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EFFECT OF GUM ARABIC CONCENTRATION ON THE QUALITY OF SPRAY DRIED PINEAPPLE FLAVOURED ENCAPSULATE

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ABSTRACT
Arabic gum (*Gum acasia*) of grade B was used for this work. The gum was cleaned; pulverized and varying concentrations of 15% - 17% at 3% intervals were prepared. The varied concentrations were flavoured with 0.01% pineapple flavour concentrate (Rynoid) and then spray dried at 120°C/70°C drying and product combination temperature at the flow rate 45 cm^3/min and 3.0 kg/dm² atomizing pressure using Niro-Atomizer Dryer Plant (NASDP). The effect of the varied Arabic gum concentration on moisture content, bulk density, recovery percentage, and flavour retention of the encapsulate were evaluated. Increase in arabic gum concentration (5 – 17 %) significantly ($p< 0.05$) increased the moisture content (5 - 10.9%), bulk density (0.3392 – 0.420), and flavour retention (16 – 500 ppm), but decreased the percentage recovery (80.72 – 62.00%). Generally, the effect of Arabic gum at level above 11% with 0.01% pineapple flavour concentration is not significant.

Keywords: Gum Arabic, *Gum acasia*, pineapple flavour, encapsulate

INTRODUCTION
In the modification of existing products as well as in the development of new ones, it is critical that the flavour be acceptable to the intended consumer, for no matter how safe, nutritious, expensive or colourful the food may be if its flavour is undesirable, it is rejected. Even hungry and nutritionally deprived populations have been known to reject foods that have strange or offensive flavour to them (Fennema, 1985; Sharma and Trwari, 2001; Nooshin 2014). Flavours can be among the most valuable ingredients in any food formula. Even small amounts of some aroma substance can be expensive, and because they are usually delicate and volatile, preserving them is often a top concern of food manufacturers Flavour plays an important role in consumer satisfaction and influences further consumption of foods (Gourdel and Tronel, 2001; Fona, 2014). Most available aroma compounds are produced via chemical synthesis or extraction. Foodstuffs containing synthetic flavour are often avoided, because the consumers suspect that these compounds are toxic or harmful to their health (Teixeira *et al*., 2004; Gouin, 2004).

Flavour materials are supplied to the food industry in many forms – liquid, (in alcohol, oil or aqueous solution), emulsions solids as pieces. They may be soluble or insoluble in water or other solvents. Because of the high volatility and low stability of flavouring compounds, the flavour of many foods becomes less desirable during storage. This have been attributed to evaporation from the food or through the various chemical reactions such as autoxidation, polymerization, decomposition and hydrolysis (IFT, 1986) occurring in the food.

Encapsulation of flavours has been attempted and commercialized using many different methods such as spray drying, spray chilling or spray cooling, extrusion, freeze drying, coacervation and molecular inclusion. The choice of appropriate microencapsulation technique depends upon the end use of the product and the processing conditions involved in the manufacturing product. This overview describes each method cited above in terms of the basic chemical and/or physical principles involved and covers mechanisms of flavour release from food matrices.(Atmane *et al*., 2006).

The recent suggestion in overcoming the problem of flavour is encapsulation (Fennma, 1985; Tari and Singhal, 2002). In form, the essential oil or concentrate is surrounded by outer coating of a natural hardening material. Coating is accomplished by spray drying of slurry of a neutral, hardening material such as Arabic gum, which envelopes oil (, Gunning *et al*., 1999; Fennma, 1985). This in powder product could increase the blending capabilities of the plated flavour.

The rapid growth in beverage and confectionery industries in developing nations like Nigeria and the great use of food flavour normally imported, urgently call for a means of producing these industrial materials using our local material. Arabic gum is produced in large quantities in the Northern States of Nigeria particularly, Bauchi, Gombe, Kano and Niger, but the bulk of it is wasted due to lack of information and knowledge as to its diverse usage. Nigeria currently ranks number seven in the world's pineapple production with an annual production of about 1.4 million metric tons, but yet to maximize the benefits derivable from the production in the international market (Awolowo, 2016; SOUTECH, 2016)

Pineapple contains low amounts of protein, fat, ash and fibre. Pineapples contain antioxidants namely flavonoids, vitamin A and C. These antioxidants reduce the oxidative damage such as that caused by free radicals and chelating metals. It also has the enzyme complex protease (bromelain). Bromelain contains peroxidase, acid phosphate, several protease inhibitors and organically bound calcium (Tochi *et al*., 2008). Pineapple peel is rich in cellulose, hemicellulose and other carbohydrates. Ensilaging of pineapple peels produces methane which can be used as a biogas. Anaerobic digestion takes place and the digested slurry may find further application as animal, poultry and fish feeds (Rani and Nand, 2004).Pineapple contains the enzyme bromelain (protease) which has several therapeutic properties including malignant cell growth, thrombus formation, inflammation, control of diarrhoea, dermatological and skin debridement (Tochi *et al*., 2008).

Varied processing methods including vacuum frying, radiation, thermal, ultrasound, osmotic evaporation, high pressure technology has researched into to improve the quality of the extract (Perez-Tinocor *et al*., 2008, Hajare *et* *al*., 2006; Chutintrasi and Noomhorn, 2007; Femande *et al*., 2008; Hongvaleeral *et al*., 2008; Delza *et al*., 2005). Processing pineapple in industries can leave a lot of waste which can cause serious environmental problems. A lot of researches have been carried out recently to counteract this problem. The main objective of this work is to encapsulate pineapple flavour using different concentration of Gum Arabic to make it more stable

MATERIALS AND METHODS

Materials:

All materials including the arabic gum and pineapple flavour concentrate Rynoid London) were purchased in Bauchi main market. The arabic gum was cleaned pulverized and used to produce 5-17% slurries. The slurries were flavored with 0.01% pineapple flavour concentrate and spray dried. The spray drying was at 120°C / 70°C drying and product combination temperature, $45cm^3$/min product flow rate and 3.00kg / dm² atomizer drying pressure using Niro - Atomizer Spray Dry Plant (NASDP).

Methods:

Moisture content was determined by drying the sample to constant weight at 105°C (FDA, 1982). The bulk density was evaluated by dropping 20g of sample in a calibrated test tube on a soft pad for 30 times and the volume difference estimated (Hall and Hedic, 1971). The total solid of the flavour slurry was determined by evaporating 25g of slurry on boiled water in a water bath to dryness, and further dried at 130°C in air oven for one hour. The total solid is estimated as solids in 100g of slurry (Adeyemi and Umar, 1994). The percentage recovery was determined by weighing the spray dried flavoured encapsule recovered from the dried with that of the total solids of the original slurries. The flavour retention power was evaluated sensorially using five trained judges to match the samples to prepared standards from different flavoured concentrates.

RESULTS AND DISCUSSION

The moisture content, percentage recovery and flavour retention of the encapsulate were significantly affected by increased in arabic gum concentration $p<=0.05$ (Table 1).

Moisture Content –

The moisture content of the pineapple encapsulates increased (5.0 to 10.9%) with increase in gum Arabic concentration corresponding to 5 to 17%, as showed in fig 1. The gum Arabic concentration had a positive correlation ($r = 0.90$) relationship with moisture content of encapsulate. The moisture content however has a moderate correlation ($r = 0.56$) relationship with bulk density but negative ($r = -0.70$) with percentage recovery. The increase in moisture content could be due to the hydrolytic nature of gum and also the possible presence of pectin (with high affinity for moisture) in the slurries. This finding agrees with the work of Alais and Lindin (1991) and Guichard (2002) who showed that the hydrophilic nature of Arabic gum encourages binding of water molecules.

Table 1. Effect of Gum Arabic Concentration on some Properties of the flavoured Encapsule.

Parameter	Gum Arabic (%)				
	5	8	11	14	17
Moisture Content (%)	5.0±0.6c	6.0±0.1c	8.8±0.1b	10.0±1.5a	10.9±0.6a
Percentage recovery (%)	80.72±5.6a	73.54±7.2b	68.25±7.2c	62.9±5.8d	62.00±6.1d
Bulk Density (g/cm^3)	0.392±0.85a	0.394±0.08a	0.400±0.09a	0.419±0.085a	0.420±0.09a
Flavour retention (ppm)	216.0±3.2c	389.0±6.2b	500.0±7.7a	489±5.55a	492±4.5a

Percentage Recovery

The percentage recovery of the pineapple encapsulate decreased from 80.72 to 62.00% with increasing Arabic gum concentration above 14% as showed in fig II. The Arabic gum concentration had a high negative correlation ($r = -0.88$) with percentage recovery of encapsulate. However, the decrease in percentage recovery above 14% of Arabic gum concentration was low but significant, $p \leq 0.05$. The decrease could be due to the losses to surface of the drying chamber, as observed. This could be as a result of absorbed water by the pineapple encapsulate from the chamber which enhanced its sticking to the surface of the drying chamber.

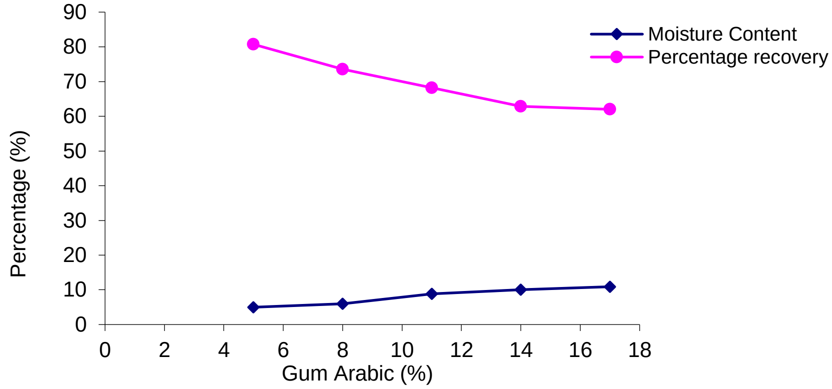

Fig 1. Effect of Gum Arabic Concentration on the Moisture Content and Recovery Percentage of flavour Encapsule

Flavour Retention –

The flavour retention of the encapsulate increased from 216.00 to 500ppm as the arabic gum concentration increased from 5.0 to 11.0%, as showed in fig.II. Further increase in the Arabic gum above 11.0% did not affect the flavour retention significantly, $p \leq 0.05$. The increase in flavour retention of the encapsulate could be due to increase in surface area offered by the soluble solid (arabic gum) for encapsulation. This agrees with Master (1985) and Gouin (2004) who demonstrated that flavaour retention is a function of concentration of the carrier. The non significant effect of the arabic gum above 11% with 0.01% pineapple flavour on the flavour retention could have been due to the maximum flavour available for encapsulation.

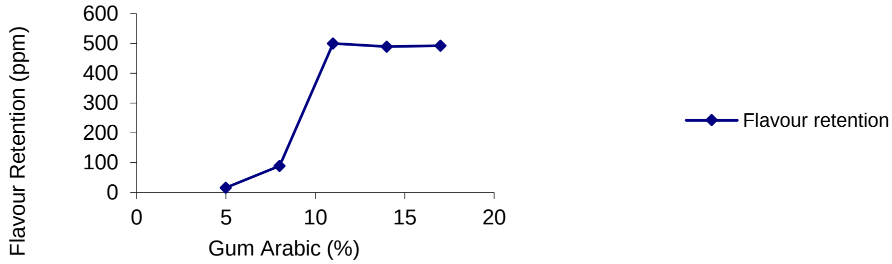

Fig.II. Effect of Gum Arabic Concentration on Flavour Retention of flavoured Encapsule

Statistical Analysis.

The data obtained from various analyses were subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version 16.0. Means were separated with Duncan Multiple Range Test (DMRT) at 95% confidence level($p=0.05$).

CONCLUSION

The effect of the arabic gum above 11% with 0.01% pineapple concentration has shown not to be significant on the moisture content, percentage recovery and flavour retention of the encapsulate. The low moisture content (5 – 8.8%) could be said to guarantee the stability of the encapsulate, while the non-significant effect on the bulk density showed that it could be easily blended with based foods. Also a flavour retention of 500ppm at 11% Arabic gum concentration and 0.01% flavour concentration confirms the potentiality of the carrier for encapsulation.

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