中 華 民 國 專 利 證 書

發明第 I 488584 號

發 明 名 稱：降低碳水化合物類食物之血糖反應的產品

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專利權期間：自 2015年 6 月 21 日至 2029年 12 月 28 日止

上開發明業經專利權人依專利法之規定取得專利權

經濟部智慧財產局

局 長 王美花

中 華 民 國 104 年 6 月 21 日

注意：專利權人未依法繳納年費者，其專利權自原繳費期限屆滿後消滅。

修正日期：2014 年 10 月 17 日

發明專利說明書

（本說明書格式、順序，請勿任意更動，※記號部分請勿填寫）

※ 申請案號：

※ 申請日：　　※IPC 分類：

一、發明名稱：（中文/英文）

降低碳水化合物類食物之血糖反應的產品/

PRODUCT TO REDUCE GLYCEMIC RESPONSE OF CARBOHYDRATE BASED FOODS

二、中文發明摘要：

攝入後會迅速大幅增加血液中葡萄糖之食物，俗稱"高血糖指數食物"（高 GI 食物）；而那些緩慢增加血糖之食物通常稱為"低血糖指數食物"（低GI 食物）。本發明係有關一種使用食用秋葵（羊角豆、黃秋葵)之可食部分-特別是果實；尤其是結合食用烏拉德-木豆（蒙戈-豇豆或黑吉豆）的可食部分-特別是種子，摻入碳水化合物類食物中以減少該食物之血糖反應，而且質地、口味、香味和顏色僅有最小的變化。

三、英文發明摘要：

Food that produce a rapid and large increase in blood glucose after ingestion are commonly called high Glycemic Index foods (high GI foods) and those that produce a slow increase in blood glucose are commonly called low glycemic index foods (low GI foods). The invention relates to the use of edible parts of edible Okra plant (Abelmoschus esculentus) specifically the fruit in combination with edible parts of edible Urad dhal (Vigna mungo) specifically the seed to reduce the glycemic response of carbohydrate based foods when incorporated in such foods which has minimal change in texture, taste, aroma and colour.

四、指定代表圖：

(一)本案指定代表圖為：第（ 1 ）圖。

(二)本代表圖之元件符號簡單說明：

無

五、本案若有化學式時，請揭示最能顯示發明特徵的化學式：

無

六、發明說明：

【發明所屬之技術領域】

本發明有關一種含豐富碳水化合物的植物可食部分之預混合粉末，其納入任何碳水化合物類食物中後可降低人體血糖反應。

【先前技術】

據報導過度食用精製穀物和穀物萃取物，會增加血糖並使耐糖量惡化。人體無法維持正常的血糖水平，或要求過量的胰島素，這樣徵候被稱為受損之耐糖量和抗胰島素性。抗胰島素性是身體中的胰島素受體對胰島素不敏感之一種徵候。這些徵候都與肥胖和2型糖尿病初步發展階段有關連。也和血脂改變和一部分代謝紊亂的廣泛徵候群(稱為"X徵候群")有關連。

「血糖指數」(Glycemic Index)或以下略為GI是衡量碳水化合物對血糖濃度的影響。它結合食品組成物資訊，可用於指導食物選擇。在消化過程中，分解迅速，並快速釋放葡萄糖進入體內循環的血液中之碳水化合物具有高GI；而分解緩慢，並逐步釋放葡萄糖進入血液之碳水化合物具有低GI(低血糖指數或略為低糖)。低糖食物對健康有重大好處。這一概念是在1980-1981年由戴維-詹金斯(David J. Jenkins)博士和同事在多倫多大學，尋找哪些食物比較適合糖尿病人的研究所發展出來。較低的GI顯示胃腸消化及吸收食物中醣類和澱粉之速度較慢。食物的GI是指攝入固定量（通常是50克）的碳水化合物後，根據"血糖反應曲線面

積"（Area Under the Blood Glucose Response Curve，以下略 AUC）評定之。測試食物之 AUC 除以標準 AUC（葡萄糖或白麵包為兩個不同定義的標準食物），再乘以 100。

為了實際應用，開發出類別的低血糖指數食物，例如菜豆、珍珠大麥、輕精製穀物（如全穀物裸麥粗麵包、或粗麵粉製成之麵包）、意大利麵食等之互換表，而以 GI 將食品分級。在有資訊之情況下，特殊的地方食物可以包括在這些表單中（例如在加勒比之綠色香蕉和在東南亞之特種水稻）。

目前的驗證方法係使用葡萄糖作為基準食物，將它的 GI 值訂為 100。這樣做的優點，即它是全世界廣泛適用的定義，最大 GI 值約 100。白麵包也可以用來作為基準食物，而得一套不同的 GI 值。低 GI 食物會更緩慢和穩定地釋放葡萄糖。高 GI 的食物會導致更迅速的血糖濃度上升，適合持久運動後的能量恢復或一個糖尿病患者遇到低血糖時使用。食物的血糖作用取決於一系列的因素，如澱粉的類型（直鏈澱粉或支鏈澱粉）、在食物內物理誘捕的澱粉分子、食物內脂肪和蛋白質含量、和膳食中有機酸或其鹽。例如添加醋，會降低 GI。脂肪或可溶性膳食纖維的存在可以減緩胃排空速率，從而降低 GI。粗製麵包的纖維含量很高，一般比白麵包具有較低的 GI 值。但是，許多褐色麵包以酶處理，使硬外皮軟化，如此使澱粉更容易取得，因而更受消費者接受。這就提升

了 GI，於是有些褐色麵包 GI 值甚至超過 100。

含低 GI 食物之膳食可同時減少餐後血糖和胰島素的反應。動物研究顯示在日常的飲食緩慢攝入消化之澱粉，可延遲抗胰島素性之發生。一些流行病學研究表明，低 GI 飲食可使男性和女性降低發展出非胰島素糖尿病之風險。在一般糖尿病和高脂血症患者的臨床試驗顯示：低 GI 飲食可降低平均血糖濃度、降低胰島素分泌、降低高三酸甘油酯血症患者之血清三酸甘油酯。

秋葵(Okra)偶爾指羊角豆或過去所謂黃秋葵(潺茄、洋辣椒)的同義詞。它是人們普遍食用的蔬菜，通常被稱為小姐的手指。烏拉德(Urad)，也被稱為烏拉德-木豆、南豆、黑綠豆、黑吉豆、黑鷹嘴豆、或白扁豆（蒙戈-豇豆），是生長在南亞的豆類。

德國專利 DE202004017554U 揭露一種降血糖之飲食營養補品，包括處理過之芙蓉科植物材料。其中申請專利範圍獨立項也包括煮沸新鮮秋葵所得的湯料包裝成為單位湯劑，並標明適合用於治療糖尿病。該單位包裝還包含了加工植物材料。可以看到該發明的缺點是湯劑形式的補品，其中秋葵的口味和顏色會使該營養補品不適合日常食用。

本發明揭露的預混合粉製劑包含食用秋葵植物，結合富含碳

水化合物的穀物和碳水化合物類食物，以減少碳水化合物類食物的血糖指數（GI），該碳水化合物類食物攝取後原本有很高的GI值。食用秋葵植物和富含碳水化合物的穀物之即食混合物納入人類的日常飲食中，能符合有機產類補品消費的需求和目前的趨勢。製造減少GI食品之一個要件是所製食品須符合個人消費所需的口味、質地、顏色和香味之要求。如果有任一這些特徵不能符合要求，則該食品大概不被大眾普遍接受。本發明已製備可日常消費之食品，適合所有年齡層人類的食用。

【發明內容】

本發明涉及使用預混合粉，其中含食用秋葵植物(Okra)之可食部分粉末和食用木豆植物(Vigna)的可食部分粉末及一種或更多型選自穀物和非穀物或其混合物之碳水化合物類食物，用於製備食品，以減少人類攝取食物後之血糖反應。

【實施方式】

在秋葵之種子和豆莢以及木豆主要是含有多醣，其中包含例如乳糖，半乳甘露聚醣，鼠李糖和半乳糖醛酸之糖類。在食用和非食用黃秋葵植物中半乳甘露聚醣的存在，有利於果實粘液。在食用黃秋葵植物中的粘液是減少碳水化合物類食物的GI值之一個重要因素。

「血糖指數」是指食用50克測試食物之碳水化合物部分的血糖反應曲線下增加之面積(ΔIAUCfood)佔同一受試者(實驗對象)

食用相同數量碳水化合物的標準食物者之百分率。

本發明有關使用食用秋葵植物可食部分(特別是其果實)粉末，結合食用木豆植物可食部分(特別是種子或豆莢或兩者的混合物)粉末，並將其融入選自穀類食物和非穀類食物之碳水化合物食物中。用於本發明的秋葵屬於一個或更多類型的常見食用秋葵物種，例如黃秋葵(學名為 Abelmoschus esculentus L)和羊角豆(Abelmoschus caillei)；配合使用烏拉德-木豆或黑鷹嘴（蒙戈-豇豆，Vigna mungo）或其他類型的食用木豆的物種，如綠鷹嘴豆（綠豆，Vigna radiata)，紅豆（小豆，Vigna angularis)。食用秋葵植物之可食部分較佳為其果實和種子，曬乾或烘乾後研磨成粉末。類似秋葵，食用烏拉德-木豆植物可食部分較佳為其種子或豆莢，或俗稱之木豆，先經曬乾或烘乾，去殼或剝皮，然後才研磨成粉末。然後將食用秋葵粉末及食用烏拉德-木豆粉末配合穀物為基礎的食物，如米粉、麵粉和玉米粉，或非穀物為基礎的食物，如馬鈴薯、木薯和西米(sago)，而製成預混合粉末。預混合粉屆時將成為即可煮之食物，例如印度薄餅(Chapatti)、麵包、比薩餅、麵條和蛋糕，以減少食用後血糖反應。低血糖指數會降低血糖濃度增加的速度，因此不會有血糖劇增而導致體重增加或血脂增加，從而不會導致高膽固醇和降低警覺性之缺點。

在具有較高血糖值的穀物類粉末-例如米粉、玉米粉及小麥粉；和非穀物類粉末-例如馬鈴薯粉，木薯粉和西米粉中，添加1.5

重量%食用秋葵粉，配合 3 重量%食用烏拉德-木豆粉。食用秋葵植物可食部分(尤其是果實)的粉末和食用烏拉德-木豆植物可食部分的粉末之混合物可以分別製備，作為中間產物，摻入即可煮之穀物類或非穀物類產物中。但是，在製備預混合粉末時，來自穀物類粉末的碳水化合物應小於食用秋葵植物可食部分粉末加上食用烏拉德-木豆可食部分粉末全重量的 10%；而來自非穀物類粉末的碳水化合物應小於食用秋葵植物可食部分粉末加上食用烏拉德-木豆可食部分粉末全重量的 30%。摻混食用秋葵粉末及食用烏拉德-木豆粉末之碳水化合物系穀物和非穀物食品原來之味道、香氣、質地和顏色僅有最小的改變。用於實施例之碳水化合物類食物是由穀粉所製的印度薄餅。這樣的組合已被用來測試麥類麵包的血糖指數。此配方減少了麥類食物之血糖指數：從 GI 值 90 降至 GI 值 50。

平均 GI 值的計算方法係從 6 個人體實驗對象(受試者)收集到的數據做平均得之。標準食物和測試食物均必須包含同量之可用碳水化合物。結果列出每種測試食物的相對排名。令 6 個受試者吃不含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅（一種由穀粉所製的碳水化合物食品），作為對照實驗，以監視每個人血糖反應曲線面積（AUC）和血糖指數（GI）。AUC 和 GI 如下表 1 和 2 所示。

受試者	1			2			3		
	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差
	0	5.0		0	4.9		0	5.0	
	15	5.2	0.2	15	4.7	0.2	15	5.0	0.0
	30	6.8	1.8	30	6.6	1.7	30	6.8	1.8
	45	7.3	2.3	45	6.9	2.0	45	7.9	2.9
	60	7.2	2.2	60	7.3	2.4	60	8.2	3.2
	90	5.6	0.6	90	6.8	1.9	90	6.2	1.2
	120	5.5	0.5	120	5.0	0.1	120	4.3	0.7
	AUC		139.5	AUC		166.7	AUC		171.9
	GI		72.4	GI		89.0	GI		118.3

表 1

表 2

受試者	4			5			6		
	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差
	0	5.2		0	5.1		0	5.0	
	15	5.5	0.3	15	5.5	0.4	15	4.5	0.5
	30	6.7	1.5	30	7.4	2.3	30	5.7	0.7
	45	6.1	0.9	45	7.6	2.5	45	7.1	2.1
	60	5.3	0.1	60	7.3	2.2	60	7.0	2.0
	90	5.7	0.5	90	5.1	0.0	90	6.8	1.8
	120	5.4	0.2	120	5.6	0.5	120	5.9	0.9
	AUC		60.8	AUC		135.0	AUC		152.3
	GI		43.309	GI		132.5	GI		79.1

表 3 列出受試者吃不含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅(對照研究)之 AUC 結果。

表 3

受試者	AUC
1	139.5
2	166.7
3	171.9
4	60.8
5	135.0
6	152.3
平均值	**137.7**
標準差	**40.4**
平均值之 標準誤差	**16.8**

表 4 列出受試者吃不含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅之血糖反應曲線下增加的面積（IAUC）。對照研究之 IAUC 平均值與時間的關係顯示在第 1 圖。

表 4

對照研究(不含烏拉德-木豆粉末和食用秋葵果實粉末的印度薄餅)									
時間（分鐘）	受試者						IAUC		
	1	2	3	4	5	6	Mean	SD	SE
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.2	-0.2	0.0	0.3	0.4	-0.5	0.0	0.3	0.1
30	1.8	1.7	1.8	1.5	2.3	0.7	1.6	0.5	0.2
45	2.3	2.0	2.9	0.9	2.5	2.1	2.1	0.7	0.3
60	2.2	2.4	3.2	0.1	2.2	2.0	2.0	1.0	0.4
90	0.6	1.9	1.2	0.5	0.0	1.8	1.0	0.8	0.3
120	0.5	0.1	-0.7	0.2	0.5	0.9	0.3	0.5	0.2

受試者吃不含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅之 GI 值列於表 5 中。對照研究的 GI 平均值為顯示在第 2 圖中。

表 5

受試者	GI 值
1	72.4
2	89.0
3	118.3
4	43.3
5	132.5
6	79.1
平均值	**89.1**
標準差	**32.3**
平均值之標準誤差	**13.5**

對照研究進行 2 至 3 天後，令相同的 6 位受試者吃含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅作為治療研究，並偵測每位受試者之 AUC 和 GI。受試者之 AUC 和 GI 列於下面表 6 和 7。

表 6

受試者	1			2			3		
	時間（分鐘）	血糖濃度（毫摩爾 / 升）	偏差	時間（分鐘）	血糖濃度（毫摩爾 / 升）	偏差	時間（分鐘）	血糖濃度（毫摩爾 / 升）	偏差
	0	5.0		0	4.9		0	5.0	
	15	5.2	0.2	15	4.8	0.1	15	5.3	0.3
	30	5.3	0.3	30	5.9	1.0	30	6.9	1.9
	45	6.8	1.8	45	6.4	1.5	45	8.3	3.3
	60	7.0	2.0	60	5.8	0.9	60	7.3	2.3
	90	5.7	0.7	90	4.5	0.4	90	6.0	1.0
	120	5.5	0.5	120	5.3	0.4	120	5.5	0.5
	AUC		108.0	AUC		55.9	AUC		171.8
	GI		49.8	GI		27.2	GI		82.4

表 7

受試者	4			5			6		
	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差	時間（分鐘）	血糖濃度（毫摩爾／升）	偏差
	0	5.3		0	4.9		0	5.0	
	15	5.3	0.0	15	4.5	0.4	15	4.8	0.2
	30	6.5	1.2	30	5.7	0.8	30	6.3	1.3
	45	7.1	1.8	45	6.6	1.7	45	6.8	1.8
	60	6.6	1.3	60	6.0	1.1	60	7.2	2.2
	90	5.8	0.5	90	5.4	0.5	90	6.9	1.9
	120	6.3	1.0	120	4.7	0.2	120	6.5	1.5
	AUC		104.3	AUC		73.1	AUC		174.2
	GI		54.1	GI		50.3	GI		55.4

受試者吃含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅之 AUC 值（治療研究）列於表 8 中。

表 8

受試者	AUC
1	108.0
2	55.9
3	171.8
4	104.3
5	73.1
6	174.2
平均值	**114.5**
標準差	**49.3**
平均值之標準誤差	**15.6**

表 9 列出受試者吃含食用秋葵果實粉末和去皮烏拉德-木豆粉

末的印度薄餅(治療研究)之血糖反應曲線下增加的面積（IAUC)。治療研究之 IAUC 平均值與時間的關係也顯示在第 1 圖。

表 9

治療研究(吃含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅)									
時間（分鐘）	受試者						IAUC		
	1	2	3	4	5	6	平均值	標準差	平均值之標準誤差
0	0	0	0	0	0	0	0	0	0
15	0.2	-0.1	0.3	0	-0.4	-0.2	0	0.3	0.1
30	0.3	1	1.9	1.2	0.8	1.3	1.1	0.5	0.2
45	1.8	1.5	3.3	1.8	1.7	1.8	2	0.7	0.3
60	2	0.9	2.3	1.3	1.1	2.2	1.6	0.6	0.3
90	0.7	-0.4	1	0.5	0.5	1.9	0.7	0.8	0.3
120	0.5	0.4	0.5	1	-0.2	1.5	0.6	0.6	0.2

吃含食用秋葵果實粉末和去皮烏拉德-木豆粉末的印度薄餅之受試者的 GI 值（治療研究）列於表 10。治療研究之 GI 平均價值顯示在第 2 圖。

表 10

受試者	GI 值
1	49.8
2	27.2
3	82.4
4	54.1
5	50.3
6	55.4
平均	**53.2**
標準差	**17.6**
平均值標準誤差	**7.3**

這項研究是使用印度薄餅：一種麵粉製成的碳水化合物類食物。除此之外，食用秋葵植物可食部分粉末及木豆植物可食部分粉末也可以加入選自穀物和非穀物植物來源之碳水化合物類食物(例如麵包、蛋糕、比薩餅和麵條)中。

【圖式簡單說明】

第 1 圖顯示血糖反應曲線下的增加的面積（IAUC)。該曲線畫出例如「印度薄餅」*之典型小麥為基礎的未添加秋葵和木豆之食物對照餐，和添加秋葵和木豆之治療餐的血糖反應比較。本試驗係根據聯合國糧食和農業組織（FAO）協議，對 6 個受試者(實驗對象）監測 120 分鐘，結果看出患者食用 45 分鐘後血糖含量下降。

第 2 圖顯示添加秋葵和木豆之印度薄餅治療餐和未添加配方之印度薄餅對照餐的對比。對照餐 GI 值幾乎是 90.0 和治療餐 GI 值是 50.0。

＊「印度薄餅」是一個未發酵麵粉所製成之圓形薄餅。

【主要元件符號說明】

無

七、申請專利範圍：

1. 一種預混合粉末之應用，其中含食用秋葵植物之可食部分粉末和食用木豆植物的可食部分粉末及選自穀物或非穀物或其混合物之碳水化合物類食物，以製備食品，減少人類攝取食物後之血糖反應。
2. 如申請專利範圍第 1 項所述預混合粉末之應用，其中該食用秋葵植物之可食部分為其果實。
3. 如申請專利範圍第 1 項所述預混合粉末之應用，其中木豆植物可食部分係豆莢或種子或其任何之組合。
4. 如申請專利範圍第 3 項所述預混合粉末之應用，其中種子經剝皮處理。
5. 如申請專利範圍第 1 項所述預混合粉末之應用，其中該食用秋葵植物係黃秋葵或羊角豆，或黃秋葵與羊角豆之混合物。
6. 如申請專利範圍第 1 項所述預混合粉末之應用，其中食用木豆植物係蒙哥豇豆、綠豆或小豆，或任三種植物之組合，或是三種植物之混合物。
7. 如申請專利範圍第 1 項所述預混合粉末之應用，其中具穀物粉末之該預混合粉末含有不到 10 重量%的食用秋葵植物之可食部分粉末之混和物，以及食用木豆植物的可食部分粉末。
8. 如申請專利範圍第 1 項所述預混合粉末之應用，係具非穀物粉末之該預混合粉末含有不到 30 重量%的食用秋葵植物之

可食部分粉末之混和物，以及食用木豆植物的可食部分粉末。

9. 如申請專利範圍第7項所述預混合粉末之應用，其中該預混合粉末含有至少1.5重量%黃秋葵或羊角豆果實粉末，或黃秋葵與羊角豆之混合物，以及至少3重量%蒙哥豇豆、綠豆或小豆種子粉末，或任三種植物之組合，或是三種植物之混合物。

10. 如申請專利範圍第8項所述預混合粉末之應用，其中該預混合粉末含有至少1.5重量%黃秋葵或羊角豆果實粉末，或黃秋葵與羊角豆之混合物，以及至少3重量%蒙哥豇豆、綠豆或小豆種子粉末，或任三種植物之組合，或三種植物之混合物。

11. 一種用來製備食物以抑制人類消化食物後血糖反應之預混合粉末，包含有：

1.5重量%黃秋葵或羊角豆果實粉末，或黃秋葵與羊角豆之混合物，以及至少3重量%蒙哥豇豆、綠豆或小豆種子粉末，或任三種植物之組合，或三種植物之混合物。

12. 一種用來製備食物以抑制人類消化食物後血糖反應的預混合粉末之應用，包含有：

黃秋葵或羊角豆果實粉末，或黃秋葵與羊角豆之混合物；和蒙哥豇豆、綠豆或小豆，或任三種植物之組合，或三種植物之混合物；以及小麥粉末。

13. 一種食品，包含申請專利範圍第 1 至 11 項之預混合粉末。

八、圖式：

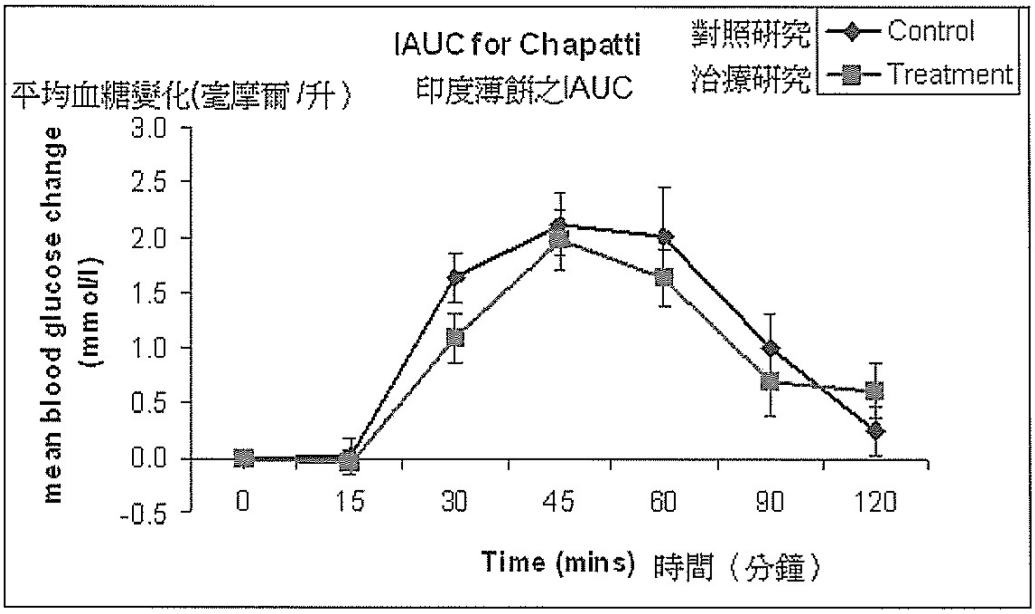
IAUC for Chapatti
印度薄餅之IAUC
對照研究
治療研究
Control
Treatment
平均血糖變化(毫摩爾/升)
mean blood glucose change (mmol/l)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0
15
30
45
60
90
120
Time (mins) 時間（分鐘）

圖 1

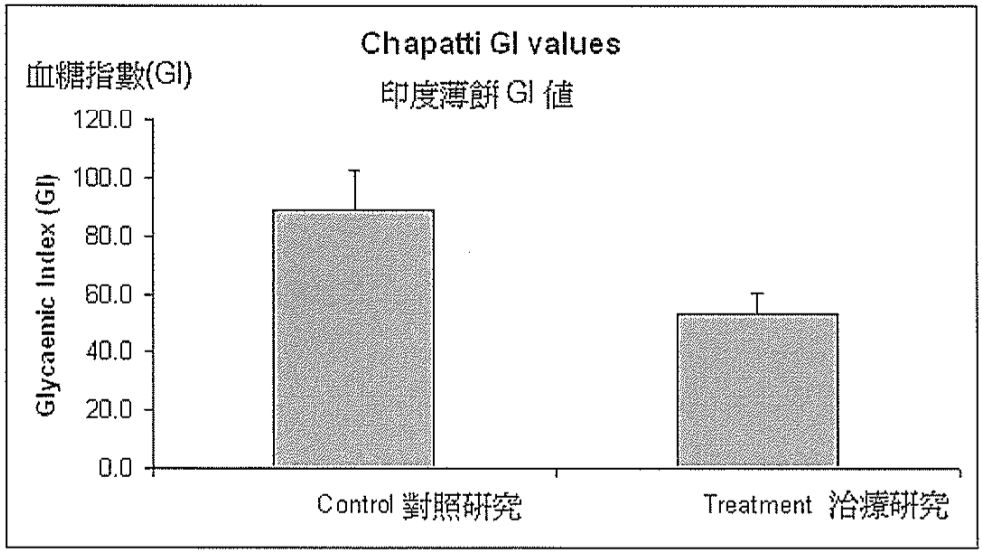
Chapatti GI values
印度薄餅 GI 值
血糖指數(GI)
Glycaemic Index (GI)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Control 對照研究
Treatment 治療研究

圖 2

PRODUCT TO REDUCE GLYCEMIC RESPONSE OF CARBOHYDRATE BASED FOODS

FIELD OF INVENTION

This invention relates to a pre-mixed flour containing carbohydrate rich source of edible parts of plants to lower the glycemic response in humans when the mixture is incorporated into any carbohydrate based food.

BACKGROUND OF INVENTION

The excessive consumption of refined grains and grain extracts has been reported to increase blood sugar and deteriorate glucose tolerance. The inability of the human body to maintain normal glucose levels or to require excessive levels of insulin to do so has been called glucose intolerance, impaired glucose tolerance and insulin resistance. Insulin resistance is a condition in which the body insulin receptors are insensitive to insulin. These conditions are associated with obesity and may be preliminary steps in the progression to type-2 diabetes mellitus. It has also been linked to alteration in blood lipid and part of a wide syndrome of metabolic disorders called "Syndrome X".

The Glycemic Index or GI is a measure of the effects of carbohydrates on blood glucose levels. It can be used, in conjunction with information about food composition, to guide food choices. Carbohydrates that break down rapidly during digestion releasing glucose rapidly into the bloodstream have a high GI; carbohydrates that break down slowly, releasing glucose gradually into the bloodstream, have a low GI. Foods with a low GI have significant health benefits. The concept was developed by Dr. David J. Jenkins and colleagues in 1980–1981 at the University of Toronto in their research to find out which foods were best for people with diabetes. A lower GI suggests slower rates of digestion and absorption of the sugars and starches in the foods. The GI of a food is defined by the Area Under the Blood Glucose Response Curve (AUC) following the ingestion of a fixed portion of carbohydrate (usually 50 g). The AUC of the test food is

divided by the AUC of a standard (either glucose or white bread, giving two different definitions) and multiplied by 100.

For practical application, the GI is useful to rank foods by developing exchange lists of categories of low glycemic index foods, such as legumes, pearled barley, lightly refined grains (e.g. whole grain pumpernickel bread, or breads made from coarse flour), pasta, etc. Specific local foods could be included in such lists where information is available (e.g. green bananas in the Caribbean and specific rice varieties in Southeast Asia).

The current validated methods use glucose as the reference food, giving it a GI value of 100 by definition. This has the advantage that it is universal and it results in maximum GI values of approximately 100. White bread can also be used as a reference food, giving a different set of GI values. A low GI food will release glucose more slowly and steadily. A high GI food causes a more rapid rise in blood glucose levels and is suitable for energy recovery after endurance exercise or for a person with diabetes experiencing low blood sugar. The glycemic effect of food depends on a number of factors, such as the type of starch (amylose vs. amylopectin), physical entrapment of the starch molecules within the food, fat and protein content of the food and organic acids or their salts in the meal. Adding vinegar, for example, will lower the GI. The presence of fat or soluble dietary fibers can slow the gastric emptying rate thus lowering the GI. Unrefined breads with higher amounts of fiber generally have a lower GI value than white breads. Many brown breads, however, are treated with enzymes to soften the crust, which makes the starch more accessible and thus more acceptable to consumers. This raises the GI, with some brown breads even having GI values over 100.

Meals containing low GI foods reduce both postprandial blood glucose and insulin responses. Animal studies suggest that incorporating slowly digested starch into the diet delays the onset of insulin resistance. Some epidemiologic studies suggest that a low GI diet is associated with reduced risk of developing non-insulin diabetes in men and women. Clinical trials in normal, diabetic and hyperlipidemic subjects show that low GI diets reduce mean blood glucose concentrations, reduce insulin secretion and reduce serum triglycerides in individuals with hypertriglyceridemia.

Okra is occasionally referred to by the synonym, *Abelmoschus esculentus* L. or formerly known as *Hibiscus esculentus*. It is commonly consumed as vegetable and is often called lady's finger. Urad, also referred to as urad dhal, urd bean, urd, urid, black matpe bean, black gram, or white lentil (*Vigna mungo*), is a bean grown in southern Asia.

Patent number DE202004017554U discloses an antidiabetic dietetic nutritional supplement comprising processed *Hibiscus* species plant material. Independent claims are also included for aqueous preparations obtained by boiling fresh okra provided in unit packaging with indication of suitability for therapy of diabetes diseases. The unit packaging also contains the processed plant material. The disadvantages of the invention can be seen in the aqueous form of the supplement in which the taste and colour of Okra makes the dietetic nutritional supplement not suitable for daily consumption.

The present invention discloses a preparation of pre-mixed flour consisting edible Okra plant in combination with carbohydrate rich cereal and carbohydrate based food to reduce the glycemic index (GI) of carbohydrate based food which shows significant GI value after consumption. A ready to eat mixture of edible Okra plant and carbohydrate rich cereal incorporated in human daily diet could comply to the needs and current trend for consumption of organic based supplementary products. One of the problems in producing a GI reducing food is the preparation of food which is acceptable for personal consumption in respect of taste, texture, colour and aroma. If any of these characteristics are unacceptable, then the food preparation likely is not well received by the public. The present invention has been prepared for daily consumption and is suitable for human of all age group.

SUMMARY OF THE INVENTION

The invention relates to the use of a pre-mixed flour containing mixture of pulverized edible parts of edible Okra plant species with pulverized edible parts of edible *Vigna* plant species and one or more types of food based carbohydrate selected from cereals or non-cereals or a mixture of both, for the preparation of food to reduce glycemic response of humans who consume the food.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the Incremental Area Under the Blood Glucose Response Curve (IAUC). The curve shows the glycemic response of a typical wheat based food for example, Chapatti* in a controlled meal (without Okra and Urad dhal) and one meal used as treatment containing Okra and Urad dhal. The trial was performed on 6 subjects, according to the protocol from the Food and Agricultural Organization of the United Nations (FAO) The response was monitored for 120 minutes in which the glucose level decreased in the patient after 45 minutes.

Fig. 2 shows the comparison between the GI value of Chapatti with Okra and Urad dhal (treatment) and Chapatti without the formulation (Control). The GI value for the controlled chapatti is almost 90.0 and the GI for the formulated chapatti is 50.0.

*Chappati is an unleavened thin and round Indian bread made of wheat flour.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The Okra seeds and pods as well as Urad dhal contain mainly polysaccharides comprising sugars such as galactose, galactomannan, rhamnose and galacturonic acid. The presence of galactomannan in edible and non-edible Okra plant contributes to the mucilage in its fruits. The mucilage in edible Okra plant is one of the important factor in reducing the GI in carbohydrate based food.

The glycemic index is defined as the Incremental Area Under The Blood Glucose Response Curve ($\Delta IAUC_{food}$) of a 50 g carbohydrate portion of a test food expressed as a percent of the response to the same amount of carbohydrate from a standard food taken by the same subject.

The invention relates to the use of pulverized edible parts of edible Okra plant, especially the fruit in combination with pulverized edible parts of edible Urad (*Vigna*) plant species especially the seed or the pod or a mixture of both by incorporating into food based carbohydrate selected from cereal based foods and non-cereal based foods. The Okra plant used in the invention belongs to one or more types of the commonly edible Abelmoschus species such as *Abelmoschus esculentus* and *Abelmoschus caillei*, in combination with Urad dhal or black gram (*Vigna mungo*) or other types of edible Vigna species such as green gram (*Vigna radiata*) and red bean (*Vigna angularis*). The edible parts of edible Okra plant preferably the fruit and seed which has been either sun-dried or oven-dried are pulverized to form its flour. Similar to Okra, the edible parts of edible Urad plant preferably the leguminous pod and seed or commonly called as dhal is sun-dried or oven-dried and will be deskinned or skinned before being pulverized to form its flour. The edible Okra flour and edible Urad flour will then be combined with cereal based food such as rice flour, wheat flour and corn flour or with non-cereal based food such as potato, cassava and sago to prepare a pre-mixed flour. The pre-mixed flour will then be a ready-to-cook food such as chappati, bread, pizza, noodles and cake in order to reduce the glycemic response upon consumption. The low glycemic index will reduce the speed at which the blood glucose level will increase and there is consequently no sugar surge which

leads to weight gain or increase of blood lipids which in turn leads to high cholesterol and reduction of alertness.

Cereal based flour such as rice flour, corn flour and wheat flour and non-cereal based flour such as potato flour, cassava flour and sago flour which has high glycemic value are added with 1.5 % by weight of edible Okra flour in combination with 3% by weight of edible Urad flour. The mixture of pulverized edible parts of edible Okra plant especially the fruit and the pulverized edible parts of edible Urad plant can be prepared separately as an intermediate product which is incorporated with a ready-to-cook cereal based or non-cereal based product. Nevertheless, the food based carbohydrate from cereal based flour should have less than 10% by weight of pulverized edible parts of edible Okra plant in combination of pulverized edible parts of edible Urad dhal flour and food based carbohydrate from non-cereal based flour should have less than 30% by weight of pulverized edible parts of edible Okra plant in combination of pulverized edible parts of edible Urad dhal flour for the preparation of the pre-mixed flour. The carbohydrate based cereal or non-cereal food which incorporates with edible Okra flour and edible Urad dhal flour will minimally change the original taste, aroma, texture and colour of the finished product. The carbohydrate based food used in the embodiment is Chappati which is produced from cereal based flour. Such combination has been used to test the glycemic index of wheat based bread. The formulation has reduced the wheat based food from a GI value of 90 to a GI value of 50.

The average GI value is calculated from data collected in 6 human subjects. Both the standard and test food must contain an equal amount of available carbohydrate. The result gives a relative ranking for each tested food. The 6 human subjects were served with chappati (a carbohydrate based food made of wheat flour) **without** pulverized edible Okra fruit and pulverized deskinned Urad dhal and were taken as a control study to monitor the Area Under the Blood Glucose Response Curve (AUC) and Glycemic Index (GI) in each individuals. The AUC and GI of the subjects are shown as below in Table 1 and 2.

Subject	1			2			3		
	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation
	0	5.0		0	4.9		0	5.0	
	15	5.2	0.2	15	4.7	0.2	15	5.0	0.0
	30	6.8	1.8	30	6.6	1.7	30	6.8	1.8
	45	7.3	2.3	45	6.9	2.0	45	7.9	2.9
	60	7.2	2.2	60	7.3	2.4	60	8.2	3.2
	90	5.6	0.6	90	6.8	1.9	90	6.2	1.2
	120	5.5	0.5	120	5.0	0.1	120	4.3	0.7
	AUC		139.5	AUC		166.7	AUC		171.9
	GI		72.4	GI		89.0	GI		118.3

Table 1

Subject	4			5			6		
	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation
	0	5.2		0	5.1		0	5.0	
	15	5.5	0.3	15	5.5	0.4	15	4.5	0.5
	30	6.7	1.5	30	7.4	2.3	30	5.7	0.7
	45	6.1	0.9	45	7.6	2.5	45	7.1	2.1
	60	5.3	0.1	60	7.3	2.2	60	7.0	2.0
	90	5.7	0.5	90	5.1	0.0	90	6.8	1.8
	120	5.4	0.2	120	5.6	0.5	120	5.9	0.9
	AUC		60.8	AUC		135.0	AUC		152.3
	GI		43.309	GI		132.5	GI		79.1

Table 2

The AUC of the subjects who consumed chappati **without** pulverized edible Okra fruit and pulverized deskinned Urad dhal (controlled study) is shown in Table 3.

Subject	AUC
1	139.5
2	166.7
3	171.9
4	60.8
5	135.0
6	152.3
Mean	**137.7**
SD	**40.4**
SEM	**16.8**

Table 3

The Incremental Area Under the Blood Glucose Response Curve (IAUC) value of the subjects who consumed chappati **without** pulverized edible Okra fruit and pulverized deskinned Urad dhal (controlled study) is shown in Table 4. The mean value IAUC against time for the controlled study is shown in the graph in Fig. 1.

Controlled (Chappati without pulverized Urad dhal and pulverized Okra fruit)									
Time (mins)	Subject						IAUC		
	1	2	3	4	5	6	Mean	SD	SE
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.2	-0.2	0.0	0.3	0.4	-0.5	0.0	0.3	0.1
30	1.8	1.7	1.8	1.5	2.3	0.7	1.6	0.5	0.2
45	2.3	2.0	2.9	0.9	2.5	2.1	2.1	0.7	0.3
60	2.2	2.4	3.2	0.1	2.2	2.0	2.0	1.0	0.4
90	0.6	1.9	1.2	0.5	0.0	1.8	1.0	0.8	0.3
120	0.5	0.1	-0.7	0.2	0.5	0.9	0.3	0.5	0.2

Table 4

The GI value of the subjects who consumed chappati **without** pulverized edible Okra fruit and pulverized deskinned Urad dhal (controlled study) is shown in Table 5. The mean value of GI for the **controlled study** is shown in the graph in Fig. 2.

Subject	GI value
1	72.4
2	89.0
3	118.3
4	43.3
5	132.5
6	79.1
Mean	**89.1**
SD	**32.3**
SEM	**13.5**

Table 5

5

After an interval of 2 to 3 days after conducting the controlled study,the same 6 human subjects as used previously were served with chappati added **with** pulverized edible Okra fruit and pulverized deskinned Urad dhal and were taken as treatment study to monitor the AUC and GI in each individuals. The AUC and GI of the subjects are shown as below in Table 6 and 7.

Subject	1			2			3		
	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation
	0	5.0		**0**	4.9		**0**	5.0	
	15	5.2	0.2	**15**	4.8	0.1	**15**	5.3	0.3
	30	5.3	0.3	**30**	5.9	1.0	**30**	6.9	1.9
	45	6.8	1.8	**45**	6.4	1.5	**45**	8.3	3.3
	60	7.0	2.0	**60**	5.8	0.9	**60**	7.3	2.3
	90	5.7	0.7	**90**	4.5	0.4	**90**	6.0	1.0
	120	5.5	0.5	**120**	5.3	0.4	**120**	5.5	0.5
	AUC		**108.0**	**AUC**		**55.9**	**AUC**		**171.8**
	GI		**49.8**	**GI**		**27.2**	**GI**		**82.4**

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Table 6

Subject	4			5			6		
	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation	Time (Mins)	Glucose Level (mmol/l)	Deviation
	0	5.3		**0**	4.9		**0**	5.0	
	15	5.3	0.0	**15**	4.5	0.4	**15**	4.8	0.2
	30	6.5	1.2	**30**	5.7	0.8	**30**	6.3	1.3
	45	7.1	1.8	**45**	6.6	1.7	**45**	6.8	1.8
	60	6.6	1.3	**60**	6.0	1.1	**60**	7.2	2.2
	90	5.8	0.5	**90**	5.4	0.5	**90**	6.9	1.9
	120	6.3	1.0	**120**	4.7	0.2	**120**	6.5	1.5
	AUC		**104.3**	**AUC**		**73.1**	**AUC**		**174.2**
	GI		**54.1**	**GI**		**50.3**	**GI**		**55.4**

Table 7

The AUC of the subjects who consumed chappati **with** pulverized edible Okra fruit and pulverized deskinned Urad dhal (controlled study) is shown in Table 8.

Subject	AUC
1	108.0
2	55.9
3	171.8
4	104.3
5	73.1
6	174.2
Mean	**114.5**
SD	**49.3**
SEM	**15.6**

Table 8

5

The Incremental Area Under the Blood Glucose Response Curve (IAUC) value of the subjects who consumed chappati **with** pulverized edible Okra fruit and pulverized deskinned Urad dhal (treatment study) is shown in Table 9. The mean value of IAUC against time for the treatment study is also shown in the graph in Fig. 1.

Treatment (Chappati with pulverized Urad dhal and pulverized Okra fruit)									
Time (mins)	Subject						IAUC		
	1	2	3	4	5	6	mean	SD	SE
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.2	-0.1	0.3	0.0	-0.4	-0.2	0.0	0.3	0.1
30	0.3	1.0	1.9	1.2	0.8	1.3	1.1	0.5	0.2
45	1.8	1.5	3.3	1.8	1.7	1.8	2.0	0.7	0.3
60	2.0	0.9	2.3	1.3	1.1	2.2	1.6	0.6	0.3
90	0.7	-0.4	1.0	0.5	0.5	1.9	0.7	0.8	0.3
120	0.5	0.4	0.5	1.0	-0.2	1.5	0.6	0.6	0.2

Table 9

The GI value of the subjects who consumed chappati added **with** pulverized edible Okra fruit and pulverized deskinned Urad dhal (treatment study) are shown in Table 10. The mean value of GI for the **treatment study** is shown in the graph in Fig. 2.

Subject	GI value
1	49.8
2	27.2
3	82.4
4	54.1
5	50.3
6	55.4
Mean	**53.2**
SD	**17.6**
SEM	**7.3**

Table 10

The study was conducted in using chapatti, a carbohydrate based food made of wheat flour. Besides that, the pulverized edible part of Okra plant and edible part of *Vigna* plant species can also be added into carbohydrate based food such as bread, cake, pizza and noodles selected from cereal or non-cereal based plant source.

CLAIMS

1. A use of pre-mixed flour containing mixture of pulverized edible parts of edible Okra plant species with pulverized edible parts of edible *Vigna* plant species and food based carbohydrate selected from cereals or non-cereals or a mixture of both, for the preparation of food to reduce glycemic response of humans who consume the food.

2. The use of pre-mixed flour as claimed in claim 1, wherein the pulverized edible parts of edible Okra plant species is fruit.

3. The use of pre-mixed flour as claimed in claim 1, wherein the pulverized edible parts of *Vigna* plant species are pods, seeds or any combination thereof.

4. The use of pre-mixed flour as claimed in claim 3, wherein the seeds are deskinned.

5. The use of pre-mixed flour as claimed in claim 1, wherein the pulverized edible Okra plant species is *Abelmoschus esculentus* or *Abelmoschus caillei* or a mixture of *Abelmoschus esculentus* and *Abelmoschus caillei.*

6. The use of pre-mixed flour as claimed in claim 1, wherein the pulverized edible *Vigna* plant species is *Vigna mungo*, *Vigna radiata* or *Vigna angularis* or any three combination mixture of species or mixture of the three species.

7. The use of pre-mixed flour as claimed in claim 1, wherein the pre-mixed flour with cereal based flour has less than 10% by weight of mixture of pulverized edible parts of edible Okra plant species with pulverized edible part of edible *Vigna* plant species.

8. The use of pre-mixed flour as claimed in claim 1, wherein the pre-mixed flour with non- cereal based flour has less than 30% by weight of mixture of pulverized edible parts of edible Okra plant species with pulverized edible part of edible *Vigna* plant species.

9. The use of pre-mixed flour as claimed in claim 7, wherein the pre-mixed flour contains at least 1.5 % by weight of pulverized fruits of *Abelmoschus esculentus* or *Abelmoschus caillei* or a mixture of *Abelmoschus esculentus* and *Abelmoschus caillei*, and, at least 3% by weight of pulverized seeds of *Vigna mungo* or *Vigna radiata* or *Vigna angularis* or any three combination mixture of species or mixture of the three species.

10. The use of pre-mixed flour as claimed in claim 8, wherein the pre-mixed flour contains at least 1.5 % by weight of pulverized fruits of *Abelmoschus esculentus* or *Abelmoschus caillei* or a mixture of *Abelmoschus esculentus* and *Abelmoschus caillei*, and, at least 3% by weight of pulverized seeds of *Vigna mungo* or *Vigna radiata* or *Vigna angularis* or any three combination mixture of species or mixture of the three species.

11. A pre-mixed flour for preparation of food to reduce glycemic response of humans who consume the food which pre-mixed flour includes at least 1.5% by weight of pulverized fruits of *Abelmoschus esculentus* or *Abelmoschus caillei* or a mixture of *Abelmoschus esculentus* and *Abelmoschus caillei*, and at least 3% by weight of

pulverized seeds of *Vigna mungo* or *Vigna radiata* or *Vigna angularis* or any three combination mixture of species or mixture of the three species.

12. A use of a mixture of pulverized fruits of *Abelmoschus esculentus* or *Abelmoschus caillei* or a mixture of *Abelmoschus esculentus* and *Abelmoschus caillei*, and pulverized seeds of *Vigna mungo* or *Vigna radiata* or *Vigna angularis* or any three combination mixture of species or mixture of the three species, and wheat flour in preparation of a pre-mixed flour utilized in preparation of food to reduce glycemic response of humans who consume the food.

13. A food prepared from pre-mixed flour as claimed in claims 1 to 11.

PRODUCT TO REDUCE GLYCEMIC RESPONSE OF CARBOHYDRATE BASED FOODS

ABSTRACT

Food that produce a rapid and large increase in blood glucose after ingestion are commonly called high Glycemic Index foods (high GI foods) and those that produce a slow increase in blood glucose are commonly called low glycemic index foods (low GI foods). The invention relates to the use of edible parts of edible Okra plant (*Abelmoschus esculentus*) specifically the fruit in combination with edible parts of edible Urad dhal (*Vigna mungo*) specifically the seed to reduce the glycemic response of carbohydrate based foods when incorporated in such foods which has minimal change in texture, taste, aroma and colour.

Fig. 1

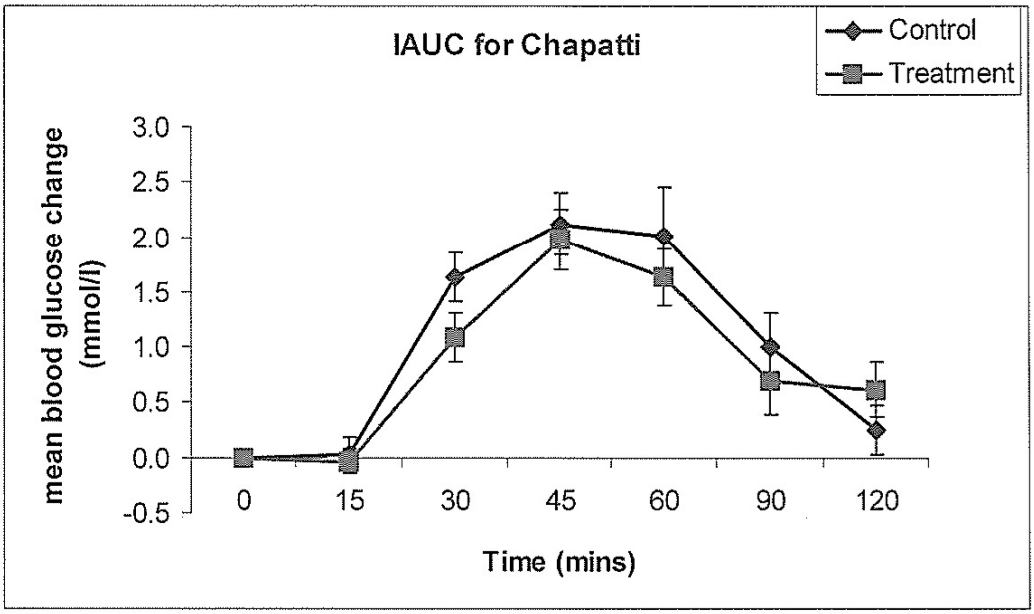
IAUC for Chapatti
Control
Treatment
mean blood glucose change (mmol/l)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0
15
30
45
60
90
120
Time (mins)

Fig. 1

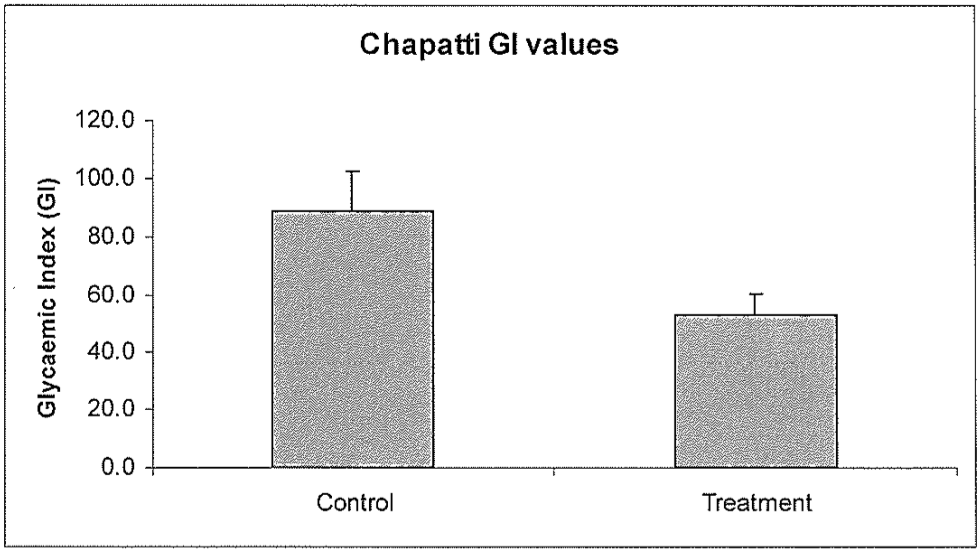
Chapatti GI values
Glycaemic Index (GI)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Control
Treatment

Fig. 2