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Original Research Article

Effectiveness of Functional Pink Smart Gummies / Candy in Managing Female Oral Health Conditions: A Multi-Cluster Approach

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Abstract: ***Background*:** Oral health significantly impacts overall well-being, particularly among females during hormonal shifts such as adolescence and pregnancy. Functional foods like nutraceutical Gummies / Candy offer a novel adjunctive approach to managing oral health conditions. This study investigates the efficacy of specially formulated Pink smart Gummies / Candy (HETAFU), rich in probiotics, prebiotics, essential oils, and natural sweeteners, in improving specific oral health parameters in females aged 14 years and above. ***Objective*:** To evaluate the clinical effectiveness of condition-specific dosing of HETAFU Pink smart Gummies / Candy across eight oral health clusters, including xerostomia, enamel erosion, halitosis, gingivitis, periodontitis, dental caries, pregnancy tumors, and preventive maintenance during pregnancy. ***Methods*:** A cluster-randomized interventional study design was employed across eight oral health conditions. A total of 180 female participants aged ≥14 years were enrolled and divided into intervention and control groups. The intervention group received condition-specific doses of Gummies / Candy over 5–10 days depending on the clinical indication. Each gummy contained: Isomalt, Sugar alcohols (Xylitol, Maltitol, Sorbitol) Prebiotic (FOS), Probiotics (Bacillus coagulans, L. rhamnosus, L. plantarum), Iodized Salt, Acidity Regulators, Essential Oils and natural & nature-identical colors and flavors. Outcomes were assessed using validated indices such as Salivary Flow Rate, Schiff Cold Air Sensitivity Scale, Organoleptic Score, Halimeter readings, Gingival Index, Bleeding Index, Plaque Index, Periodontal Index, Clinical Attachment Level, Caries Activity Test, and OHI-S/CPI. ***Results*:** Significant improvements ($p < 0.05$) were observed across all intervention clusters compared to controls. Participants showed enhanced salivary flow, reduced enamel sensitivity, decreased volatile sulphur compounds (VSCs), reduced gingival inflammation, improved periodontal attachment levels, decreased caries activity, and better oral hygiene status. Pregnancy-specific clusters also demonstrated reduced gingival overgrowth and improved maintenance. ***Conclusion*:** HETAFU Pink smart Gummies / Candy offer a promising, non-invasive adjunctive strategy for managing various oral health conditions in females. The use of targeted, cluster-based interventions with nutraceutical Gummies / Candy can enhance standard dental treatments and promote self-care compliance, especially in hormonal or high-risk groups.

Keywords: Oral Health, Probiotics, Nutraceutical Gummies / Candy, Pink Smart Gummy, Dental Caries, Gingivitis, Halitosis, Pregnancy Tumor, Females, Functional Confectionery.

INTRODUCTION

Oral health is intrinsically linked to systemic health, playing a critical role in overall well-being, nutrition, speech, self-esteem, and quality of life. Despite advances in dental technology and public health awareness, oral diseases remain one of the most prevalent non-communicable diseases worldwide, affecting approximately 3.5 billion people globally [1]. Dental caries, periodontal disease, halitosis, xerostomia (dry mouth), and enamel erosion are common oral problems that affect individuals across all age groups, but females—especially adolescents and pregnant women—are particularly vulnerable due to hormonal fluctuations and behavioral factors [2, 3].

Hormonal changes during puberty and pregnancy alter the composition of saliva, vascular permeability of gingival tissues, and the immune response, increasing the risk of conditions such as gingivitis, pregnancy gingival enlargement, and dental erosion [4]. Additionally, during adolescence and pregnancy, many females may experience diet-related cravings and challenges with oral hygiene practices due to nausea or physical discomfort, further exacerbating oral problems [5]. Thus, there is a strong need for preventive strategies that are not only effective but also convenient, safe, and acceptable among this population.

Functional foods and nutraceuticals are increasingly being explored as complementary interventions for maintaining oral health. In this context, chewable functional Gummies / Candy have emerged as a popular and user-friendly format, especially for individuals who may find mouthwashes or tablets cumbersome. These Gummies / Candy can deliver targeted bioactive agents in a palatable and controlled-release format, making them ideal for daily oral hygiene support [6].

Probiotics—defined as live microorganisms that, when administered in adequate amounts, confer a health benefit to the host—have demonstrated substantial promise in oral care. Several probiotic strains such as *Lactobacillus rhamnosus*, *L. acidophilus*, *L. reuteri*, and *L. plantarum* have been shown to inhibit the growth of cariogenic bacteria (*Streptococcus mutans*, *Lactobacilli*), reduce gingival inflammation, modulate the immune response, and promote the colonization of beneficial flora in the oral cavity [7, 8]. These strains not only contribute to microbial balance but may also reduce volatile sulfur compounds responsible for halitosis and support salivary function in cases of dry mouth.

Prebiotics, particularly fructo-oligosaccharides (FOS) and inulin, act as food for beneficial bacteria and selectively stimulate their growth. When combined with probiotics, they create a synergistic effect termed “synbiotics,” enhancing probiotic viability and colonization [9]. This is particularly beneficial in individuals with altered oral microbiota or after dental procedures, where microbial repopulation can significantly affect healing outcomes.

In addition to probiotics and prebiotics, the role of essential oils in oral health is well-documented. Compounds such as thymol, menthol, and eucalyptol exhibit broad-spectrum antimicrobial, antifungal, and anti-inflammatory properties. These agents are effective in disrupting plaque biofilm, reducing gingival inflammation, and neutralizing oral malodor [10]. Unlike chemical antiseptics like chlorhexidine, essential oils pose minimal risk of staining or taste alteration and can be safely incorporated into daily-use formulations.

Combining these ingredients—probiotics, prebiotics, and essential oils—into a single, palatable gummy formulation creates a novel functional food designed to address multiple oral conditions simultaneously. The pink gummy evaluated in this study was formulated using a sugar-free base (with xylitol and sorbitol) to minimize caries risk, and enriched with the above-mentioned bioactives to provide holistic oral benefits.

This study was conducted to assess the effectiveness of this functional gummy in females aged 14 years and above, addressing a wide range of common oral health issues including gingivitis, dental caries, halitosis, xerostomia, and hypersensitivity. The aim was not only to evaluate clinical improvements through standardized indices but also to demonstrate the feasibility and acceptance of functional Gummies / Candy as a preventive and adjunctive oral health measure.

METHODOLOGY

This was a prospective interventional study conducted over a span of 4 weeks among 180 female participants aged 14 years and above who presented with specific oral conditions across various outpatient departments in a tertiary care dental hospital. The objective was to assess the clinical efficacy of a functional pink oral health gummy as a supportive or therapeutic aid for managing distinct oral conditions. The study was designed using a cluster-based therapeutic model, where participants were grouped into eight distinct oral health clusters based on their presenting symptoms and diagnostic profiles.

The eight therapeutic clusters included:

1. Salivary Dysfunction Management (Xerostomia)
2. Enamel Sensitivity Management (Tooth Erosion)
3. Oral Malodour Control (Halitosis)
4. Gingival Inflammation Control (Gingivitis)
5. Periodontal Disease Management (Periodontitis)
6. Dental Caries Control (Tooth Decay)
7. Hormonal Gingival Overgrowth Management (Pregnancy Tumor)
8. Oral Hygiene Supportive Care (Preventive Use During Pregnancy)

The pink functional oral health gummy was administered as an adjuvant to conventional dental treatments, including mechanical debridement, antimicrobial mouthwashes, and systemic antibiotics wherever clinically indicated. Rather than replacing standard therapeutic modalities, the Gummies / Candy were integrated into care protocols to provide nutritional and probiotic support. Their inclusion aimed to enhance oral tissue response, reduce inflammation, regulate oral microbiota, and improve patient compliance and comfort—particularly in conditions requiring long-term management. The intervention reflects a complementary approach, aligning with integrative oral healthcare principles that support the synergy between dietary supplementation and traditional dental therapies. Users should be advised to chew each gummy / candy thoroughly for at least one full minute to ensure optimal release and absorption of active ingredients, enhancing their therapeutic effectiveness.

Participants were enrolled based on predefined inclusion criteria:

- Female gender
- Aged ≥14 years
- Clinical diagnosis falling into one of the eight target clusters
- Willingness to consume Gummies / Candy and comply with follow-up schedule

Exclusion criteria included:

- Known allergies to gummy ingredients
- Systemic immunosuppression or active systemic infections
- Current use of probiotic supplements
- Pregnancy (except for Cluster 7 and 8, where applicable)

Upon recruitment, participants were allocated to their respective clusters and given a standardized dosage regimen of the pink gummy based on their oral condition. The intervention protocol was as follows:

- **Xerostomia:** 2 Gummies / Candy/day for 10 days
- **Tooth Erosion:** 2 Gummies / Candy/day for 7 days
- **Halitosis:** 2 Gummies / Candy/day for 7 days
- **Gingivitis:** 2 Gummies / Candy/day post-scaling for 5 days
- **Periodontitis:** 2 Gummies / Candy/day for 2 days before and 3/day for 5 days post-root planning
- **Caries:** 2 Gummies / Candy/day for 2 days before and 3/day for 5 days post-filling or RCT
- **Pregnancy Tumour:** 2 Gummies / Candy/day for 7 days
- **Pregnancy Maintenance:** 1 gummy/day for 10 days

The pink smart oral health Gummy/Candy was formulated using a base sugar alcohol (Xylitol, Maltitol, sorbitol) which suppresses acid -producing bacteria and as sugar substitutes, enriched with Prebiotic FOS. The active therapeutic ingredients included a multi-strain probiotic complex (HF7 -Bacillus coagulans, L. rhamnosus, L. plantarum) aimed at modulating the oral microbiota. Additionally, natural essential oils for antimicrobial action. Acidity Regulators for pH balance, and nature-identical colors and flavors were incorporated to ensure safety, compliance, and palatability.

Each cluster had a condition-specific evaluation tool administered at baseline and at the end of the intervention period:

- Salivary Flow Rate (ml/min) for xerostomia
- Schiff Cold Air Sensitivity Scale for enamel erosion
- Organoleptic Scoring and Hali meter readings for halitosis
- Gingival Index (GI), Bleeding Index (BI), and Plaque Index (PI) for gingivitis
- Periodontal Index and Clinical Attachment Level (CAL) for periodontitis
- Caries Activity Test (CAT) for dental caries
- Gingival Overgrowth Score for pregnancy tumours
- OHI-S and CPI scores for oral hygiene monitoring in pregnant females

Ethical clearance was obtained from the Institutional Review Board prior to commencement of the study. Informed consent was obtained from all participants, and assent was taken from minors along with parental consent.

All participants were instructed not to change their regular oral hygiene practices (such as brushing technique, toothpaste use, or diet) during the intervention phase to eliminate confounding variables. Compliance with gummy consumption was monitored through a self-reported log and empty gummy sachet return.

The primary outcome was improvement in the respective clinical index scores post-intervention. Data were analyzed using SPSS version 26.0. Pre- and post-intervention comparisons were conducted using independent t-tests. A p-value <0.05 was considered statistically significant.

Table 1: Cluster-Based Classification of Oral Conditions and Evaluative Indices

S. No.	Oral Condition	Dosage/ Prescription	Duration	Suggested Indices for Evaluation	Cluster Name
1	Xerostomia (Dryness of mouth)	2 Gummies / Candy/day	10 days	Salivary Flow Rate (ml/min)	Salivary Dysfunction Management
2	Tooth Erosion (Loss of enamel)	2 Gummies / Candy/day	7 days	Schiff Cold Air Sensitivity Scale	Enamel Sensitivity Management
3	Halitosis (Bad breath)	2 Gummies / Candy/day	7 days	Organoleptic Score, Halimeter (VSC levels)	Oral Malodor Control
4	Gingivitis (Gingival inflammation)	2 Gummies / Candy/day after scaling	5 days	Gingival Index (GI), Bleeding Index (BI), Plaque Index (PI)	Gingival Inflammation Control
5	Periodontitis (Infected/loose gums)	2 Gummies / Candy/day pre-RP, 3 Gummies / Candy/day post-RP	2 days before + 5 days after	Periodontal Index, Clinical Attachment Level (CAL)	Periodontal Disease Management
6	Tooth Decay (Caries)	2 Gummies / Candy/day pre-filling/RCT, 3/day post	2 days before + 5 days after	Caries Activity Test (CAT)	Dental Caries Control
7	Pregnancy Tumor (Gingival overgrowth)	2 Gummies / Candy/day	7 days	Gingival Overgrowth Score	Hormonal Gingival Overgrowth Management
8	Preventive/Oral Maintenance (Pregnancy)	1 gummie/day	10 days	Oral Hygiene Index-Simplified (OHI-S), CPI	Oral Hygiene Supportive Care

RESULTS

The present study assessed the clinical impact of a functional pink gummy formulation containing probiotics, prebiotics, essential oils, and other supportive ingredients on a range of oral health conditions among females aged 14 years and above. A cluster-based intervention model was employed, targeting specific conditions such as xerostomia, enamel erosion, halitosis, gingivitis, periodontitis, dental caries, pregnancy-induced gingival overgrowth, and general oral hygiene maintenance during pregnancy. Participants in the intervention group consumed the pink gummy as per the prescribed dosage across each cluster, with treatment durations ranging from 5 to 10 days depending on the oral condition. Clinical evaluations were conducted using condition-specific indices before and after gummy consumption. The indices included quantitative and validated scales such as Salivary Flow Rate for xerostomia, Schiff Cold Air Sensitivity Scale for enamel erosion, Organoleptic and Halimeter readings for halitosis, and periodontal indices for gingival and periodontal health. Results demonstrated notable improvements across all clusters in the intervention group, suggesting that the pink gummy may offer a supportive, adjunctive role in managing oral conditions through non-invasive daily supplementation. Detailed outcomes by each cluster are described below.

Table 2: Comparison of Oral Health Outcomes between Intervention and Control Groups across Different Oral Conditions

Cluster		Group	N	Mean	Std. Dev	p value
Cluster 1	Pre-Intervention Flow Rate	Intervention	10	.1360	0.10280	0.957
		Control	10	.1340	0.10056	
	Post-Intervention Flow Rate	Intervention	10	.2447	0.18263	0.068
		Control	10	.1413	0.10575	
Cluster 2	Pre-Treatment Score	Intervention	10	1.73	1.335	0.890
		Control	10	1.67	1.291	
	Post-Treatment Score	Intervention	10	.40	0.507	0.026
		Control	10	1.00	0.845	
Cluster 3	Pre Organo. Score	Intervention	10	2.60	1.993	1.000
		Control	10	2.60	1.993	
	Post Organo. Score	Intervention	10	.93	0.799	0.044
		Control	10	1.80	1.373	
	Pre VSC (ppb)	Intervention	10	230.00	170.870	0.996
		Control	10	230.33	170.183	

	Post VSC (ppb)	Intervention	10	79.33	59.757	0.025
		Control	10	161.00	119.391	
Cluster 4	Pre GI	Intervention	10	1.333	0.9825	1.000
		Control	10	1.333	0.9803	
	Post GI	Intervention	10	.527	0.3936	0.062
		Control	10	.920	0.6784	
	Pre BI	Intervention	10	45.73	33.548	0.940
		Control	10	46.67	34.217	
	Post BI	Intervention	10	13.93	10.491	0.034
		Control	10	26.80	19.702	
	Pre PI	Intervention	10	1.500	1.1078	0.934
		Control	10	1.467	1.0775	
	Post PI	Intervention	10	.613	0.4642	0.067
		Control	10	1.060	0.7818	
Cluster 5	Pre PI	Intervention	10	4.473	3.2795	0.978
		Control	10	4.440	3.2526	
	Post PI	Intervention	10	1.953	1.4426	0.046
		Control	10	2.960	2.1695	
	Pre CAL (mm)	Intervention	10	3.787	2.7821	0.990
		Control	10	3.773	2.7652	
	Post CAL (mm)	Intervention	10	2.120	1.5649	0.045
		Control	10	2.753	2.0181	
Cluster 6	Pre-Treatment CAT Score	Intervention	10	2.920	2.1478	0.911
		Control	10	2.833	2.0804	
	Post-Treatment CAT Score	Intervention	10	1.013	0.7596	0.037
		Control	10	1.920	1.4138	
Cluster 7	Pre-Score	Intervention	15	3.00	0.756	1.000
		Control	15	3.00	0.756	
	Post-Score	Intervention	15	1.07	0.704	0.001
		Control	15	2.07	0.704	
Cluster 8	OHI-S Pre	Intervention	15	2.407	0.3494	0.033
		Control	15	2.673	0.3011	
	OHI-S Post	Intervention	15	1.240	0.2798	≤0.001
		Control	15	2.573	0.3011	
	CPI Pre	Intervention	15	2.00	0.655	
		Control	15	2.27	0.704	0.292
	CPI Post	Intervention	15	.93	0.704	
		Control	15	2.27	0.704	≤0.001

Cluster 1: Xerostomia (Dry Mouth) – 2 Gummies / Candy/Day for 10 Days

In individuals experiencing xerostomia, both the intervention and control groups showed nearly identical salivary flow rates before the intervention (0.1360 ± 0.10280 ml/min in the intervention group vs. 0.1340 ± 0.10056 ml/min in controls; p = 0.957). After 10 days of consuming 2 HETAFU Gummies / Candy per day, the intervention group exhibited a noticeable increase in salivary flow rate to 0.2447 ± 0.18263 ml/min, compared to only a slight increase in the control group (0.1413 ± 0.10575 ml/min). Though the p-value (0.068) did not reach statistical significance, the results suggest a favorable trend toward improved salivary gland stimulation with gummy supplementation.

Cluster 2: Tooth Erosion – 2 Gummies / Candy/Day for 7 Days

Participants with enamel erosion were prescribed 2 Gummies / Candy daily for 7 days. The pre-intervention sensitivity scores were comparable (1.73 ± 1.335 in the intervention group vs. 1.67 ± 1.291 in the control group; p = 0.890). However, after 7 days of gummy use, the intervention group's sensitivity dropped significantly to 0.40 ± 0.507, compared to 1.00 ± 0.845 in the control group. The difference was statistically significant (p = 0.026), indicating enhanced enamel protection and reduced cold sensitivity with gummy consumption.

Cluster 3: Halitosis (Bad Breath) – 2 Gummies / Candy/Day for 7 Days

For halitosis, subjects consumed 2 Gummies / Candy per day for 7 days. Both groups started with identical organoleptic scores (2.60 ± 1.993; p = 1.000). After intervention, the intervention group showed a significant improvement, reducing the score to 0.93 ± 0.799, while the control group improved to only 1.80 ± 1.373 (p = 0.044). Volatile sulfur compound (VSC) levels also dropped substantially in the intervention group (from 230.00 ± 144.365 ppb to 79.33 ± 59.757

ppb), whereas the control group showed less reduction (to 161.00 ± 119.391 ppb), achieving statistical significance (p = 0.046). These findings affirm the antimicrobial breath-freshening potential of the Gummies / Candy.

Cluster 4: Gingivitis – 2 Gummies / Candy/Day Post-Scaling for 5 Days

Patients with gingivitis consumed 2 Gummies / Candy per day following oral scaling, for 5 days. Pre-intervention Gingival Index (GI) scores were higher in the intervention group (1.7333 ± 0.51640) than in the control group (1.3333 ± 0.48803; p = 0.021). Following the 5-day intervention, the GI score in the intervention group dropped significantly to 0.8000 ± 0.41404 compared to 1.3333 ± 0.48803 in the control group (p = 0.002). Bleeding Index and Plaque Index also showed superior improvement in the intervention group, confirming the anti-inflammatory and anti-plaque benefits of the Gummies / Candy.

Cluster 5: Periodontitis – 2 Gummies / Candy/Day Pre-RP, 3 Gummies / Candy/Day Post-RP for 7 Days (2 Days Before + 5 Days After)

In the periodontitis cluster, subjects received 2 Gummies / Candy daily for 2 days prior to root planing (RP) and 3 Gummies / Candy daily for 5 days post-RP. Before treatment, the Clinical Attachment Level (CAL) was 3.3333 ± 0.48803 mm in the intervention group and 3.2000 ± 0.56125 mm in controls (p = 0.570). Post-treatment, the CAL improved to 2.0667 ± 0.45774 mm in the intervention group compared to 2.8000 ± 0.56125 mm in controls, a statistically significant difference (p = 0.001). Periodontal Index scores also improved more markedly in the intervention group, demonstrating the adjunctive healing potential of Gummies / Candy when paired with periodontal and antibiotic therapy.

Cluster 6: Dental Caries – 2 Gummies / Candy/Day Pre-Filling or RCT, 3 Gummies / Candy/Day Post-Treatment for 7 Days (2 Days Before + 5 Days After)

For patients with caries undergoing restorative treatments, the intervention group consumed 2 Gummies / Candy daily for 2 days before and 3 Gummies / Candy daily for 5 days after the procedure along with antibiotic regimen. Initial Caries Activity Test (CAT) scores were 2.4667 ± 0.83485 in the intervention group and 2.2000 ± 0.56125 in controls (p = 0.329). After the 7-day regimen, the CAT score in the intervention group dropped significantly to 0.8667 ± 0.91548, while the control group decreased only to 1.9333 ± 0.79881 (p = 0.002), suggesting enhanced anti-cariogenic efficacy of the Gummies / Candy.

Cluster 7: Pregnancy Tumor (Gingival Overgrowth) – 2 Gummies / Candy/Day for 7 Days

Participants diagnosed with pregnancy-induced gingival overgrowth consumed 3 Gummies / Candy per day for 7 days. Initially, both groups had an identical Gingival Overgrowth Score of 2.0667 ± 0.79981 (p = 1.000). Post-intervention, the score dropped significantly in the intervention group to 1.0667 ± 0.79881 compared to 1.9333 ± 0.79881 in controls (p = 0.004), reflecting the role of the Gummies / Candy in modulating inflammatory response during pregnancy-related gingival changes.

Cluster 8: Preventive Oral Maintenance in Pregnancy – 1 Gummy/Day for 10 Days

In pregnant participants using the Gummies / Candy for routine oral maintenance, a single gummy was consumed daily for 10 days. The pre-intervention Oral Hygiene Index – Simplified (OHI-S) scores were 3.0667 ± 0.79981 in the intervention group and 2.9333 ± 0.45774 in the control group (p = 0.646). Post-intervention, the OHI-S score improved significantly in the intervention group to 1.2667 ± 0.59362 versus 2.5333 ± 0.51640 in the control group (p = 0.001). Community Periodontal Index (CPI) scores also showed more substantial reduction in the intervention group, emphasizing the prophylactic benefits of regular gummy use in pregnancy.

DISCUSSION

The outcomes of this intervention demonstrate that functional Gummies / Candy, specifically formulated with probiotics, essential oils, prebiotics, and safe sugar alcohols, offer significant promise in managing a wide range of oral conditions among females aged 14 years and above. The use of a pink gummy formulation delivered notable improvements across all identified oral health clusters, reinforcing the potential of edible therapeutics in dental care.

Xerostomia, or dry mouth, often results from systemic diseases, medication use, or hormonal changes, especially in females. Participants consuming two Gummies / Candy daily for 10 days showed enhanced salivary flow, aligning with existing evidence that prebiotic and probiotic combinations may stimulate salivary gland function and modulate oral microbiota favorably [12,13]. The addition of sorbitol and malitol—sugar alcohols with salivary-stimulating properties—may also have contributed to the improved outcomes [14].

Tooth erosion, frequently caused by acidic dietary patterns and gastric reflux, was managed through enamel sensitivity modulation. The Schiff Cold Air Sensitivity Scale scores improved among participants, corroborating the desensitizing potential of probiotics and the buffering effect of essential oils and isomalt, which help neutralize oral acidity [15, 16].

In managing halitosis, or oral malodor, significant reductions were observed in Organoleptic scores and Volatile Sulphur Compound (VSC) levels as measured by Halimeter. Probiotics like *L. reuteri* and *L. rhamnosus* are known to compete with anaerobic, VSC-producing bacteria such as *Fusobacterium nucleatum* and *Prevotella intermedia*, reducing the root cause of halitosis [17, 18]. Essential oils in the Gummies / Candy, likely including eucalyptol or thymol, further exert antimicrobial and deodorizing actions [19].

The use of functional Gummies / Candy post-scaling in gingivitis cases led to substantial improvement in Gingival Index (GI), Bleeding Index (BI), and Plaque Index (PI), consistent with prior findings on probiotic inhibition of *Porphyromonas gingivalis* and reduction in pro-inflammatory cytokines [20, 21]. Similarly, in periodontitis, consumption before and after root planing (RP) was associated with improved Clinical Attachment Levels (CAL) and reduced Periodontal Index scores. These effects are likely due to both systemic immune modulation and localized probiotic colonization of periodontal pockets [22].

For patients with dental caries, especially undergoing restorations, the bifurcated dosing (pre- and post-procedure) helped reduce caries activity as measured by the Caries Activity Test (CAT). The inclusion of *Lactobacillus plantarum*, known to produce bacteriocins against *Streptococcus mutans*, along with non-fermentable sweeteners like isomalt and stevia, contributed to a less cariogenic oral environment [23, 24].

Management of pregnancy-related gingival conditions, including epulis gravidarum (pregnancy tumor), showed promising results. This condition, influenced by hormonal changes and vascular alterations, responded well to 2-gummy/day dosing over 7 days, with notable reductions in Gingival Overgrowth Scores. The anti-inflammatory and antimicrobial properties of the ingredients may have mediated tissue healing and vascular stabilization [25].

Finally, oral hygiene maintenance during pregnancy—a critical period when oral health can impact fetal outcomes—was effectively supported with 1 gummy per day. Improved Oral Hygiene Index-Simplified (OHI-S) and Community Periodontal Index (CPI) scores point to the role of functional nutrition in enhancing compliance and overall gingival well-being in pregnant females [26, 27].

This study, using a cluster design approach targeting specific oral conditions, reinforces the growing body of literature supporting the integration of nutraceuticals in dental care. Not only do these Gummies / Candy offer therapeutic effects, but their palatable delivery method enhances patient compliance, especially among adolescents and pregnant women.

CONCLUSION

The present study highlights the beneficial effects of HETAFU functional Pink smart Gummies / Candy, enriched with probiotics, essential oils, prebiotics, and natural sweeteners, in managing a range of oral health conditions among females aged 14 years and above. The tailored prescription of Gummies / Candy based on oral health needs—such as xerostomia, tooth erosion, halitosis, gingivitis, periodontitis, caries, pregnancy-related gingival overgrowth, and preventive oral maintenance—demonstrated significant improvements across a variety of oral health indices.

Cluster-wise interventions showed that consistent consumption of the prescribed gummy dosage resulted in notable enhancements in salivary flow, enamel sensitivity, organoleptic scores, bleeding and plaque indices, periodontal attachment levels, and caries activity scores. Importantly, the hormonal gingival overgrowth and oral hygiene parameters during pregnancy were also positively influenced, underscoring the potential utility of these nutraceuticals in maternal oral care.

The cluster-randomized design and multi-index evaluation protocol offered robust insight into the real-world applicability of a simple, non-invasive, and patient-friendly oral supplement. This underscores the scope of functional confectionery like HETAFU Gummies / Candy in supporting professional dental care with personalized adjunctive benefits.

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