release of glucose. Thus, can be used as substitution in noodles and can be included in the diet of mal-nutrition and diabetic population.

Vernaza and Chang, (2012) studied the effects of the addition of salt and guar gum on the technological properties of instant noodles, and also studied the relationship between the water absorption obtained using a farinograph with the optimum water absorption for instant noodles production when salt and guar gum are added. A 22 complete factorial design was followed, which permitted the analysis of the results by Response Surface Methodology. The results showed that the addition of salt (0-3%) and guar gum (0-1.5%) in instant noodles production changed the properties of the
dough and the quality of the final products. The highest values of fat absorption and the lowest values of firmness were obtained when medium levels of the two variables were used (0.5-1% guar gum and 1.12-1.80% salt).

It was possible to find a relationship between the water absorption obtained with the farinograph with the optimum water absorption for instant noodles production, where the Response Surfaces showed that the lowest water absorption was obtained by decreasing the levels of guar gum (0-0.375%) and increasing the levels of salt (1.5-3%).

Lu-Qi-Yu et al., (2007) studied the effects of modified starches, compound polyphosphates, glycerin monostearate and guar gum in improving the rehydration characteristics of non-fried instant noodles was investigated. Results showed that optimal noodle additives composition was modified starch 6%, compound polyphosphates 0.2%, glycerin monostearate 0.1% and guar gum 0.3% and that optimal drying condition were 105 degrees C for 30 min.

Zheng and Hu-Aijun, (2007) studied the effects of food additives on the quality of instant noodles with vegetable and coarse cereals were investigated. The percentages of broken noodles and water adsorption both increased after addition of sodium carboxy methyl cellulose (Na-CMC), guar gum or xanthan gum. Boiling loss was not affected by Na-CMC at concn. <0.5%, but this parameter was affected by guar gum or xanthan gum, with max. effect at 0.3%. Some additives which decreased boiling loss and the percentage of broken instant noodles were identified; monoglyceride was better than sucrose ester and modified potato starch was better than untreated potato starch.
Kanda and Namiki, (2006) showed that noodle dough sheets that consist mainly of rice flour, have good flavour and mouth feel and do not require heating prior to noodle making. The dough sheets and the resulting noodles are prepared from a powder obtained by adding a polysaccharide thickener, including a mixture of guar gum and xanthan gum, to rice flour.

Patent

Parada et al., (2011) studied the effect of guar gum (0-10%) added to flour (maize, potato, rice, and wheat) prior to extrusion on the microstructure, physical properties (texture, expansion, density, pasting) and nutritional properties (starch digestibility) was investigated. The inclusion of guar gum did not decrease starch digestibility; rather, at 10% guar gum rapidly digestible starch increased by 24%, 15%, 25% and 43%, in maize, potato, rice and wheat flour-based products, respectively. In general, increases in starch digestibility appear to be related to the weaker microstructure (i.e., lower textural hardness), larger matrix surface area, and lower viscosity (pasting properties) of extrudates containing guar gum. These results suggest that micro structural changes affect the starch digestibility of extrudates; nevertheless, probably other factors such as particle size during digestion may also play an important role.

Ravindran et al., (2011) studied and evaluated the effects of three galactomannans on the physical and nutritional characteristics, and sensory acceptability of pea-rice based extruded products, targeted as nutritional snacks. A base blend of 70:30 pea and rice fortified with guar gum (GG), locust bean gum (LBG) and fenugreek gum (FG), at 5%, 10%, 15% and 20%, was extruded at pre-determined optimum processing conditions. All three
gums resulted in good expanded products. Increasing the inclusion levels of gums, however, had no effect (P>0.05) on the degree of expansion. Addition of 5% GG and LBG reduced (P<0.05) the hardness, while the inclusion of GG and LBG at levels higher than 5%, and all inclusion levels of FG, increased (P<0.05) the hardness of extruded products. Relative to other treatments, FG produced extrudates that were harder and crispier. The mean scores of sensory evaluation indicated that all products containing gums up to 15% were within the acceptable range. Extrusion increased (P<0.001) the soluble fibre content and decreased the insoluble fraction; the magnitude of these changes were greater in GG and FG. The addition of 15% gums in the pea-rice blend reduced (P<0.05) the glycemic index to less than 55. Overall, the data suggest that all three galactomannans could be incorporated up to 15% in a pea-rice blend to develop nutritious, organoleptically acceptable, extruded snack products with low glycemic index.